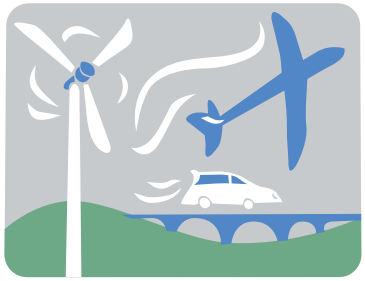

14th European Conference on Composite Materials

7-10 June, 2010, Budapest, Hungary

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ECCM 14

1. Welcome to Budapest at the 14th European Conference on Composite Materials

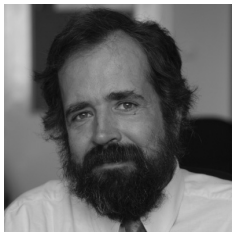
Dear Delegate,

The European Conference on Composite Materials is a regular forum for scientist, specialists and industrial experts dedicated to polymers/metals/ceramic materials, to their technology, design, simulation, testing and application aspects. This conference series was founded after realizing the interest of scientist and technologists, not only from Europe but from all over the World, in getting general and specific knowledge about the most current advancements of the cutting edge composite materials topics. The first conference was organized in France (Bordeaux) in 1985, then second in UK (London) in 1987, third in France (Bordeaux) in 1989, fourth in Germany (Stuttgart) in 1990, fifth in France (Bordeaux) in 1992, sixth in France (Bordeaux) in 1993, seventh in UK (London) in 1996, eighth in Italy (Naples) in 1998, ninth in UK (Brighton) in 2000, tenth in Belgium (Brugge) in 2002, eleventh in Greece (Rhodes) in 2004, twelfth in France (Biarritz) in 2006, thirteenth in Sweden (Stockholm) in 2008 and this fourteenth conference is going to be held in Hungary (Budapest) in 2010.

Besides looking forward, the 25th anniversary of the conference provides an opportunity for retrospection. This review is going to be given by the first day's plenary lecture speaker, Prof. G.S. Springer (USA), doyen of composite science and technology. Material science and technology has gone through vast development in the last decades. Modern composites are essential in all fields of life, including building and transportation industry, information technology, energy sector and medical applications. In this context, the current and future composite materials, technologies and application fields are going to be presented during the next days' plenary lectures: Prof. I. Verpoest (B) gives a talk on nano and biocomposites, Prof. O.T. Thomsen's (DK) lecture addresses wind turbine composite rotor blades, while Dr. C. Weimer's (D) presentation focuses on future processing techniques for cost-effective high performance composites.

During these four days of the conference 395 oral lectures and 195 posters will be presented by experts from 60 countries in 6 parallel sessions. The organizers hope that the conference provides a platform for presentation and discussion of your latest results and offers an opportunity for young scientists to learn and to present their work. We do our best to create a friendly atmosphere for social contacts and to create and strengthen personal ties. The conference brings together the researchers from west and east, from academia and industry, serving as an open forum for the exchange of knowledge, and helping to establish worldwide scientific cooperation.

We are committed to making your stay a memorable scientific and professional experience. Warm and sincere welcome to Hungary,



László KOLLÁR
CHAIRMAN

Tibor CZIGÁNY
CHAIRMAN

József KARGER-KOCSIS
CHAIRMAN

2. Conference Guidelines & Facilities

2.1. Conference Registration Desk

The Conference is organized in Building "I" of Budapest University of Technology and Economics (H-1111, 11th District, Magyar Tudósok körútja 2.). The registration and information desk is located in the hall of the building. The desk will be staffed throughout the opening hours of the conference. The personnel will be glad to help you with any problem and question.

2.2. Internet

Free wireless internet is available in the Conference Halls and in the Aula of the building.

2.3. Language

The working language of the Conference is English.

2.4. Name Badges

Participants are kindly requested to wear their name badge at all times during the Conference. Admittance to all meals and special events requires wearing the name badge.

2.5. Information for Speakers

After registration, please give your presentation (on a CD or a USB stick) to the technicians in the technical room who will help to upload it to the central computer. It is crucial that you keep the time limit for your presentation: it is recommended to use 15 minutes for the presentation and leave 5 minutes for discussion, so that the planned timetable can be kept.

2.6. Information for Poster Presenters

Please check the day of your poster presentation. After registration, please give your poster to the technicians in the technical room who will install your poster. At the end of your poster session you are kindly requested to detach your poster. The size of the posters is max. 90 cm (width) × 130 cm (height).

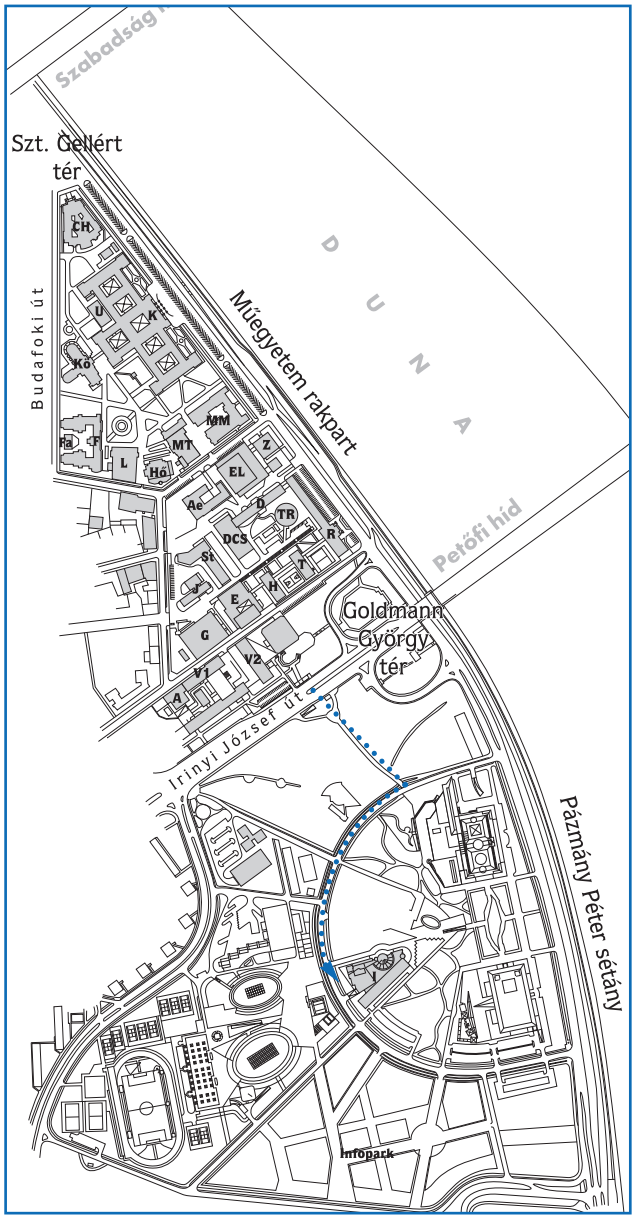
2.7. Conference Papers

The conference papers are electronically available on a memory stick to all participants of the conference. Selected papers will be considered for publication in eXPRESS Polymer Letters.

2.8. Travelling to the Conference

Budapest can easily be reached by plane, train or car. Minibuses and Airport Zone Taxi run regularly from the "Ferihegy" airport to major downtown hotels. The Conference venue can be reached by means of public transportation easily. The stops of tram No. 4 or 6 (stop: Petőfi Híd-Budai Hídfő /Petofi Bridge-Buda Side/) and bus No. 12 (stop: Petőfi Híd-Budai Hídfő /Petofi Bridge-Buda Side/). Travelling to Móricz Zs. Körtér (Móricz Zs. square) by buses No. 33, 33E, 7, 7E, 40, 40E, 153, 173, 173E, or by trams No. 18, 19, 41, 47, 49, 61. After taking off at Móricz Zs. Körtér, the conference venue can be reached quickly on foot (see the map).

Address: Building “I” of Budapest University of Technology and Economics, H-1111, 11th District, Magyar Tudósok körútja 2.
GPS: N47°28'21.386" x E19°3'33.798"



2.9. Coffee Breaks, Lunches

Coffee breaks, lunches are organized in the Aula of Building "I" (at the conference venue).

2.10. Social Events

On Sunday (6 June), before the conference there will be a possibility to get to know Budapest in the frame of the pre-conference tour. Departure time at 11:00 and at 15:00 (duration: 3 hours) from conference venue.

On Monday, at 8:30 p.m., the welcome reception will be held in Gellért Bath which is one of the most popular historical baths in Budapest. The venue is 20 min pleasant walk from the conference venue.

On Wednesday we kindly invite you to Gala dinner to Lázár Equestrian Park. We hope that you will enjoy the beautiful landscape with horses, the best Hungarian dishes and wines complemented by excellent Hungarian hospitality in a great atmosphere with traditional music. The meeting point is in front of the Building "I" and the group will start by bus at 5.15 p.m.

3. Practical Information

3.1. Budapest

Budapest, the capital of Hungary, is an economic, financial and cultural centre with two million inhabitants. The city is beautifully situated on both sides of river Danube and has a 2000-year history. There are ruins from the time of the Roman Empire as well as from the Middle Ages. However, it mainly reflects the atmosphere of the end of the 19th century, when the millennium of Hungary was celebrated. Many places of entertainment are available, in addition to places for peaceful relaxation. Several baths offer the pleasure of the waters of various medicinal thermal springs. The weather in June is pleasant, 24-28°C.

3.2. Bank & Business Hours

Public offices and banks are generally open from 9 a.m. to 4 p.m. (Mon-Thu) and 9 a.m. to 2 p.m. (Fri) and are usually closed on Saturday and Sunday. Opening hours of shops are usually 9 a.m.- 6 p.m. on weekdays (and 9 a.m.-1 p.m. on Saturdays) but several shopping centers are open every day from 8 a.m. until 10 p.m.

3.3. Emergency Calls
Medical emergency: 104
Fire brigade: 105
Police: 107
General emergency: 112

3.4. Tips
Tips are not included in prices, hence hotel and restaurant staff and taxi drivers may expect about 5-10%.

3.5. Currency & Credit Card
The currency of Hungary is Hungarian Forint (HUF, Ft). The exchange rate of 1 USD is around 200 HUF and 1 EUR is approximately 270 HUF. Most foreign currencies can be exchanged to HUF in hotels, banks and exchange offices. Foreign currency (even Euro) is usally not accepted in shops. Credit cards are widely accepted, check the emblems displayed at the entrance of the shop. Cheques are not accepted.

3.6. Time Zone
Hungary belongs to the Central European time zone, i.e. GMT+1 hour.

3.7. Telephone
The country code for Hungary is 36. The area code for Budapest is 1.

3.8. Travelling in Budapest
The public transportation system of Budapest is good. You can purchase (credit cards are only accepted at major underground stations, otherwise only cash is accepted) tickets at the main underground stations and at news-agents. Since a new ticket must be validated every time you change a vehicle, it is advisable to buy a one-day, three-day or seven-day travel card. In case you take a taxi, ask for the price before starting the way (otherwise it could cost too much). There are several international car rental companies in Hungary, You can easily rent a car but driving in the rush hours is difficult in Budapest.

3.9. Electricity
Electricity is supplied in 230 voltages, 50 Hz.

3.10. Water
Budapest's tap water is drinking water, which is among the best quality waters in Europe.

9:20 **Opening Ceremony**
LEIF E. ASP
LÁSZLÓ KOLLÁR
TIBOR CZIGÁNY
JÓZSEF KARGER-KOCSIS
TIBOR CZVIKOVSZKY

9:50 **Composites: Why and why not?**
G.S. SPRINGER STANFORD UNIVERSITY
Applications are described where composites have and have not yet fulfilled their promise and where they have exceeded expectations. Reasons are given for successes as well as for failures. Steps needed for further utilization of composites are outlined with focus on important problems awaiting solutions.

Lectures

A	Nanocomposites Chair: B. Pukánszky	B	Smart/intelligent materials Chair: M.Z. Rong	C	Biocomposites Chair: I. Verpoest	NOTES

11:10 CFRP structural capacitor materials for automotive applications
L.E. Asp, M. Wysocki, T. Carlson, D. Ordéus
In this paper an approach towards realising novel multifunctional polymer composites is presented. A series of structural capacitor materials made from CFRP woven electrodes separated by paper or polymer film dielectrics have been developed, manufactured and tested.

Self-healing epoxy composites based on microencapsulated healing agent
M.Q. Zhang, M.Z. Rong, Y.C. Yuan, D.S. Xiao, T. Yin, H.L. Lu
Two-component healing agent was developed for making self-healing epoxy composites, which consisted of microencapsulated low-viscous epoxy and its hardener. The healing systems proved to be able to offer satisfactory repair effectiveness at low concentration.

Preparation and characterisation of nano-cellulose reinforced polymers
P. Hornsby, P. Qua
A comparison is made between cellulose nanofibres prepared by acid hydrolysis and high pressure microfluidisation. Cellulose nanofibre-reinforced composites made using polyamide-6 and polyvinyl alcohol were subsequently characterised to determine their microstructure and mechanical properties.

10:40 - 11:10 Coffee Break

11:30 Hierarchical carbon fibre reinforced CNT PolyVinylideneFluoride composites
S. Riaz, E.S. Greenhalgh, M.S.P. Shaffer, A. Bismarck
In-house manufactured carbon fibre reinforced PVDF hierarchical composites exhibit excellent transverse, longitudinal and toughness properties over traditional composites. These encouraging developments will make such materials ideal for use in harsh environments.

Experimental and numerical evaluation of CFRP passive damping improvement from embedded SMA wires
R. de Oliveira, A. Sigg, F. Dujonc, F. Dauphin, V. Michaud, J.-A.E. Manson • In this study, superelastic NiTi wires were embedded during the infusion processing of woven CFRP composite plates to passively increase their damping. The passive damping effect produced by the SMA wires was evaluated from free vibration tests on composite plates. A numerical analysis was done in parallel.

Properties of new fully bio-based thermoset composites
M. Bierer, **T. Pohl,** B. Madsen, H. Hoydonckx, R. Schledjewski
In the present study, natural fibre textiles had been impregnated with the furan resin to form pre-pregs. The pre-pregs were consolidated into composites in a compression mould and the mechanical properties, the burning behaviour and the moisture sorption behaviour had been determined.

11:50 Characterization of mechanical properties of CFRP laminates using epoxy modified by CNTs with various aspect ratios
T. Yokozeki, C. Jitpipatpong, A. Arai, M. Ishibashi, T. Yanagisawa, A. Kawasaki, T. Aoki • This research focuses on the effect of CNT length on the mechanical properties of CNT-based composites. CNT-dispersed epoxy and CFRP laminates using CNT-dispersed epoxy were prepared and subject to several mechanical tests. Use of adequately long CNTs resulted in best performance of matrix-dominated properties.

Fundamentals of self healing resin matrices for composites
M.S. Bin Md Jamil, F.R. Jones
This paper will describe the concept of a solid-state healable system and its efficiency. In order to optimise the system, the effects of linear polymer with different molecular weight, physical ageing and/or phase separation and the implementation of ionomer interaction have been studied.

Structure property relationships of all-cellulose composites
T. Pullawan, S.J. Eichhorn, A.N. Wilkinson
All-cellulose composite films of microcrystalline cellulose and cellulose whiskers were prepared by dissolving in lithium chloride-N,N-dimethylacetamide.The mechanical properties of the films were then obtained by using tensile testing,and the micromechanical properties by using a Raman spectroscopy technique.

D Processing & manufacturing Chair: S. Ghose	E Experimental techniques Chair: D. Van Hemelrijck	F Modelling and simulation Chair: V. Kostopoulus	NOTES
11:10 **Numerical modeling of ultrasonic tape lamination** **J. Justo,** F. Chinesta, E. Graciani, F. París, R. Ávila In this paper ultrasonic debulking of composite automatic tape laminaton is considered. Analytical solutions of the heat generated during the process are presented. These solutions can be implemented in a finite elements model to assess the quality of the compaction.	**Effect of glass fiber hybridization on the impact resistance of woven carbon fiber/epoxy laminates** A. Enfedaque, J. M. Molina-Aldareguía, F. Gálvez, **C. González,** J. Llorca Hybrid laminates manufactured by RTM with woven carbon and S2 glass fabrics were subjected to drop weight low velocity impact. Fracture micromechanisms were studied using X-ray microtomography in order to elucidate the role played by glass fiber hybridization.	**Constitutive modelling of composite materials with full 3D orientation of reinforcement** **F. Stig,** S. Hallström True 3D weaving, incorporating dual shedding of warp yarns, is a new textile principle that inherently generates fabrics with yarns oriented in three orthogonal directions. This paper presents a method for characterising the constitutive behaviour of composite materials containing such weaves.	**10:40 - 11:10 Coffee Break**
11:30 **Inductive heating of polymer matrixes by particulate heating promoters** **T. Bayerl,** R. Schledjewski, P. Mitschang The use of particulate induction heating aims at the selective and intrinsic heating of thermoplastic composites by ferromagnetic heating promoters. A melting of HDPE as well as PA6 with this method within three minutes is possible by an incorporation of only 5 wt% of additives.	**Pulse-phase-thermographic non-destructive testing for CFRP specimen** **M. Ishikawa,** H. Hatta, Y. Habuka, S. Jinnai, S. Utsunomiya, K. Goto Pulse Phase Thermography method was examined in order to increase the depth of defects detectable by thermographic testing. The experimental and analytical results predicted that deeper defects can be detected by using lower frequency data after applying Fourier transformation to temperature data.	**Comparative analysis of numerical strategies for simulation of delamination in advanced composites** **S. Jacques** A comparative analysis was made in order to point out the advantages and disadvantages of the existing strategies for the simulation of delamination in composites using: cohesive elements/behaviour, VCCT and XFEM, regarding the geometry, mesh, computational efficiency and loading conditions.	
11:50 **Study and characterization of advanced composites materials using pitch as matrix precursor** **F. Cioeta,** M. Marchetti, R. Santamaria Ramirez Carbon fiber is a material consisting of extremely thin fibers.The important properties of a carbon fiber are low weight,low thermal expansion.The target of this work is a detailed description of the process and the setup of a plant on laboratory scale in order to produce pitch-based carbon fiber.	**Innovative non-destructive evaluations and damage characterization of composite aerostructures** **S. Grammatikos,** E.Z. Kordatos, N-M. Barkoula, T.E. Matikas, A. Paipetis Innovative non-destructive techniques for damage characterization and evaluation of aerospace materials and structures. Infrared Thermography (IrT), Ultrasonics (C-scan) and Electrical Resistance Tomography (ERT) were used in order to assess the structural integrity of composite aerostructures.	**Multi-scale modeling of the effect of damage in woven fiber reinforced composites** **M. Hirsekorn,** G. Grail, N. Carrere A multi-scale modeling approach of composites with woven fiber reinforcements is presented, in which the effect of damage and its influence onto a homogenized behavior at the next higher scale is analyzed. The aim is to derive a macroscopic damage model for Finite Element simulations.	

A Nanocomposites
Chair: B. Pukánszky

B Smart/intelligent materials
Chair: M.Z. Rong

C Biocomposites
Chair: I. Verpoest

NOTES

12:10 Microwave absorbent nanocomposite films

A. Bhattacharyya, M. Joshi

In this study, in house synthesized hybrid nanoparticles (nanographite based), nickel-zinc ferrite, carbon nanofiber, nanographite and iron powder are dispersed in polyurethane to produce microwave absorbent nanocomposite films and their performance has been evaluated under wide frequency ranges.

Measurement of strain distribution in bonded joints and detection of debondings in composite structures by distributed sensing

A. Güemes, A. Fernandez-Lopez

The optical fibre is used as a Health Monitoring system, to detect the onset of debonding in composite structures, and particularly in skin-stiffener debonding. These results have practical importance for enabling the inspection of hidden structures.

Effect of processing on defects and tensile strength of single flax fibres

M. Aslan, B. Madsen, S. Goutianos, B.F. Sorensen

This study is to investigate the influence of consecutive processing steps on the defects and the tensile strength of single flax fibres. It was found that each processing step leads to an increasing number of defects and larger defect sizes, as well as decreasing tensile strength of the fibres.

12:30 Enhanced and tailored emission from nanocomposite films by nanopatterning

L. Persano, A. Camposeo, **G. Potente**, R. Cingolani, D. Pisignano

This work reports on the development of gentle nanolithographic methods for micro- and nano-structuring hybrid organic/inorganic nanocomposite materials, consisting of inorganic semiconductor and oxide nanoparticles incorporated in light emitting conjugated polymers.

Self- healing and damage indicating composites using microcapsules approach

A. Gregor, A. Aniskevich, M. Sjöberg, A. Picot, S. Vidineev

The aim of the study was to develop a fibre reinforced self-healing polymer composite material that has healant filled microcapsules embedded into the matrix. The top surface of the composite material was covered with pressure sensitive coatings that change its colour upon receiving impact damage.

Effect of the fibres nature on the thermo-mechanical properties of polypropylene-vegetal fibre composites

A. Agnelot, A. Bourmaud, G. Ausias, J-M. Veille, C. Baley

Composite materials reinforced with vegetal fibres are developed for automotive applications. The biocomposites parts were fabricated by extrusion and injection moulding processes and are designed to have good mechanical properties, dimensional stability and reduced environmental impacts.

12:50 - 13:50 Lunch

12:10 **The experimental determination and control of prepreg tack for automated manufacture**

R.J. Crossley, P.J. Schubel, N.A. Warrior

A peel tack test has been developed to characterise tack and stiffness under ATL conditions. The temperature and feedrate effect on newly developed wind energy tapes followed the WLF time temperature superposition principle, which was then subsequently used to stabilise tack over a feed rate range.

An experimental study on lightning damage of CFRP-relationship between electrical properties and damage behaviour

Y. Hirano, S. Katsumata, Y. Iwahori, A. Todoroki • This study examines the relationship between electrical properties of CFRP laminate and lightning damage. It was confirmed that damage progress is governed by the strong electrical orthotropic properties of the laminates and they are not negligible to discuss the lightning damage of CFRP laminate.

Effects of uncertain mechanical properties on wave propagation in thick hollow cylinder made of functionally graded materials (FGMs) using a probabilistic analysis

S.M. Hosseini, F. Shahabian • The dynamic analysis of stresses in a FG thick hollow cylinder subjected to sudden unloading are stochastically studied using combined Galerkin finite element and Newmark finite difference methods. The mechanical properties of FGMs are considered uncertain variables with Gaussian distribution.

12:30 **Experimental approach for optimizing dry fabric formability**

S. Allaoui, G. Hivet, A. Wendling, D. Soulat, S. Chatel

This paper presents an experimental approach for optimizing dry fabric formability by using a specific demonstrator. The first tests carried out on an interlock woven permit to highlight new defects shape and the importance of mechanical behaviours until neglected for woven shaping such bending.

Development of test methods for measuring thick section tensile and compression properties of polymer matrix composites

M.R.L. Gower, R.M. Shaw

This paper details the development of tension and compression test methods for ~20 mm thick CFRP laminates in support of the design of components comprising of thick sections. The effect of increasing coupon size for distributed ply laminates and the effect of ply-level scaling has been evaluated.

On the transverse strength of unidirectional composite based on FEM considering randomness of fiber arrangement

Y. Fujtia, T. Kurashiki, M. Zako

Some FE models of unidirectional composited with the random arrangement of filaments have been generated and the transversal crack propagation has been simulated. In the analysis, interfacial strength between filaments and resin and residual thermal stresses has been considered.

12:50 - 13:50 Lunch

A	Nanocomposites Chair: S-J. Kim	B	Smart/intelligent materials Chair: M.Q. Zhang	C	Biocomposites Chair: H. Kishi	NOTES

13:50

Mouldable, tough, high porosity, low density permeable macroporous polymer nanocomposites made by emulsion templating

R. Wu, A. Menner, **A. Bismarck**

Open porous high porosity nanocomposite macroporous polymers were prepared by emulsion templating. The physical and mechanical (compression, tensile and shear) properities of the foams will be presented. The liquid nature of the templates allows foams to be moulded into any form.

Intrinsic self-repairing of epoxy resin with thermal remendability

Q. Tian, **M.Z. Rong,** M.Q. Zhang

To endow epoxy resin with remendability, we synthesized a novel epoxy resin to combine epoxide with furan groups in one molecule, thus, the advantages of epoxy and intrinsic reworkable ability join together. This paper discussed synthesis and self-repairing characterization of this epoxy resin.

Development of biodegradable polymer-polymer composites

P.B.S. Bailey, A. Hodzic, S.A. Hayes, J.P. Fairclough

A comparison of commercially available, biodegradable polymers, compounded with PLA to produce phase separated composites with improved toughness. Results are presented for static and dynamic properties, melt flow and water absorption, as well as electron microscopy of phase structure.

14:10

Effect of micro- and nano-filler modification of an epoxy matrix on the in-plane shear response of a woven composite

V. Calard, M. Sales, L. Baca, A. Schindel, J. Wendrinsky

In this paper, a dispersion process has been developed in order to modify an epoxy resin with nano-particles (Alumina, Boehmite, Zirconia). Composites and bulk materials have been produced with the modified resins and mechanically characterized by bending and in-plane shear response.

Fracture behaviour of a self-healing microcapsule-loaded epoxy system

J. Lee, D. Bhattacharyya, M.Q. Zhang

The fracture behaviour of microcapsule-loaded epoxy matrix are investigated. The addition of microcapsules appears to significantly increase the load carrying capacity. Once healed, the composite exhibits the ability to achieve 93-173 percent of its virgin maximum load.

Bio-based nanocomposite foams from bacterial cellulose whiskers and PLA via cryogenic in situ porosification techniques

J.J. Blaker, K-Y. Lee, A. Bismarck

Novel nanocomposite foams have been fabricated using bacterial cellulose and polylactic acid (PLA) using a combined frozen microsphere templating and thermally induced phase separation approach, the technique enables porosity control and pores to be selectively lined by cellulose nano-whiskers.

14:30

Carbon aerogel / phenolic resin for nano-composite

A.W-J. Chen, B.M-Y. Shen, C.Y-L. Li, D.M-C. Yip

Carbon aerogel , a spongy porosity carbon material, gathered by a fixed amount of nano-particles possesses particular physical property. Results of reveal that electrical conductivity, tensile strength, flesural strength and impact strength increase around 58 %, 18 %, 14 %, 24 % respectively.

Fabrication and analysis of smart air intake structure using shape memory alloy wire embedded composite

M.S. Kim, B.S. Jung, J.H. Ryu, M.H. Cho, S.H. Ahn

SMA wire embedded composite was fabricated. The structure was composed of Ni-Ti SMA wires embedded in U-shape GFRP. The activation angle generated from the composite structure was large enough to make a smart air intake structure. The results were then studied using nonlinear analysis.

Properties of high impact modified PLA and PLA / man made cellulose fiber compounds

R. Forstner, W. Stadlbauer

The goal of this study was to improve impact properties with different commercial available additives as well as to improve thermal stability of PLA by incorporating man made cellulose fibres into PLA compounds. Various impact modifier classes were tested and impact strengths of 100 kJ/m² were found.

13:50

Processing of carbon nanotubes filled carbon fibre/epoxy composites by VARIM

M. Sánchez, M. Campo, A. Jiménez-Suárez, C. Romón, A. Urena

Carbon fibre composites with epoxy matrix filled with different contents of CNTs and with different surface treatment have been manufactured by VARIM. The mechanical properties of the composites, dominated by the matrix enhanced with the incorporation of the CNTs into the matrix.

Synthesis, characterization and properties of green silane functionalized expandable graphite composites

C-H. Chen, S-L. Chiu, C-F. Kuan, H-C. Kuan, **C-L. Chiang** • In this work, synthesis and properties of green flame retardant of silane functionalized expandable graphite composites were investigated. The modified expandable graphite composites improved thermal property and the anti-oxidant ability, corresponding to functionalized expandable graphite.

Blast response of composite fuselage structures using explicit finite element analysis

T. Kotzakolios, D.E. Vlachos, **V. Kostopoulos**

The scope of this study is to identify ways to protect a fuselage structure and insure its survival under a blast event. A key point of this study is to assess the damage generated to the fuselage by an explosive placed in different locations by means of explicit FE models using FSI schemes.

14:10

In-line process monitoring of morphologic and mechanical properties of polymer nanocomposites during extrusion and comparison with different off-line methods

D. Fischer, J. Müller, S. Kummer, B. Kretzschmar, S. Grosse • The novelty of this paper is the real time measurement of morphology and nanostructure formation of polymer nanocomposites by Ultrasonic measurements, NIR spectroscopy and light scattering during extrusion and correlation of these data with off-line measurements (TEM, RAMAN, mechanical properties).

On the effect of interlaminar compressive stresses in double-notch shear specimens

G. Allegri, M. May, S. Hallett

FE simulations are performed in order to assess the magnitude of stress concentrations in double notch shear (DNS) specimens and the effect of interlaminar compression. A corrected expression of the material interlaminar shear strength (ILSS) obtained by DNS specimens is introduced.

Three dimensional finite element study of in-plane behaviour and failure mechanism of a non-crimp fabric composite

L.M. Ferreira, E. Graciani, F. París

The behaviour and the mechanism responsible for failure of a NCF composite laminate is studied using a 3D FEM of a RUC at mesoscopic scale. A new approach is presented, in which the geometrical crimp of the tows is despised and a 3D FEM with straight tows with crimped material properties is created.

14:30

High temperature VARTM of phenylethynyl terminated imides

S. Ghose, R.J. Cano, S.M. Britton, K.A. Watson, B.J. Jensen, J.W. Connell

LaRC phenylethynyl terminated imide resins were processed using high temperature vacuum assisted resin transfer molding. Various process modifications yielded composites with voids < 3%. Photomicrographs were taken and void contents and mechanical properties of the composites were determined.

The relationship between the strength distribution of unnotched and notched composite laminates as a function of test condition

P.R. Spendley, S.L.Ogin, P.A. Smith, A.B. Clarke

Analytical models are used to investigate the relationship between the unnotched and notched strength of CFRP coupons under various test conditions. It is shown that a given variability in unnotched strength translates into less variability in the notched strength.

A numerical simulation of damage development for non-crimp fabric composites based on multi-scale analysis

T. Kurashiki, S. Honda, M. Zako

We have developed a simulation procedure of mechanical behaviors for NCF composites under static tensile and bending loading based on the multi-scale analytical methods. The effects of parameters, such as the pitch between stitching yarns, on the damage developments have been investigated.

A	Nanocomposites Chair: S-J. Kim	B	Smart/intelligent materials Chair: M.Q. Zhang	C	Biocomposites Chair: H. Kishi	NOTES

14:50 **Nanofilled unsaturated polyester matrices for composite materials**
A. Ciappa, R. Sulcis, A. Brunetin
Thermosetting polymeric materials are used for several applications. Our research has focused on UP based in situ functionalised nanosilica containing nano-materials. The viscoelastic behaviour of the cured resins have been determined by means of a rheometer, by a temperature ramp step.

Self sensing composites for structural health monitoring
T.J. Swait, S.A. Hayes, F. R. Jones
A method of detecting barely visible impact damage in CFRP is demonstrated which uses the inherent electrical properties of the carbon fibres themselves. Changes in electrical resistance were monitored as damage was applied. Damage was found to be reliably detected and located.

Characterisation of functionalised bacterial cellulose for green nanocomposite reinforcement applications
F. Quero, K-Y. Lee, J.J. Blaker, A. Bismarck, S.J. Eichhorn
This work presents physical characterisation of functionalised bacterial cellulose (BC) and composites using Raman spectroscopy. The BC is blended with a poly(L-lactic) acid resin and the interface between the resin and fibres are characterised using a Raman spectroscopy technique.

15:10 **Effects of maleated compatibilizers on the properties of polycarbonate and poly(lactic acid) nanocomposites**
W.S. Chow, S.S. Neoh, S.K. Lok
The effects of maleated compatibilizers (SEBSgMA and EPRgMA) on the injection molded polycarbonate and poly(lactic acid) nanocomposites were studied. Both SEBSgMA and EPRgMA have been proven to be effective compatibilizers and toughening agents for PC/OMMT and PLA/OMMT nanocomposites.

Shape recovery of thermoset shape memory polymers and fibre reinforced shape memory polymers
J. Ivens, M. Urbanus, C. De Smet
Shape memory polymers can transform for a temporary to a permanent shape under an external stimulus. Deformations are high, but recovery stresses are low. The recovery stress is increased using fiber reinforcement. The effect of different fiber architectures on shape recovery was evaluated.

Biopolymer-hydroxyapatite scaffolds for advanced prosthetics
C. Balazsi
The objective of this study was to fabricate hydroxyapatite-biopolimer nanofiber mats by electrospinning. Fibers with big HA agglomerates were fabricated using acetone and acetic acid whereas fibers with homogenous distributed HA particles were produced applying acetone and isopropanol.

15:30 **Polymer nanocomposites based on unmodified montmorillonite: water assisted extrusion**
F. Cordenier, F. Touchaleaume, P. Van Velthem, J. Soulestini, M. Sclavons, M-F. Lacrampe, J. Devaux, P. Krawczak • Water assisted extrusion is used to improve the dispersion of unmodified clay platelets. Water in the liquid state is injected in the twin-screw extruder to promote the dispersion of clay platelets thanks to the swelling of highly hydrophilic clay by water.

Toward the modelling of a CMC Yarn
B. Tranquart, P. Ladeveze, E. Baranger, A. Mouret
Ceramic Matrix Composite yarns are modeled using a multiscale approach, based on the Generalized Finite Elements Method together with “patterns”, identified on micrographics. This allows one to predict yarn behavior according to its microstructure and up to its cracked state.

Morphology and barrier properties of poly(lactic acid)/nano-sized precipitated calcium carbonate composites: effect of the filler surface treatment
F. Morel, E. Espuche, V. Bounor-Legare
Nanocomposites PLA/PCC were prepared by melt blending for a fixed amount of nanofillers. The effect of the filler and filler surface modification (stearic agents and PCL) was studied on the PLA cristallisation, the filler dispersion state and the nanocomposites gas transport properties.

15:50 - 16:20 Coffee Break

14:50

A new methodology for the placement of reinforcement doublers on composite space structures

B. Schläpfer, G. Kress

The concept of Ghost Layers allows optimizing the layout of composite material doublers for mitigating the weakening effects of coutouts in shell structures. The objectives of maximum eigenfrequency values and minimum mass make the new concept attractive for space applications structural design.

Monitoring delaminations in ENF specimens using chirped fibre Bragg grating sensors

T.F. Capell, S.L. Ogin, A.M. Thorne, G.T. Reed, A.D. Crocombe, S.C. Tjin, B. Lin

Chirped FBG sensors have been used to monitor delaminations within End Notch Flexure specimens, where the strain field is due to mode II loading. Sensors were embedded in the ENF specimens. Delamination was grown incrementally and monitored using the CFBG sensor.

Finite element modelling of composite laminates with integrated damping treatment in cylindrical bending

G. Lepoittevin, G. Kress

A finite element modeling of a composite laminate with integrated damping layer in cylindrical bending is compared with Pagano's exact solution. A parametric study investigates the effect of the position of the viscoelastic core in the laminate on the bending stiffness.

15:10

Forming predictions of UD reinforced thermoplastic laminates

S.P. Haanappel, R. Akkerman

A preliminary study was made of the thermoforming process of UD fibre reinforced thermoplastic laminates. Forming experiments and simulations were performed with a single dome. The effect of in-plane viscosities on the forming predictions was examined and the potential of a novel in-plane shear characterisation technique will be shown briefly.

High strain rate characterisation of unidirectional carbon-epoxy IM7-8552 in compression and in-plane shear using digital image correlation

H. Koerber, J.C. Xavier, P.P. Camanho

Experiments at strain rates up to 350 s^{-1} were performed on a Split-Hopkinson Bar. A high speed camera was used to monitor the specimen failure and to measure the fracture angle. The quasi-static and dynamic failure envelopes correlate very well with the Puck failure criteria for matrix compression.

An experimentally based cohesive law for delamination of composites

U. Stigh, D. Svensson

A method to measure cohesive laws for delamination of laminated composites is presented. Laws for pure mode I and mode II loading are implemented in a new cohesive law. The cohesive law provides some flexibility in interpolating cohesive properties for mixed mode loading.

15:30

Influence of production technology on the consolidation of fibre reinforced high performance thermoplastics

M. Horn, M. Kaden, R. Keck

For the consolidation of fibre reinforced thermoplastics could mainly hot pressing achieve acceptance. The presentation will give a comparison to the DLR-developed vacuum consolidation technique. The determined characteristics and the process experiences will be presented and discussed.

Influence of voids on the behaviour of composites

W.V. Liebig, F. Gehrig, K. Schulte

The relationship between porosity and compressive strength has been further investigated. Quasiisotropic CFRP laminates were cured with different autoclave pressure levels to obtain various void contents. It shows that compressive strength is significantly decreasing with increasing void content.

Development of an improved fatigue model for composites for wind turbine applications

J. Lambert, A.R. Chambers, I. Sinclair, S.M. Spearing

The work combines mechanical coupon testing with high resolution computed tomography (CT) to gain an understanding of damage micromechanisms. In addition to the damage, the CT permitted mapping of individual voids and their impact on the fatigue performance was assessed.

15:50 - 16:20 Coffee Break

A	Nanocomposites Chair: A. Bismarck	B	Damage and fracture Chair: P. Frontini	C	Biocomposites Chair: R.P. Wool	NOTES
16:20	**Hybrid filler networks from nano-fillers** M. Galimbertii, P. Riccio, S. Giudice, A. Citterio, G. Raffaini, T. Ricco, S. Passera, G. Ramorino, **L. Conzatti** Poly-isoprene was melt compounded with either organoclays or CNT. Hybrid filler networks were formed in the presence of carbon black as revealed by TEM and by calculating the initial modulus from stress–elongation curves. Polymer chains/fullerenes interaction was studied with molecular modeling.		**Interlaminar fracture energy evaluation of 3D woven composites** **D.T. Fishpool,** A. Rezai, S.L. Ogin, P.A. Smith Three 3D woven CFRP geometries were tested using the DCB method. Failure in bending of the cantilever arms in some geometries was overcome by reinforcing the arms with 2D CFRP tabs. Initiation and steady-state toughness were similar for reinforced and un-reinforced DCB.		**Epoxy resins from alcohol-liquefied wood and the cellulose fibre reinforced composites** **H. Kishi,** Y. Akamatsu, M. Noguchi, T. Fujiwara, S. Matsuda, H. Nishida New wood-based epoxy resins were synthesized from alcohol-liquefied wood. The T_g and tensile properties of the wood-based epoxy resin were higher than those of the corresponding PEG based epoxy resin. New green composites composed of cellulose fibres / the wood-based epoxy resins were fabricated.	
16:40	**Synthesis and characterization of nano-graphite composites: graphite multilayer hollows** J. Park, **S.-J. Kim** We used a soft chemical route of hydrothermal glucose carbonization on double shell Fe_3O_4@SiO_2 templates. Carbonization on the template happens as the Fe_3O_4 core is eliminated, resulting in SiO_2@C hollow. The Fe_3O_4 cores could be completely or partly eliminated in a controllable way.		**Damage and fracture resistance of the RTM6 structural epoxy with thermoplastic additions** **S. André,** F. Mathieu, D. Dumont, V. Destoop, D. Daoust, C. Bailly, T. Pardoen • This work aims at studying the mechanical behaviour of an epoxy resin which is widely used in aeronautical composites (HexFlow® RTM6 from Hexcel) with different amount of thermoplastic in order to understand the mechanisms that lead to an improvement of damage resistance and fracture toughness.		**Adsorption of proteins on layered silicates – a way towards nanostructured, biofunctional material** **A. Kiersnowski,** K. Czuba, G. Bugla-Płoskonska, M. Gazinska, K. Szustakiewicz, J. Pigłowski • The communication reports on materials based on montmorillonite and natural protein systems. It is demonstrated, that formation of the systems relies on synergistic adsorption of proteins onto silicate surface, which leads to formation of hybrids resembling exfoliated polymer-clay nanocomposites.	
17:00	**Fire resistance of poly(methyl methacrylate) (PMMA) containing metal oxide nanoparticles, ammonium and melamine polyphosphates** **B. Friederich,** A. Laachachi, M. Ferriol, D. Ruch, M. Cochez, V. Toniazzo • Metal oxides nanoparticles are known for improving thermal stability of polymers. The combination between these oxides and phosphorus compound leads to a synergism on flame retardancy in polymers. The present study aims to optimize this system in PMMA for improving flame-retardant properties.		**Fatigue strength and cyclic creep behavior of PEEK based composites** **A. Avanzini,** G. Donzella, D. Gallina, S. Pandini, C. Petrogalli Fatigue strength and cyclic creep of PEEK based composites reinforced with short carbon fibers and fillers is discussed by comparing S-N curves, progressive damage index, correlation of cyclic creep speed with number of cycles to failure and fatigue failure mechanisms by fractographic analyses.		**Calcium phosphate – reinforced hydrogel composites** **J.A. Juhasz,** K.A. Kwon, R.A. Brooks, N. Rushton, S.M. Best A nano and micro-calcium phosphate-hydrogel has been investigated.The composite takes advantage of the swelling ability of the hydrogel and the bioactivity of the calcium phosphate filler.The results of this study illustrate the highly suitable nature of this composite for use as a coating material.	

16:20

Controlling the locus of failure in composites from molecularly engineered fibre surfaces

F.R. Jones, T.J. Swait, T. Whittle, C. Soutis

Plasma polymerisation was used to conformally coat glass reinforcing fibres. The surface chemistry can be matched to the epoxy resin matrix, for optimal adhesion for tough composites. TOF-SIMS imaging has been used to identify the change in the locus of failure with chemistry of the interphase.

Relaxation phenomena and dynamics in polyoxymethylene/polyurethane/alumina hybrid nanocomposites

S. Siengchin, P. K. Karahaliou, S.N. Georga, C.A. Krontiras, J. Karger-Kocsis, **G.C. Psarras** • Ternary hybrid composites composed of POM/PU/alumina nanoparticles were produced by melt blending with and without latex precompounding. Their electrical properties were examined by means of Broadband Dielectric Spectroscopy. Recorded relaxations arise from both polymers and the presence of filler.

Advances in numerical methods for analysis and optimisation of composite structures for industrial applications

M. Bruyneel, **J.P. Delsemme,** Ph. Jetteur, A. Remouchamps, F. Germain

This paper presents recent advances in the non linear analysis and structural optimisation of thin-walled stiffened composite panels, which provide satisfying answers to the industrial needs for large scale finite element models with high non linearities (contact, material and geometrical NL).

16:40

High speed laser cutting of carbon fibre reinforced thermoplastic composites – Investigation on static strength properties

P. Jaeschke, D. Herzog, M. Kern, C. Noelke, C. Peters, A.S. Herrmann

The influence on the thermal effect caused by laser cutting with respect to the static strength of TPC material is studied. Applying different process optimization strategies, the heat affected zone within the TPC due to laser impact can be minimized and cutting speeds above 10 m/min are realized.

Assessment of laminate damage micromechanisms using high resolution synchrotron radiation computed tomography

M. Mavrogordato, P. Wright, I. Sinclair, S.M. Spearing • Synchrotron radiation computed tomography has been exploited to enable detailed multi-scale failure analysis & damage characterisation of toughened/ non-toughened laminates. Particular attention is paid to local microstructural effects on progressive matrix cracking, delamination and fibre failure.

Modelling and experimental investigation on the effect of interlaminar nano fibre layers on the delamination behaviour in a epoxy fiber glass composite

R. Mohan, A. Kelkar, N. Chinnannavar, S. Shendokar • The use of nano fibre interface layers formed with Tetra Ethyl Ortho Silicate and its effect on the delamination in epoxy-glass composite system is studied. The load-displacement and fracture toughness during delamination from the finite element modeling are compared with the experimental data.

17:00

Optimisation of mould filling parameters during the compression resin transfer moulding manufacturing process

W.K. Kam, **P.A. Kelly,** M. Ehrgott, S. Bickerton • Manufacturing parameters for the CRTM process were chosen such that the process time was kept short and the maximum mould closing force was kept low. The multi-objective optimisation problem was solved using a genetic algorithmic approach. Full-scale analyses were carried out on realistic geometries.

Study on the stress softening effect of silica filled rubber composites

M. Ito

Electron spin measurements under the tensile deformation, transmission electron microscopy observations and measurements of tensile properties were carried out for silica filled SBR and IR vulcanizates to discuss on the mechanism of stress softening effect (Mullins effect).

Optimization of modal loss factor of laminated composites including viscoelastic components

N. Le Maout, V. Verron

The optimization of a hybrid sandwich structure is studied. Several design variables such as number of plies or the position of the viscoelastic core are considered. The geometrical optimization consists in maximizing the damping loss factor of the whole structure using the linear search algorithm.

17:20 **Thermoplastic yarns filled with carbon nanotubes for reinforcement of composite matrices based on epoxy resins**
D. Dumont, D. Daoust, M. Sclavons, J. Devaux
A method to disperse simultaneously soluble thermoplastics and nanofillers in epoxy resins is proposed for composite liquid moulding technologies. The dissolution of thermoplastic yarns and the diffusion of carbon nanotubes initially dispersed in the correspondent nanocomposites are investigated.

Impact damage quantification by analyses of acoustic emission data
M. Scheerer, T. Goss, M. Henzel, M. Marischler, R. Wagner
In this work the authors present an algorithm for impact damage quantification in fibre reinforced plastic structures, based on acoustic emission data acquired only for a defined time period, where only the acoustic emission events coming from the friction of the damage will be taken into account.

Single step functionalisation of cellulose to produce all-cellulose nanocomposites
K-Y. Lee, A. Delille, J. J Blaker, A. Mantalaris, A. Bismarck
We develop a method to modify bacterial cellulose (BC) in the presence of microcrystalline cellulose (MCC), reactively compatibilising the two phases to make nanocomposite. As a result, all-cellulose nanocomposites reinforced by highly crystalline BC was produced.

17:40 **Tailoring the interfacial properties and flame retardancy of polymer/short-fiber composites through a reinforcement at nano-scale**
N.A. Isitman, C. Kaynak
In this study, apparent fiber/matrix interfacial shear strength and fire behavior of short fiber-reinforced, organophosphorus flame retardant nylon-6/montmorillonite nanocomposites were investigated by means of continuum micromechanics and cone calorimetry.

On the interaction between intralaminar cracking and delamination: mesoscale modeling, identification and validation
E. Abisset, P. Ladeveze, F. Daghia
The interaction between intra- and interlaminar degradation of a laminate can be crucial to predict complex damage scenario associated for example to impact. Such coupling was recently introduced in the mesomodel developed at the LMT-Cachan. A description of the model and some examples are given.

Micromechanical deformation processes in natural fiber reinforced PLA composites
J. Móczó, G. Faludi, K. Renner, B. Pukánszky
PLA was reinforced with four natural fillers having different particle characteristics. The mechanical properties of the composites were characterized by tensile testing. Micromechanical deformation processes were studied by acoustic emission measurements and scanning electron microscopy (SEM).

18:00-19:40 Poster Sessions

17:20

Improving the manufacture of complex geometries through the use of a novel highly drapable preform- a tow steering approach

K. Hazra, C. Ward, K. Potter

Different geometrical features in a part require different formability characteristics. Automated forming techniques often deform reinforcements that could easily be formed manually. This paper will investigate preforming techniques that enhance formability during automated lay-up over complex core.

Development of experimental and modelling tools for electro – mechanical fatigue tests in composite materials for aircraft applications

M. Gigliotti, J-C. Grandidier, M. C. Lafarie-Frenot, D. Marchand • The present paper focuses on the development of experimental and modelling tools for electro-mechanical fatigue tests in CFRP for fuselage applications. Preliminary results show that the number of cycles to rupture of electrified samples falls within the scatter of the non-electrified ones.

Effect of realistic waviness defects on compressive strength of fibre composites

S.L. Lemanski, M.P.F. Sutcliffe

Compressive failure of UD composite with fibre waviness defects. Several parameters investigated using finite element models, including material model, size and position of fibre misalignment, & laminate thickness. Results are explained from micromechanics of fibre reinforced materials.

17:40

Production technology route planning of composite parts

K. Karjust, M. Pohlak, J. Majak

There have analyzed the adhesion processes between the glass-fiber reinforcement layer and acrylic sheet. For optimal selection of the adhesion area the optimization model has proposed. Together with the adhesion area optimization found out max Tensile Force using Finite Element Analysis.

Development of a pressurized ring test to evaluate the influence of the tow tension on high pressure composite tank

A. Pilato, C. Bois, J.-C. Wahl, N. Perry

In order to stock hydrogen under gaseous form, high pressure carbon/epoxy tanks are realized using the filament winding process. A pressurized ring test was developed to represent the real solicitation of the structure and to leave free the thick cut edge for material heterogeneity observations.

Blast response of GLARE laminates using explicit finite element analysis-comparison against experimental results

T. Kotzakolios, D. E. Vlachos, V. Kostopoulos • Glare is a fibre metal laminate developed as analternative for aluminium used in aerospace applications due to its superior fatigue and impact characteristics.In this work, finite element models were generated for various charge sizes for a typical GLARE configuration used for fuselage skin.

18:00-19:40 Poster Sessions

20:30 WELCOME RECEPTION IN GELLÉRT BATH

Free of charge. 20 min pleasant walk from the conference venue.

The welcome reception will be held in Gellért bath, which is one of the most popular historical baths in Budapest. The medicinal spring here was already famed in the 13th century. The spa is decorated with a wealth of original Art Nouveau furnishings, artistic mosaics, stained glass windows and sculptures, although the interior of the hotel built alongside has lost many of these fittings over the years.

Monday 20:30-22:30

A

Plenary lecture

Chair: G.S. Springer

8:00 **Composites for a sustainable society: is the future nano, bio or both?**

I. Verpoest
Catholic University Leuven

Nano-engineered composites offer a great potential in improving toughness and impact resistance, if the nano-scale reinforcement is correctly positioned on or inbetween the fibres. Biobased polymer matrices and fibres can greatly reduce the ecological impact during the production of composites.

Lectures

A	Nanocomposites Chair: L. Bokobza	B	Damage and fracture Chair: A.T. Marques	C	Biocomposites Chair: P. Hornsby	NOTES
9:00	**Surfactant effect and structure-property correlations in PA6/layered silicate nanocomposites: particle structure, exfoliation, reinforcement** E. Naveau, Z. Dominkovics, C. Jerome, K. Renner, J. Móczó, M. Alexandre, **B. Pukánszky** • PA composites were prepared from clays modified with organophosphonium and ammonium salts of similar chemical structure. Structure was characterized by SEM, TEM, WAXS, rheology and mechanical testing. The phosphonium salt results in more homogeneous structure, better exfoliation and reinforcement.		**Damage tolerance and interlaminar crack growth of braided composites** **S. Stelzer,** M. Wolfahrt, G. Pinter, T. von Reden, J. Noisternig Within this work an experimental investigation of the damage tolerance and the interlaminar crack growth of braided composites under monotonic and fatigue loading was undertaken. Monotonic and cyclic mode I, monotonic Mode II and compression after impact measurements were carried out.		**Functionalised hydrotalcite-like anionic clays, nano-fillers of biodegradable polymers** **U. Costantino,** M. Nocchetti, G. Gorrasi, L. Tammaro, V. Vittoria Hydrotalcite-like compounds modified by intercalation with anti-inflammatory drugs, antibiotic, antimicrobial and antioxidant species have been dispersed in biodegradable and biocompatible polymeric matrices to obtain biomedical and active food packaging systems as films or fibers.	
9:20	**Electrical, mechanical and thermal properties of multiwall carbon nanotube modified linear poly(p-phenylene sulfide) manufactured via twin screw extrusion** **A. Noll,** T. Burkhart Electrical, thermal and mechanical properties of MWNT/PPS nanocomposites manufactured via twin screw extrusion were investigated. A low electrical percolation threshold was observed, and a good dispersion quality of MWNTs on micro- and nanoscale was verified.		**Static and fatigue tensile behaviour of 3D braided carbon/epoxy composite** M. Li, J. Pazmino, **V. Carvelli,** S.V. Lomov, A.E. Bogdanovich, J. Xu, D.D. Mungalov, I. Verpoest The present work presents an experimental study of a 3D braided carbon/epoxy composite. The preform material is produced by 3TEX Inc. The experimental study involves static tensile tests to have the in-plane properties and tensile-tensile fatigue tests to produce the Wöhler (S-N) curves.		**Mophological and microstructural characterisation of bamboo fibres and the relation with mechanical properties** **L. Osorio,** E.Trujillo, A.W. Van Vuure, I. Verpoest Because of its good mechanical properties and low density, Bamboo fibre represents a good alternative as reinforcing material. The goal is to make it suitable to be used as reinforcement in composites. To have the good knowledge about its microstructural and mechanical characteristics is imperative.	
9:40	**Creation of nano-composites with various nano-structures by biomimetic approach** **K. Kazama,** H. Hatta, M. Koyama, H. Fukuda Living tissue are formed by self-assembling processes and are attained environmentally-adapted structure. To produce structurally-optimized composites by a biomimetic approach, we investigated the condition of controlling factors yielding various liquid crystalline states of collagen solution.		**Proposition of 3D progressive failure approach and validation on tests cases** **J.-S. Charrier,** N. Carrere, F. Laurin, T. Bretheau, J.-M. Laborie This paper proposes a failure approach dedicated to 3D loadings and matching the requirements of design office. The out-of-plane strengths are identified through two simple tests. The evaluation of the stability of the delamination and the influence of the edge effects will be studied.		**Origin of kink bands in bast fibres and their effects on the fibre strength** **T. Hänninen**, M.S. Alam, A. Michud, M. Hughes Mechanical treatments are commonly used to separate the fibres from stems and subsequently to technical fibres. These treatments are known to cause defects in the fibres. In this study we are investigating how defects affect the fibre strength by using several techniques.	

D Processing & manufacturing
Chair: J.P. Nunes

E Experimental techniques
Chair: J.Y. Cognard

F Modelling and simulation
F. Paris

NOTES

9:00

An investigation on the development of the transverse bonding in automated tape placement process
M.A. Khan, J. Litchner, R. Schledjewski
This research work deals with some technical issues in thermoplastic tape placement process like thermal energy input, width deformation, positioning and overlapping of the adjacent tape and corresponding transverse strength development. Simulation are also performed to verify the width change.

Progressive crushing of pultruded tubes under quasistatic and blast loading
D. Kakogiannis, D. Van Hemelrijck, J. Van Ackeren, J. Wastiels, S. Palanivelu, W. Van Paepegem, B. Reymen, J. Vantomme
In the present study the influence of triggering on the energy absorption of circular pultruded composite tubes is investigated. The tubes are tested under quasistatic and blast load, applied axially. For the measurements was used a ballistic pendulum.

Virtual modelling of microscopic damage in polymer composite materials at high rates of strain
M. Lidgett, R. Brooks, N.A. Warrior, K. Brown
This work integrates a micro scale composite model which accurately reflects the fibre architecture, failure mechanisms and high strain rate properties, into a meso scale composite model. User subroutines define material behaviour of the fibre, interface and matrix in Abaqus®.

9:20

Effects of the impregnation die geometry on the roving tension and laminate quality during filament winding
A. Miaris, M. Pässler, R. Schledjewski
Filament winding is a method for the production of high end structures. IVW is developing a new impregnation unit for the continuous processing of carbon fiber rovings. The present work discusses the mechanisms that act inside the impregnation unit and correlates them with the processing parameters.

Behaviour of optical fibre Bragg grating sensors embedded into composite material under flexion
D. Kinet, D. Garray, M. Wuilpart, F. Dortu, X. Dusermont, D. Giannone, P. Mégret
A high number of fibre Bragg grating (FBG) sensors have been embedded without spectral deformation and were used for traction and flexion measurements. The results are promising and could provide a powerful tool to predict rupture threshold in composite materials.

Shape optimisation of a biaxially loaded cruciform specimen
A. Makris, T. Vandenbergh, C. Ramault, D. Zarouchas, D. Van Hemelrijck, E. Lamkanfi, W. Van Paepegem • A numerical optimisation technique (sequential quadratic programming or SQP) is coupled with a parametrically built finite element model (FEM) to concentrate and initiate damage in the centre of cruciform specimens and achieve a uniform strain field by varying the geometrical characteristics of it.

9:40

Fabrication and characterization of MWCNT reinforced carbon fabric/epoxy
O. Choi, **B.S. Kim,** J.H. Byun, D.L. Cho, K.S. Kim
Charged MWCNTs were deposited on carbon fabric by EPD. Charges were by plasma polymerizations and acid solution, respectively. Compared to the unmodified carbon fabric/EP, the in-plane electrical conductivity has increased by 40% and acrylic acid plasma treated case increased only 14%.

Experimental analysis of fibre orientation in injection moulded notched plates made of short fibre reinforced polyamide
A. Bernasconi, F. Cosmi
Fibre orientation in injection moulded samples of short glass fibre reinforced polyamide was analyzed experimentally using micro-tomography and phase contrast imaging techniques. Samples were analyzed and results compared with that predicted by commercial software simulating injection moulding.

Three-dimensional damage analysis of laminated composites using parallel boundary element method
J. E. Ortiz, P.P. Camanho
We present numerical implementation of 3D cohesive zone model into the boundary element formulation. The model uses quadratic boundary element to simulate initiation and evolution of the damage in unidirectional composite material. A benchmark is discussed and comparative results are presented.

A Nanocomposites
Chair: L. Bokobza

B Damage and fracture
Chair: A.T. Marques

C Biocomposites
Chair: P. Hornsby

NOTES

10:00

Electronic and opto-electronic properties of TiO_2 composite single nanofibers with mesoporosity
Y-R. Kim

Semiconductor nanowires have intensively been investigated in nanodomain for their applications of gas sensor. In this study, fabrication of mesoporous TiO_2 nanofiber (MTNF) is reported and their various applications are discussed in the aspects of electronic, optical, and opto-electronic factors.

BEM analysis of Inter-fibre failure in composites. Comparison between carbon fibre and glass fibre systems
E. Correa, F. París, V. Mantic

The evolution of the matrix/inter-fibre failure for two different bi-material systems: glass-epoxy and graphite-epoxy is analysed by means of a Boundary Element model. The results are analysed using the concepts derived from Interfacial Fracture Mechanics.

Compression moulding of laminates based on all-cellulose composites or high strength laminates based on all-cellulose composites
T. Huber, J. Müssig, S. Bickerton, S. Pang, M.P. Staiger • A lamination procedure for all-cellulose composites using partial dissolution of cellulosic fibre surfaces by a treatment with the ionic liquid (1-Butyl-3-methylimidazolium acetate) will be presented. The so produced all-cellulose composites were analyzed using tensile testing, SEM and XRD.

10:20

Experimental analysis for mechanical properties of the carbon nanotube fibers
K. Yilan, L. Qiu

In this paper, two kinds of experiment have been done by tension and micro-Raman Spectroscopy for the mechanical properties of the nanotube fibers. The mechanical model of the fibers has been made and the main effect factors for mechanical properties are discussion and analysis.

Visual detectability of blunt impact damage in a stringer-stiffened CFRP fuselage panel
J. Baaran, S. Waite, W. Kleine-Beek

The influence of inspection parameters (lighting, surface colour/finish, cleanliness, inspection angle) on the detectability of damages has been determined by visual inspections of two nominally equal composite structures with blunt impact damages. Inspections were carried out by 100 test persons.

Thermal properties of microfibrillated cellulose modified with polymers
P. Pietikäinen, T. Mehtiö, J. Seppälä

Microfibrillated cellulose (MFC) forms uniform web-like structure with wide range of polymer/MFC mass ratios. It was shown that polymer/MFC composites can be used in applications where thermal stability is required. These properties can be fine-tuned by adjusting polymer/MFC mass ratio.

10:40 - 11:10 Coffee Break

10:00

An overview of heat transfer studies during the curing of thermosets in moulds

V. Kosar, Z. Gomzi

Experimental measurements of time - temperature profiles across the body of the mould serves as input experimental data for testing mathematical models of curing process. By solving the model, useful relations between the process and equipment variables were revealed and could be easily observed.

Mechanical properties of core-shell rubber particles toughened epoxy resins and composites

J. Krämer, U. Beier, V. Altstädt

In this study the modification of a thermoset resin (DGEBA) with core-shell particles of different sizes is presented. The characterization of the neat resins and carbon fibre reinforced composite materials included water absorption, dynamical mechanical analysis and the mechanical performance.

Numerical macro scale modelling of discontinuous fibre architectures

R. Luchoo, L.T. Harper, M. Bond, N.A. Warrior

A random fibre network model distributes non-linear discontinuous tows, as 1D beam elements in a 3D volume, using a non-contact algorithm. The model is used in conjunction with an FE package to investigate fibre length, size and volume fraction effects under quasi-static tensile loading conditions.

10:20

Automation of tow placement preforming using binder coated carbon fibre tows

M. Asareh, A.R. Mills

An Automated Tow Placement (ATP) device for preforming with binder coated carbon fibre tows was designed and built at Cranfield Composites Centre. A thermal imaging system was used for calibration of the ATP device. A modified tow pullout test was used to compare preform adhesion strength.

Health monitoring system of composite structures based on dynamic response measurements and advanced signal processing techniques

A. Panopoulou, T. Loutas, V. Kostopoulos, T. Henriksen • The work deals with the development of a system for SHM of composite structures based on real-time dynamic measurements using Fiber Bragg Grating (FBG). Damage was simulated by adding known masses in different locations of a test panel. An artificial neural net was applied for damage identification.

Haar wavelet based discretization technique for analysis and design of composite plate and shell structures

J. Majak, M. Pohlak, M. Eerme, K. Karjust, J. Kers

The Haar wavelet discretization technique for the solution of the elastic bending problems of composite structures is proposed. Strong and weak formulations based discretization schemes are discussed.The higher order approximation has been introduced, including local and global terms.

10:40 - 11:10 Coffee Break

A	Nanocomposites Chair: W.H. Ruan	B	Damage and fracture Chair: V. Carvelli	C	Biocomposites Chair: A. Hassan	NOTES
11:10	**Mechanical and thermal response of i-PP & s-PP/MWNT nanocomposites** D.E. Mouzakis, I. Zuburtikudis Nanocomposites based on i-PP and s-PP and Multiwall Carbon Nanotubes (MWNTs), were prepared. Static and dynamic testing, fracture toughness of notched specimens and DMA tests were performed in order to access mechanical, viscoelastic, and fracture toughness response, of these nanocomposites.		**Fracture toughness of injection moulded organoclay reinforced polypropylene composites** P. Frontini, V. Pettarin, F. Brun, A. Pontes, J. Viana, A. Pouzada Fracture toughness, K_C of injection molded polypropylene/nanorganoclay composites was determined at different positions in the moldings using SENT specimens. Kc variation was assessed at the bulk and at the weld line region. K_C was affected by mouldingposition, clay content and particle orientation.		**Environmentally friendly poly(lactic acid)/phormium tenax composite: thermal and mechanical characterization** I.M. De Rosa, A. Iannoni, J.M. Kenny, D. Puglia, C. Santulli, F. Sarasini A polylactic acid (PLA) matrix has been reinforced with different tenors of Phormium Tenax short fibres (20, 30 and 40%) and characterised from thermo-mechanical point of view. The results show in general for the composites a considerable improvement over the properties of the pure matrix.	
11:30	**Manufacture and characterization of hollow carbon nanofibers** B.S. Lee, W-.R. Yu This study is concerned with hollow carbon 'nano'fibers, in particular manufacturing process that can control their wall thickness and core size. We will focus on the electrospinning conditions to find a relationship between these parameters and hollowness.		**Development of fatigue delamination onset and growth criteria for damage tolerant design of small aircraft composite structures** S. Giannis Delamination failure is one of the main failure mechanisms in most applications that advanced composite materials are used. This paper discusses the development of suitable mixed-mode fatigue delamination criteria to describe delamination onset and growth.		**Green processing of nanofibers** R. Krishnan, S. Ramakrishna Current electrospinning method is used organic solvents as a medium and a trace amount of organic solvent in the electrospun scaffolds will damage the human tissues. In the present study, nanofibers were fabricated from water soluble polymers to improve eco-friendliness of the process.	
11:50	**Nano-engineered fibre reinforced composite: Gain in properties and limitations of the manufacturing** S.V. Lomov, L. Gorbatikh, A. Godara, L. Mezzo, F. Luizi, I. Verpoest It is possible to achieve a significant increase in toughness after addition of CNT to the composite. Fracture toughness, interlaminar shear strength, fibre-matrix interface shear strength are higher in nFRC. A factor of improvement ranges from 30...70% to about 2 times.		**A cumulative damage law based on continuum damage mechanics approach** R.M. Guedes A modification of the classical failure condition in the framework of continuum damage mechanics (CDM), based on original ideas of Kachanov, is proposed. This new formulation is combined with a general damage growth law to obtain a different cumulative damage law (CDL).		**Glass transition temperature behaviour and viscoelastic properties of polylactide-co-glycolide/alpha-tricalcium phosphate nanocomposites** A.S.I. J Wilberforce, B.S.M. Best, C.R.E. Cameron • Polylactide-co-glycolide/alpha-tricalcium phosphate nanocomposites showed lower temperature transitions to the leathery region and had lower glass transition temperatures than the unfilled polymer. This was thought to be due to weak interfacial bonding between the nano-particles and polymer matrix.	

11:10

Spring-in of composite parts manufactured by Liquid Resin Infusion (LRI) processes

H.-F. Perrin, A. D'Acunto, P. Martin, J.-P. Cauchois

This work propose a method to predict deformation of angled part manufactured by LRI processes. The contribution of the specific to LRI processes deformation mechanism is experimentally investigated. A simple model is proposed in ordner to predict spring-in angle as function of intrinsec parameters.

Mechanical properties of all poly(ethylene terephthalate) composites

C.M. Wu, F.C. Pu, C.H. Chiu, J.C. Chen

Self-reinforced PET composites were produced by film-stacking technique. It was established that the best condition is low consolidation temperature and short holding time. A significant improvement on the tensile, flexure and impact properties were obtained in all srPET composites.

The incorporation of nano and micron-scale fillers to enhance the interlayer adhesion of hot compacted single polymer polypropylene composites

R.J. Foster, P.J. Hine, **I.M. Ward**

The current work is a major extension of two very different studies carried out previously to investigate factors that affect the peel strength of single-polymer composites produced by the Leeds hot compaction process. We have now investigated the amalgamation of these two approaches.

11:30

Optimizing the continuous dry impregnation of thermoplastic matrix fiber reinforced materials

J.P. Nunes, L.M. Amorim, J.F. Silva

This work establishes process windows for efficient continuous dry production of thermoplastic matrix fibre reinforced towpregs in a recently developed coating line. Relevant processing parameters were varied to determine their influence on the final polymer mass fraction and material quality.

Some remarks concerning the gelation of PVC/Wood flour composites

J. Tomaszewska, S. Zajchowski, **T. Sterzynski**

Structural and thermal effect in PVC/wood flakes composite (WPC) by gelation were determined. It was found that PVC matrix gelation occurs at lower temperature, accompanied by thermal effects due to self heating of the compound. Significant changes of the primary grain structure were also noted.

Modelling of the interfacial debonding in SiC/SiC microcomposites

L. Gélébart

In 1D models of micro-composites, the behaviour of the interphase does not rely on a refined description of the debonding. The purpose of this presentation is to derive a 1D model of the interphase behaviour from 2D axisymmetric finite element calculations accounting for debonding propagation.

11:50

PP-EPDM thermoplastic vulcanizates (TPVs) by electron induced reactive processing

K. Naskar, U. Gohs, U. Wagenknecht, G. Heinrich

TPVs can be produced by reactive processing. A 1.5 MeV electron accelerator was directly coupled to an internal mixer by energy input via high energy electrons under dynamic conditions of melt mixing of PP and EPDM. Influence of absorbed dose, electron energy and treatment time have been studied.

Four-point bending test of asymetrical tapered carbon/epoxy composite laminates

D. Carrella-Payan, G. Allegri, J. Lander

In this study, four point bending tests have been performed on assymmetrically tapered specimens aimed at characterising the onset of delamination from ply drop-offs. The specimen failure mode has been further investigated by analytical methods and FE analysis.

Interfacial properties of CNT grafted carbon fibers

K.J. Kim, W-R. Yu, J.H. Youk

Carbon nanotubes grafted carbon fibers were fabricated to improve the interfacial properties between carbon fibers and resin matrix. The effect of the parameters such as the size (diameter and length) of CNTs was quantitatively evaluated on the interfacial properties.

12:10 **Effect of dispersion state on mechanical properties of CNT/epoxy nanocomposite**
S.H. Kim, J.W. Jung, S.H. Yum, J.M. Park, J.K. Park, **W.I. Lee**
Using the new method to assess the dispersion state from the DSC analysis, the relationship between the dispersion state and mechanical property was investigated. It was found that the key to the extent of improvement seemed to be the number of well dispersed CNTs, not the absolute amount of CNTs.

Damage in textile laminates of various inter-ply shift
D.S. Ivanov, S.V. Lomov, I. Verpoest
The deformation and failure of textile laminates are strongly affected by inter-layer configurations. As an alternative to large representative volumes, we propose boundary conditions imitating the interaction with the surrounding non-periodic media.

The effect of kink bands on the strength distribution of flax fibers
E. Sparnins, J. Andersons
The mechanical properties of flax fibers are affected by natural variability and damage. The strength distribution of elementary flax fibers is determined at several lengths by standard tensile tests. Strength distribution function is derived and found to provide good agreement with test results.

12:30 **Development of Hybrid-Buckypaper (HBP) structures and multi-functional assessment of composites incorporating HBP**
V. Kostopoulos, **A. Baltopoulos,** S. Eleftheriou, A. Vavouliotis
MWCNTs together with CNF and SiC nanoparticles were combined to produce hybrid buckypaper (HBP). SEM-characterization of the microstructure was performed and correlated with manufacturing parameters.The sensing performance of HBP composites was evaluated as embedded sensors in larger structures.

Damage initiation and growth in laminates with ply drop-offs under quasi-static and fatigue loading
A.R. Sanderson, T.F. Capell, S.L. Ogin, S.C. Tjin, B. Lin
Composite laminates commonly include dropped plies to allow for changes in cross section. Damage observations are reported in a model test specimen intended to be used for assessing whether chirped fibre Bragg grating (CFBG) sensors are suitable for monitoring damage development associated with dropped plies.

Effect of enzyme treatment on properties of pineapple leaf fiber-polycarbonate composites
C. Silapasunthorn,
P. Threepopnatkul, W. Srijaratsin
The treatment effect of cellulase enzyme for pineapple leaf fibres (PALF) on properties of fiber reinforced polycarbonate composites (PC/PALF) was investigated. The results show that surface modification with cellulase could improve mechanical properties of the composites.

12:50 - 13:50 Lunch

12:10

Drilling process of composite laminates – a tool based analysis

L. Miguel, **P. Durao,** D.J.S. Gonçalves, J.M.R.S. Tavares, V.H.C. de Albuquerque, A.T. Marques

The characteristics of carbon fibre reinforced plastics had broadened their use. In result of their inhomogeneity, machining can lead to different damages, like delamination. This work shows that a proper combination of tool material, drill geometry or cutting parameters can reduce delamination.

A modified arcan test suited to analyse the behaviour of composites and their assemblies under out-of-plane loadings

J.Y. Cognard, L. Sohier, P. Davies

Numerical and experimental results indicate that the proposed modified Arcan fixture is suitable for obtaining the response of hybrid bonded assemblies with composites. Experimental results underline the influence of different parameters on the out-of-plane strength of the composite.

Effect of silane coupling agents on the durability of glass fiber/epoxy laminates

A. Marques, D. Deheunynck, P. Chevalier

Commercially available and new fiber-sizing products, with different organic functionalities, are evaluated with the purpose of enhancing the strength, the moisture and thermal resistance of composites, in particular E-glass fiber/epoxy resin laminates, for e.g. Printed Circuit Boards applications.

12:30

Time reduction of manufacturing cycle in a high heating ramp process for carbon/polymeric composite: thermokinetic characterization

C. Paris, P.A. Olivier, G. Bernhart

Our work focuses on curing time reduction owing to an out-of-autoclave process. Beside the determination of the prepreg cure kinetics, the degradation was studied and the morphology of cured matrix analysed. The effects of melting of thermoplastic particles on mechanical properties were assessed.

Study of interlaminar shear and interlaminar tensile behaviour of angled laminate beams

G. Zhou, J. Haworth, B. Aspinall, P. Nash

Large curved composites structures in use lack reinforcement in the thickness direction. Delamination could occur and bends in the structures cause stress concentrations. We design and manufacture angled laminates with crease and investigate its effect on their interlaminar behaviour.

Newly developed grafted polymer type coupling agents and impregnation technique for carbon fibre reinforced polyethylene composites

Cs. Varga, N. Miskolczi, L. Bartha, L. Falussy • The aim of our work was developing of new coupling agents for carbon fibre reinforced PEs in order to overcome their incompatibility problems. Their effectiveness were followed by the changes in the mechanical properties of the composites and the possible interactions were studied on SEM graphs.

12:50 - 13:50 Lunch

13:50 Carbon nanotube-reinforced elastomers

L. Bokobza

Carbon nanotubes display exceptional stiffness and strength and remarkable thermal and electrical properties, which make them ideal candidates as fillers for elastomeric materials. This paper will give some recent advances in processing and characterization of elastomers filled with multiwall carbon nanotubes.

Damage tolerance to repeated impacts of glass fibre laminates with cork film interleaves

P.J.R.O. Nóvoa, D. Dias, **A.T. Marques**

Interlayers are used to increase the toughness of composite laminates. Cork films were selected as interlayer material. The toughening strategy is evaluated studying the damage tolerance to repeated impacts. Results show a clear influence of interlayer material on the composite structure toughness.

Bio-based composites: Solutions to global warming

R.P. Wool

Biobased Composites: Solutions to Global Warming. As a viable solution to global warming, bio-based materials are designed using the Twinkling Fractal Theory to support the green energy infrastructure with wind and hydro turbines, solar integrated energy efficient housing and hydrogen storage.

14:10 Synthesis and properties of PEEK/carbon nanotube nanocomposites

A.M. Díez-Pascual, M. Naffakh, M.A. Gómez, M.T. Martínez, J.M. González-Domínguez, Y. Martínez-Rubi, B. Simard • This study deals with the development of high-performance poly(ether ether ketone) based nanocomposites including single-walled carbon nanotubes. The incorporation of fillers improves the thermal stability, electrical and thermal conductivity, strength, storage and young modulus of the composites.

The use of a controlled multiple impact test to characterise through-thickness penetration of composite panels

J. Sirichantra, S.L. Ogin, D.A. Jesson

For certain materials (e.g. CFRP panels based on plies of plain-woven fabric) features, akin to “flaps”, develop during low-velocity impact. Measurements of the flap length enable a compliance/crack-length relationship to be determined, from which, it is proposed, a toughness value can be derived.

Characterization of polymer composite materials based on bamboo fibres

E. Trujillo, L. Osorio, A.W. Van Vuure, I. Verpoest

Bamboo (Guadua angustifolia) fibres are studied to be used as reinforcement in continuous thermoset and thermoplastic composite materials. The results illustrate that bamboo presents a natural and renewable option as reinforcement where glass fibre and traditional natural fibres are used nowadays.

14:30 On the prediction of mechanical properties of nanocomposites

M. Quaresimin, M. Zappalorto, **M. Salviato**

A classification of the available modelling strategies is proposed, depending on the scale used to address the problem. Some of the existing toughening models will be modified, in order to make them size-dependent. Accurate results will be presented and discussed.

Delayed fracture of woven GFRP under constant load in hydrothermal environment

M. Kotani, Y. Yasufuku, H. Kawada

Constant load test of plain woven GFRP was conducted in air and under water to investigate its degradation behavior under hydrothermal environment. The rupture time shortened with higher applied stress and higher temperature due to the acceleration of damage accumulation within GFRP constituents.

Properties of kenaf filled polypropylene composites containing ammonium polyphosphate as flame retardant

A. Hassan, A. Ismail, Z. Mohamad

The main objective of this study is to determine the effects of ammonium polyphosphate on flammability and thermal properties of kenaf-filled polypropylene composites. Ammonium polyphosphate increased the flame resistance and thermal stability of kenaf-filled polypropylene composites.

13:50 **Manufacturing of thick-skin honeycomb sandwich structures**
S.S. Tavares, Y. Roulin, **V. Michaud,** J.A-E. Manson
We report results on alternative manufacturing strategies to produce honeycomb sandwich structures with thick skins with vacuum-bag only processing. Partially impregnated prepregs are combined with traditional prepregs to form a hybrid structure. Final part quality is assessed by DCB testing.

Virtual testing and stochastic approach to fragmentation of 0° tows in woven ceramic matrix composite (CMC)
P. Pineau, **J. Lamon**
A multi-scale model of multiple cracking in the 0° tows of 2D woven 0°/90° CMCs is proposed. The 2D mesh for finite element analysis reproduces the heterogeneous features of the microstructure. It was obtained by image analysis of micrographs. Cracks were introduced at predicted location.

Influence of thermal stress on interface strength of fibre-reinforced thermoplastic investigated by a novel single fibre technique
J.L. Thomason, L. Yang
We present data on the temperature dependence of glass-polypropylene IFSS obtained by a novel combination of the microbond test with a thermomechanical analyser. The values for residual stress and IFSS give an upper limit on the temperature dependence of the coefficient of friction for this system.

14:10 **Thermoplastic prepreg laminate processing - quality control and mechanical properties**
R.T. Durai Prabhakaran, A. Lystrup
The present article investigates the process intricacies involved in making Glass/PA6 prepreg composites. Vacuum consolidation technique used to estimate process parameters and to control laminate quality. Standard tests are performed to evaluate the material properties like compression strength

Identification of a nonlinear elastic model with damage variables for a 2.5D SiC/SiC composite
E. Castelier, G. Camus, S. Sauder
A simple model has been developed within a rigorous thermodynamic framework to model the elastic-damageable behaviour of SiC/SiC composites. It consists of a non linear elastic model, enriched with a few damage variables. Its parameters have been easily fitted on several tensile curves.

Influence of the interface on the strength of fiber reinforced polymers
C. Marotzke
The dependence of fiber debonding on the ratio of normal to shear stresses is studied on model composites. Fibers with different orientations with respect to the loading direction are tested, exhibiting different debonding behaviour. Pure debonding as well as debonding plus fiber breakage is found.

14:30 **Evaluation of RTM produced CNT doped GFRP laminates**
G. Rieber, P. Mitschang
The filtering of CNTs by RTM produced GFRP-laminates is evaluated by through-the-thickness conductivity measurements. Compression RTM laminates show less filtering effects in comparison to conventional RTM or VARI. The Charpy impact toughness of the NCF laminates increased by 15%.

Influence of atmosphere and carbon contamination on activated pressureless infiltration of alumina-steel composites
J. Kuebler, M. Bahraini, E. Schlenther, J. Kriegesmann, T. Graule
MMCs were fabricated by pressureless infiltration in different gas atmospheres. Based on the MMC quality, Argon was chosen for improvement of infiltration. Further improvement was achieved by addition of Si or SiO_2 powder to the preform in order to reduce the effect of the residual carbon.

Carbon fibre reinforced polyvinylidene fluoride (PVDF): effect of matrix and carbon fibre modification on composite performance
S. R. Shamsuddin, K. K.C. Ho, A. Bismarck • Continuous unidirectional carbon fibre reinforced PVDF composite tapes were manufactured using atmospheric plasma fluorinated fibres & MAH-grafted PVDF matrix through powder impregnation process. Adhesive properties were investigated by means of interface dominated micro & macro mechanical tests.

A	Nanocomposites Chair: D.E. Mouzakis	B	Damage and fracture Chair: J. Degrieck	C	Biocomposites Chair: J. Karger-Kocsis	NOTES
14:50	**Toughness and fatigue analysis of polypropylene nanoclayed composites** **P.N.B. Reis,** J.A.M. Ferreira, J.D.M. Costa, M.O.W. Richardson, B.C.H. Richardson The paper presents results of a study centered on strain energy release rate and fatigue behavior of a polypropylene binder resin enhanced by using nanoclay reinforcement. Fatigue tests were performed in tensile load control. Control material and also clayed composites exhibits high cyclic creep.		**On longitudinal compressive failure of CFRP: not just fibre kinking** **S.T. Pinho,** R. Gutkin, S Pimenta, N.V. de Carvalho, P. Robinson, P.T. Curtis Experimental information for longitudinal compressive failure of UD CFRP is presented, indicating that there is more than one mechanism that can lead to this failure; corresponding models are detailed. An analogous study is then carried-out for woven composites and for recycled composites.		**Chemical surface modification of sisal fibres by nano-size bacterial cellulose** **A. Delille,** K.-Y. Lee, A. Mantalaris, A. Bismarck To improve at both scales, micro and nano, the reinforcement between the polymeric matrix and the natural fibres (NF) in composites, different fibre pretreatments were used. The resulting effects on the fibres and the composites will be assessed by mechanical, thermal and morphological analysis.	
15:10	**Influence of nanoclays on mechanical and barrier properties of hydrogenated acrylonitrile butadiene rubber nanocomposites** **R.M. Cadambi,** E. Ghassemieh HNBR clay nanocomposites were prepared by conventional rubber mixing technique and the various methods have been tried out to incorporate the nanoclays. Significant improvements in mechanical properties and permeability properties were observed at 5 phr levels of organoclays.		**A surface cut ply specimen for the determination of mixed-mode interlaminar fracture toughness** **J.K. Lander,** L.F. Kawashita, G. Allegri, S. R. Hallett, M.R. Wisnom This paper reports a study on a new specimen for measuring the critical mixed-mode Energy Release Rate (ERR), also referred to as G_C, which is applicable to the characterisation of continuous-fibre reinforced composite materials.		**High performance natural fibre hybrid composites based on biobased thermoset resin for use in structural applications** **K.F. Adekunle,** R. Ketzscher, M. Skrifvars Health related issues, stringent environmental protection policies, search for cost effective and alternative materials and quest for renewability, sustainability and high performance materials for technical applications has led to an intense research in manufacturing biobased composites.	
15:30	**Optical properties of polymer and nanocomposite light-emitting nanofibers** **S. Pagliara,** F. Di Benedetto, A. Camposeo, D. Pisignano Here we report on the emission properties of light-emitting nanofibers fabricated by electrospinning of conjugated polymers and low-molar-mass molecules embedded in thermoplastic polymer matrices, and discuss the wide potential applications of these novel building blocks.		**Experimental characterization of strength, damage, and repair of thin-ply carbon fiber / polyamide 6 laminates** **M. Kanesaki,** H. Saito, M. Tanaka, K. Kawabe, I. Kimpara If thermoplastic is used as matrix of thin-ply laminates, it is supposed that internal damage growth is decreased. This study investigates relations between ply thickness and mechanical properties and damage growth on CFRTP. Besides preliminary repairing test of internal damage is experimented.		**Novel multifunctional nanocellulose composites** **X.W. Yuan,** D.Y. Liu, D. Bhattacharyya, A.J. Easteal Poor dispersion of the reinforcement adversely affects the properties of nano/micro composites. A method to improve the dispersion of microcrystalline cellulose (MCC) in PLA composites is described. The mechanical properties were improved after coating the MCC using pre-treatment.	**15:50 - 16:20 Coffee Break** **16:20 - 18:00 Poster Sessions**

14:50

Processing and characterization of highly filled polymer nanoparticle composites for micro injection molding applications

M. Rudolph, C. Turan, S. Kirchberg, U.A. Peuker, G. Ziegmann

This study deals with the synthesis of highly filled nanoparticle polymer composites with a novel process chain based on a solution method. We reach a high degree of dispersion and homogeneous distribution of the nanoparticle fillers at loads exceeding 50 mass% up to theoretical limits presented.

Metal matrix composite coatings of magnesium alloys by HVOF

J. Rams, B. Torres, A.J. López-Galisteo, M. Campo, P. Rodrigo, E. Otero

Magnesium alloys have been coated with an aluminium metal matrix reinforced with SiCp by the high velocity oxy-fuel thermal spraying procedure. The coatings were compact, had very low porosity and provided high resistance to corrosion in chloride medium and improved wear resistance.

Influence of thermal degradation on interface strength of glass fibre-polypropylene measured by different single fibre techniques

L. Yang, J.L. Thomason

In this work, effect of oxidative-thermal degradation of polypropylene on measured interfacial shear strength of glass fibre-polypropylene was investigated on a base of single fibre composite model with aid of hot-stage microscopy, nanoindentation technique, SEM and thermal analysis techniques.

15:10

Multifunctional polymer nanocomposites made by selective laser sintering

S. Athreya, C. Chun, S. Das, **K. Kalaitzidou**

The focus of this study is to explore the potential of using selective laser sintering (SLS) for fabrication of electrically and thermally conductive polymer nanocomposites. SLS is a free-form fabrication method that can lead to functionally graded materials in a single step process.

Friction stir processing for fabricating a zirconium nitride/AW5083 aluminium alloy surface composite

D. Gesto, **P. Rey**

Friction Stir Processing (FSP) is a very useful route for fabricating surface metal matrix composites with improved properties. In this work ZrN particles were dispersed into an AW5083. A coating ranging from 75 to 150 microns of an aluminium composite reinforced with ceramic particles was obtained.

Effect of surface treatment on the mode I fracture toughness of adhesive joints with nanoreinforced epoxy adhesives

M.R. Gude, S.G. Prolongo, **A. Urena**

The effect of different surface treatments of the carbon fiber/epoxy laminates in the mode I fracture toughness of adhesive joints and the addition of carbon nanoreinforcements to the adhesive have been studied. Both modifications affect the adhesive fracture toughness changing the failure mode.

15:30

Stress-strain modelling in wound laminates under processing conditions

H. Faria, V. Gomes, F.M.A. Pires, A.T. Marques

A stress-strain constitutive relationship was established for composite laminates while being processed by filament winding. Different models were studied from literature and a new model was developed that accounts for the several phenomena occurring simultaneously in this manufacturing process.

Microstructural design and study of fibre reinforced refractory concretes

N. Donval, T. Cutard, A. Mazzoni

Refractory concretes are characterized by a low tensile strength and a brittle or quasi-brittle failure. The aim is to quantify and to understand the effect of a short fibre reinforcement, of the testing and of the firing temperatures on the refractory concrete thermomechanical properties.

Formulation and adhesion of polymers films for composites steel/polymer/steel

F. Avril, R. Rahme, P. Cassagnau, D. Sage, M. Doux, L. Lucchini, D. Verchere • A solution to lighten steel structure for automotive applications is to develop steel/polymer/steel composites. This new material must fulfill several requirements such as high distortion to pass the stamping, flow resistance at high temperature and aggressive environment resistance.

15:50 - 16:20 Coffee Break

16:20 - 18:00 Poster Sessions

18:00 ESCM Grand Assembly

The Grand Assembly meets once at each ECCM Conference to elect the Council Members of the ESCM, ratify changes to the Constitution and By-Laws of the ESCM and to make other decisions as called for by the operating rules of the ESCM.

All Individual and Honorary members of the ESCM are eligible to participate in and vote at the General Assembly.

The Council consists of the Officers of the ESCM (President, Vice-President, Secretary, Past President), along with elected, co-opted, and ex officio members. The total membership on the Council cannot be more than 35.

The Chair of an ECCM Conference Organising Committee serves as an ex officio member of the Council for two ECCM cycles: the one immediately preceding that ECCM and the one immediately following that ECCM.

In each cycle, ten new members of the Council are elected by majority vote of the Grand Assembly from nominations provided by the membership from the membership.

Tuesday 18:00-19:00

A Plenary Lecture

Chair: I. Verpoest / L. Asp

8:00 **Wind turbine rotor blades: the bigger, the better?**

O.T.Thomsen Aalborg University

The presentation will give an overview of the current status of wind turbine blade technology. An overview is given of the use of composite materials, loads, failure modes, strength-controlling properties, test methods and future directions of technology including condition monitoring.

13:50 **The Albert Cardon Lecture**

The Albert Cardon Lecture is given by the winner of the ESCM Award, which recognizes the accomplishments of a young researcher, active in Europe, who has made significant contributions in the field of Composite Materials.

Lectures

8:00-8:50 /13:50-14:30 Wednesday

A Nanocomposites
Chair: A. Pegoretti

B Damage and fracture
Chair: A. Todoroki

C Dental/medical/health
Chair: N. Moszner

NOTES

9:00

Crystallization behaviors and properties of nano-$CaCO_3$/beta nucleating agent/PPR composites
W.H. Ruan, J.H. Mai, M.Q. Zhang, M.Z. Rong
The non-isothermal crystallization and melting behaviors of nano-$CaCO_3$/beta nucleating agent/ Ethylene-Propylene random copolymer(PPR) composites were investigated. The results suggest that both beta nucleating agent and nano-$CaCO_3$ have synergistic effects on the crystallization of PPR.

Multiaxial fatigue testing of composite tubes
M. Quaresimin, R. Talreja
The paper illustrates the results of an extensive investigation on the damage evolution in composite glass/epoxy tubes subjected cyclic tension-torsion loading. S-N fatigue curve, stiffness trends and microscopic damage evolution for different values of biaxiality ratio are discussed.

Design of 3D braided composite scaffold using nonlinear mechanics
H-C. Ahn, W-R. Yu
If damaged severely, articular cartilage should be regenerated or replaced. We developed 3D braiding structure composite scaffold for mimicking native cartilage properties. This research explores mechanical properties of the composite scaffold and proves its utility using cell growth test.

9:20

The effect of functionality of multi wall carbon nanotube on the thermal properties of polyurethane foam
M. Bandarian, **A. Shojaei,** A.M. Rashidi
TGA data showed that the thermal stability of foam increases by incorporation of nanotube in the order of PU/CNT-COOH>PU/CNT-OH>PU/CNT-NH>Pure PU foam. DMTA results revealed that the T_g of the PU foams increases while the damping factor ($\tan\delta$) shows an increase for all CNT included foam.

Mechanical property characterization of carbon/aramid interply hybrid laminates
H. Kasano
The present paper considers the basic mechanical properties of carbon/aramid interply hybrid omposites,and also investigates the effects of stacking sequences and degree of hybridization on these properties. The tensile, flexural, and fracture toughness tests are performed on these hybrid composites.

Long-term fatigue and dynamic creep performance of dendritic polyisobutylene-based nanocomposites for biomedical devices
C. Götz, P. Pavka, G.T. Lim, F. Fischer, J.E. Puskas, V. Altstädt • This work looks at the dynamic creep and fatigue behavior of a new generation of poly (styrene-b-isobutylene-b-styrene) block copolymers for medical applications, which consists of a branched polyisobutylene core and poly-(isobutylene-b-methylstyrene) end blocks, that was reinforced with carbon black.

9:40

Reducing the agglomerate size in nanoparticle/polymer nanocomposites
D.V. Szabó, S. Schlabach, R. Ochs, T. Hanemann
We present results of particle size/agglomerate size distribution measurements by TEM in comparison with Photon Correlation Spectroscopy of back scattered light, rheology measurements, as well as mechanical and optical properties as a function of nanoparticle load for different systems.

Tensile fatigue behavior of single fibres and fibre bundles
C. Qian, R.P.L. Nijssen, D.R.V. van Delft, C. Kassapoglou, Z. Gürdal, G.Q. Zhang
A test setup and method are developed for testing single fibre fatigue behaviour and a fracture mechanics based model is fit to the fatigue data. Moreover, the fibre fatigue test results are compared to the fatigue test results of glass fibre bundles consisting of 45 fibres.

Study of stimuli sensitive chitosan/acrylamide/nano hydroxyapatite composites for drug delivery and tissue engineering applications
K. Aravind, R. Padmavathi, D. Sangeetha, Ramadhar. K, P.K. Sehgal
In this study, we fabricated polymer blend composite films of Cs/AAm/nHA using different concentrations of chlorotrimethyl silane as a blending agent and compared their properties with Cs/AAm/ nHA composites with a cross linker methylene bis acrylamide and Cs/AAm/nHA composites.

D Processing & manufacturing
Chair: V. Altstädt

E Adhesion and joining
Chair: P. Tsotra

F Modelling and simulation
Chair: M. Sutcliffe

NOTES

9:00

Resin Transfer Molding (RTM) process optimization software considering laminate porosity
G.A. Barandun, **P. Ermanni,** M. Zogg
RTM is an alternative to autoclave processes. Unsatisfactory process reproducibility and part quality are limiting a wider utilization. Process simulation and numerical optimization can support the development of optimal processes and include effects directly related to the final component quality.

Monitoring of disbonding in bonded composite joints using CFBG sensors embedded within the adhesive bondline
Y. Guo, **S.L. Ogin,** T.F. Capell, A.M. Thorne, G.T. Reed, S.C. Tjin, Y. Wang
In this work, CFBG sensors have been embedded within the adhesive bondline of single-lap bonded composite joints. During fatigue cycling, disbonds initiated adjacent to the cut ends of one, or both, of the adherends and disbond intiation and growth have been monitored using the CFBG sensor.

High velocity impact and armour design
L. Iannucci
Improving combat survivability is an important aspect of military technology. It has been widely recognised that the use of multi-scale modelling can provide a technique to model novel armour materials. In this paper a modelling strategy is presented which links the behaviour of the mesoscale to the macroscale.

9:20

A 2.5D simulation of the resin infusion process, addressing complex reinforcement compaction response
B. Verleye, S. Bickerton, P.A. Kelly
The implementation of new viscoelastic compaction models is part of the development of the finite element LCM simulation tool simLCM. Also the inclusion of Resin Infusion simulations is an important extension of the software, which currently addresses complex geometries for RTM and CRTM.

Ultrasonic Welding. Simulation of the flow at the interface
A. Poitou, A. Levy, S. Le Corre, E. Soccard
Numerical modelling of thermoplastic composite ultrasonic welding. It involves a process with two time scales. A short time scale is associated with the US frequency, whereas the second one is associated with the welding time scale (1 s). To cope with this difficulty,we propose a time homogeneization procedure.

A novel adaptive wing concept
K. Ruangjirakit, L. Iannucci
This paper investigates the use of carbon fibre reinforced polyurethane as a composite material for corrugated flexible skin for adaptive wing applications. Finite element analysis confirms that corrugated structure is highly anisotropic and could be a solution for a novel adaptive wing.

9:40

Determining the final properties of thermoplastic matrix composite produced from towpregs
J.F. Silva, J.P. Nunes, C.A. Bernardo
Towpregs with different fibres and thermoplastic matrices were processed for demanding and commercial applications. Such towpregs were produced by using a powder coating equipment. The relevant processing parameters of the different processing technologies used to produce composites were studied.

Laser surface preparation and bonding of aerospace structural composites
M.A. Belcher, C.J. Wohl, J.W. Hopkins, J.W. Connell
A Nd:YAG laser was used to etch patterns conducive to adhesive bonding onto CFRP surfaces. These were compared to typical pre-bonding surface treatments. Laser treated composites were then subjected to optical microscopy, contact angle measurements, and post-bonding mechanical testing.

The order of stress singularities at a Multi-Material-Junction
C. Sator, W. Becker
The asymptotic behaviour of the stresses at plane and linear-elastic multi-material-junctions is analyzed by complex variable method. It is demostrated, that there are many situations where singularities occur, which are more severe than those due to a crack inside a homogeneous material.

	A Nanocomposites Chair: A. Pegoretti	B Damage and fracture Chair: A. Todoroki	C Dental/medical/health Chair: N. Moszner	NOTES
10:00	**Conductive behaviour of thermo- and photo-responsive nanostructured thermosetting systems based on block copolymers and TiO_2 nanoparticles** **A. Tercjak,** J. Gutierrez, I. Mondragon The main aim of this work was the generation of novel smart materials, in this case thermo and photo-responsive inorganic/organic meso/nanostructured hybrids based on different low molecular weight liquid crystals and conductive rutile TiO_2 nanoparticles.	**Fatigue damage modelling for short glass fibre reinforced polyamide (PA6-GF30): Experimental identification and validation** H. Nouri, **F. Meraghni,** C. Czarnota, N. Bourgeois, P. Lory The work deals with the experimental parameters identification and validation of a new phenomenological modelling for polycyclic fatigue damage of short glass fibre reinforced polyamide (PA6-GF30). Material damage parameters have been identified using a mixed experimental-numerical inverse method.	**Regeneration of critical tibial defect of dog by unidirectional porous hydroxyapatite/collagen bone-like nanocomposite** **M. Kikuchi,** K. Edamura, Y. Koyama, K. Takakuda, S. Tanaka Unidirectional porous scaffolds were prepared from hydroxyapatite/collagen (HAp/Col) nanocomposite with bone-like nanostructure and evaluated by regeneration of critical tibial defect of dog. Bone defect was filled by bone at 12 weeks and the HAp/Col was absorbed.	
10:20	**Effect of carbon nanofiber on morphology, mechanical, thermal and rheological, electrical properties of thermoplastic polyurethane/carbon nanofiber (TPU/CNF) nanocomposites by melt blending** A.K. Barik, **D.K. Tripathy** • Nanocomposites based on thermoplastic polyurethane & vapourgrown carbon nanofibers have been characterised through SEM. X-ray diffraction, DSC, DMA, TGA and RPA to study morphology, crystallinity, thermal, dynamic mechanical & rheological properties in addition to mechanical & electrical properties.	**Validation of analytical model for hail impact on composite laminates** **R. Olsson**, R. Juntikka Analytical models for delamination onset during hail impact on laminates are examined, including detailed comparisons with the response histories from experiments and finite element simulations. The significance of the finite contact area and elastic/plastic properties of hail is highlighted.	**Dental composites based on dimethacrylate resin reinforced by nanoparticles** **J. Kleczewska,** D.M. Bielinski, E. Cichomski The work presents mechanical and tribological properties of new dental nanocomposites, based on a standard matrix (bis-GMA and TEGDMA). The possibility of using dispersion of silver nanoparticles in silane to silica modification has been examined. Antibacterial activity of the composites was checked.	
				10:40 - 11:10 Coffee Break

D Processing & manufacturing
Chair: V. Altstädt

E Adhesion and joining
Chair: P. Tsotra

F Modelling and simulation
Chair: M. Sutcliffe

NOTES

10:00

Development of polymer matrix composites for the realization of ceramic and metal microcomponents using micro powder injection molding
O. Weber, T. Mueller, T. Hanemann
In this article the development of reactive resin based new feedstock systems for ceramic and metal micro powder injection molding is described. Results covering the composite flow properties, molding capability as well as sintered parts are presented.

Investigations on the mechanical behaviour of hybrid polymer metal joints
H. Eisler, M.Reif
The objective is to model and to evaluate deformation and damage of joints between long glass fibre reinforced nylon (PA66 GF40) and a steel inlay. Two series of pull-out tests were carried out with different surface treatments of the metal and with different geometries of mechanical interlocking.

Modeling of the thermoelastic properties of carbon/carbon composites for arbitrary fibers distribution
R. Piat, **G. Stasiuk,** J.-M. Gebert, S. Dietrich, A. Wanner, A. Bussiba, T. Böhlke, I. Tsukrov • Computer tomographic information about microstructure is used for construction of the ODFs of the fibers and the pores. It was used as input for material parameter identification of the CFCs by numerical implementation of semi-analytical methods. Results were compared to ultrasonic measurements.

10:20

Builging up biomimetic hierarchical layered microstructure in bulk commodity polymer and its composites by a simple pressure-induced processing
M. Yu, S. Zhu, S. Zhang, K. Han
By formation of a nacre-like micro-sheet morphology by align hard domain into microsheet, the strength, stiffness and toughness of the commodity polymers can be simultaneously enhanced; especially, the impact strengths were up to more 30 times higher than those obtained by injection moulding.

Enhanced bonded aircraft repair using nano-modified adhesives
G. Gkikas, A. Paipetis, N.M. Barkoula, A. Lekatou, D. Sioulas
The scope of this work is to incorporate Carbon Nanotubes in aerospace adhesive repair systems in order to enhance the adhesion and control the galvanic corrosion between the patch and the substrate. This is expected to have impact on enabling the usage of Carbon Fiber Reinforced Plastic patches.

Genetic algorithm used to optimize fibre steering in composite laminates
J.V. Risicato
In our research Genetic Algorithm (GA) has been used to realize a set of orientations on a composite laminate divided into Finite Elements (FE). This mapping designs a fibre path through an interpretation. It allows the use of different mechanical criterions.

10:40 - 11:10 Coffee Break

10:00 - 11:10 Wednesday

11:10 High performance nanocomposite fibers

A. Pegoretti, M. D'Amato, A. Dorigato, L. Fambri, Z. Zhang

Silica nanoparticles improved the drawability of HDPE, and higher draw ratios were reached for nanofilled fibers with respect to pure HDPE fibers. The elastic modulus of the nanocomposite fibers was higher than that of unfilled polyethylene fibers, without any loss of the ultimate properties.

Buckling, propagation and stability of delaminated anisotropic layers

A.T. Rhead, R. Butler

Compression tests on laminates with various stacking sequences containing artificial delaminations are used to validate a methodology for assessing and improving the damage tolerance of composite laminates. Stability and direction of damage growth are investigated experimentally and theoretically.

Development of new components for restorative composites

N. Moszner, J. Angermann, U. Fischer

New tailor-made compounds for restorative composites, such as bicyclic cyclopropyl acrylate or methacrylated calix[6]arenes, which contribute to a reduction of the polymerization shrinkage, and novel dibenzoylgermane photoinitiators for visible-light curing of dental composites, will be discussed.

11:30 Nanomechanics of graphene reinforced nanocomposites

L. Gong, I.A. Kinloch, **R.J. Young,** K.S. Novoselov

We have demonstrated that stress transfer can take place from a polymer matrix to a graphene monolayer and have modelled the behaviour using shear-lag theory. Additionally, we have been able to monitor the stress transfer efficiency and breakdown of the graphene/polymer interface.

Analysis of progressive failure of composite T-joints

A. Baldi, A. Airoldi, P. Domenichini, M. Crespi, G. Sala

The paper presents a series of tests to evaluate the strength and the failure modes of T-joints between carbon composite laminates. A numerical approach, which is based on explicit FE analyses, is assessed, focusing on its capability to model the onset and the progression of damage in interfaces.

Characterisation of a volume stable resin composite for dental restoration

M. Skovgaard, K. Almdal, B.F. Sorensen, S. Linderoth, A. van Lelieveld • A problem with dental resin composites is the polymerization shrinkage, which makes the filling loosen from the tooth or induces crack formation. We have developed an expandable metastable tetragonal zirconia filler, which upon reaction with water, is able to counter the polymer shrinkage.

11:50 Interlaminar properties of clay-modified epoxy-glass reinforced laminates

P. Carraro, M. Quaresimin, M. Salviato, **M. Zappalorto**

The paper presents the preliminary experimental results of a project aiming to assess the benefits for ternary composite laminates deriving from the matrix nanomodification, with particular reference to the matrix-controlled interlaminar properties and delamination resistance.

Evaluation of a predictive stacked-shell analysis methodology for the analysis of energy absorbing composite crush elements

M.W. Joosten, S. Dutton, D. Kelly, R. Thomson • The evaluation of a predictive analysis methodology was used to model the failure of crush elements of various thicknesses. The explicit solver PAM-CRASH was used to model these structures. The methodology was capable of predicting the loads and failure modes of several crush elements.

Effect of PEG content on morphology and in-vitro drug release of electrospun PLA/PEG fiber mats

K. Vichitchote, P. Threepopnatkul, S. Saewong, T. Tangsupa-anan, S. Suttiruengwong

The presence of PEG incorporated into electrospun PLA fiber mats would improve the morphological appearances in term of help reducing the beads. The release of Gentamicin from the drug-loaded electrospun PLA/PEG fiber mats is higher than from the drug-loaded electrospun PLA fiber mats.

11:10

Quality assurance aspects of modern preforming

V. Altstädt, K. Starzynski, J. Krämer, U. Beier

The cost-reduced manufacturing of complex textile preforms, including quality assurance, used for infusion processes is of significant importance. This study overviews the mechanical performance like dimensional stability of the fibre-reinforced composite in correlation of the preforming parameter.

Adhesion of thermoplastic polyurethane elastomer onto galvanized steel

B. Golaz, V. Michaud, J.-A.E. Manson

A TPU was co-molded onto galvanized steel wires with various surface treatments or gamma-APS coatings resulting in different pull-out adhesion values and hydrothermal aging durability. FEM was used to consider residual stresses and to validate an analytical calculation of the interfacial shear strength.

Modelling generation of fibre waviness during processing

B.B. Qu, **M.P.F. Sutcliffe**

Experiments are described using model materials to explore generation of fibre waviness in composites. Multi-fibre experiments show how groups of fibres move together, with gaps opening up as resin flows past the fibres. A mathematical model is constructed to model the initiation of waviness.

11:30

Modeling and phenomena investigation of velocity depending laminate quality for thermoplastic tape placement by means of diode laser heating

M. Brzeski, R. Schledjewski

A thermal consolidation model is adapted to predict the maximum process velocity of a desired laminate quality by using diode laser for a thermoplastic tape placement process, which includes an investigation of polymer healing, intermediate contact, deconsolidation, and degradation.

Implementation of composite material car body structural joint and investigation of its characteristics with geometry modifications

G. Belingardi, **E. Koricho**

Mechanical behaviour of composite T-joint in B-pillar has been discussed thoroughly. Effects of orientation and number plies on the stiffness of selected composite material are presented. The load carrying capacity and stiffness of T-joint are predicted under different circumstances.

Analytical and numerical cohesive zone models in the fracture simulation of fiber-reinforced materials

A. Szekrényes

In the present work a cohesive zone model is extended to mode-III fracture in glass/polyester composite. The experiments are performed using the modified split-cantilever beam and the energy release rate is measured in a quite extended crack length range. Numerical results are obtained by ANSYS.

11:50

Processing parameters for direct long fibre extrusion and resulting material properties

M. Priebe, R. Schledjewski

Different processing parameters were investigated for extrusion of long fibre reinforced Polypropylene. The extruded material was evaluated with tensile tests and with determination of the fibre length distribution. Additionally the effect of MSA-grafted PP was examined.

A novel textile-adapted notching technology for bolted joints in textile-reinforced thermoplastic composites

W. Hufenbach, F. Adam, **R. Kupfer**

A novel notching method for bolted joints of textile reinforced thermoplastics leads to significantly increased failure loads in bearing tests compared to drilled holes. The technique has been implemented into a prototypical pressing mould, demonstrating a high potential for industrial application.

Modelling of nanofibre composites

T. Thorvaldsen, B.B. Johnsen, H. Osnes

A survey of models for the macroscopic mechanical properties of short fibre composites is given. These models are applied to nanocomposites and compared to experimental test results to decide what level of complexity is needed in the modelling of such composites.

A	Nanocomposites Chair: J. Karger-Kocsis	B	Damage and fracture Chair: W. Van Paepegem	C	Dental/medical/health Chair: M. Kikuchi	NOTES

12:10 **Aligned and dispersed carbon nanotube (CNT) composites: manufacturing and characterisation**
M. Beard, **O. Ghita,** B. Farmer, D. Johns, K.E. Evans
This study reports the development of a novel two layered, fully aligned CNT polymer composite, with a final aim of in-situ CNTs composite production within ALM environment. A significant increase in the compressive, tensile strength is reported in the alignment direction of the composite.

Mechanical protection for composite structures submitted to low energy impact
P. Rahmé, C. Bouvet, S. Rivallant, V. Fascio
In this paper, a study on different concepts of protective layers (core: foam, honeycomb or hollow spheres. skin: kevlar) against impact at low velocity is presented. Resistance of these protections is then compared and discussed taking into account the thickness and the surface density.

Effect of bioglass particle size on the in vitro bioactivity of polycaprolactone/bioglass composite scaffolds
E. Tamjid, A. Simchi, R. Bagheri, M. Vossoughi
The paper reports the effect of Bioglass particle size on the bioactivity of PCL/Bioglass composites by studying the formation of hydroxyapatite upon immersion in SBF. It is shown that decreasing the particle size of bioglass particles results in the enhanced bioactivity of the composite films.

12:30 **Refining the thermal and electrical properties of aerospace epoxy resins**
P. Karapappas, P. Tsotra, K. Scobbie
The effect of the inclusion of conductive and non-conductive nanofillers in an aerospace epoxy system was studied. The conductive fillers used were multi-wall carbon nantubes and exfoliated nanographene, while the non-conductive ones have been nanoclay (montmorillonite) and nano titanium dioxide.

Fatigue damage assessment of UD CFRP composite under spectrum loading using acoustic emission
M. Bourchak, I.R. Farrow
Notched laminates were subjected to static and complex fatigue Testing. Acoustic Emission (AE) monitoring revealed significant matrix failure as early as 50% UTS. AE energy showed that cyclic fatigue damage is reasonably linear at low cyclic stress levels up to the first “effective failure” state.

12:50 - 13:50 Lunch

13:50 - 14:30 A. Cardon lecture

12:10

A process simulation tool for laser assisted tape placement

W.J.B. Grouve, R. Akkerman

A predictive process tool based on physical phenomena is developed for the laser assisted tape placement process. The tool comprises three submodels: 1. an optical model, 2. a thermal model and 3. a healing model. The tool is used to optimise processing parameters, such as laser power and placement velocity.

Multi-scale modelling of the interfaces in pultrusion joints

J.A. Nisar, S.A. Hashim, P. Dobson

Meso-scale laminates of 10x10x1mm were moulded, bonded and mechanically tested In addition FEA models were constructed to determine failure load/stresses. A good agreement was found between the meso and the micro models with respect to composite transverse/peel stresses within a 20% error margin.

Modelling the damage tolerance of composites to blast loading in pressurised cylindrical structures

G. Mohamed, C. Soutis, A. Hodzic

The dynamic behaviour and failure characteristics of typical aircraft structural materials such as GLARE will be investigated through a combined experimental-numerical approach. Well-controlled and minimal experiments have been performed for the validation of large scale simulations.

12:30

Forming analysis of metal-composite sandwich structures

S. DharMalingam, P. Compston, **S. Kalyanasundaram**

This study investigates the effect of preheat temperature, blank holder force and feed rate on the formability of metal-composite sandwich structures through finite element simulations and experimental work. Blank holder force was found to be the dominant factor governing the formability.

Investigation of hot-air welding parameters of polyethylene homocomposites

A. Altinbay, Z. Gemici, M. Dogu, A. Unal

PE tarpaulin is a homocomposite which composed of HDPE woven fabric in between LDPE matrix layers. The most used joining method for this composite is hot-air welding. In this study typical process parameters of hot air welding such as welding speed, temperature and pressure were investigated.

Modelling size effects of fibrous materials using fibre-bundle-cells

L.M. Vas, P. Tamás

Based on statistical fibre-bundle-cells (FBCs) a modelling method and a software named FibreSpace have been developed. By serial connection of FBCs size effects can be studied. For estimating the properties of serial connected FBCs two methods are presented and demonstrated.

12:50 - 13:50 Lunch

13:50 - 14:30 A Cardon lecture

14:40

Modelling the fire response of 3-D aerospace composite structures

J.K. Humphrey, A.P. Mouritz, B. Lattimer, J. Carruthers, M. Robinson, **A.G. Gibson**

The fire response of CFRP is strongly influenced by anisotropy, endothermic resin decomposition and the permeation of volatile products through the structure. Characterisation methods will be discussed, along with approximations that facillitate the use of commercial FE packages.

Measurement of the fracture toughness associated with model fibre compressive failure

M.J. Laffan, S.T. Pinho, P. Robinson, L. Iannucci, A. McMillan

A procedure for the experimental determination of the fracture toughness associated with fibre compressive failure will be presented. The method is superior to others as this property can be determined directly from UD specimens without splitting or having to account for damage in non 0° plies.

Investigating damping responses of particulate nanocomposites and nanocomposite sandwich structures

J-L. Tsai

The research aims to investigate the damping responses of the epoxy based nanocomposites and their sandwich structures. Results indicated that by introducing the hybrid material system, the superior damping properties and flexural stiffness can be concurrently accomplished.

15:00

Viscoelastic stress analysis and creep behaviour of epoxy resin in variable humid environment

A.N. Aniskevich, R.M. Guedes

The objective of the research was to estimate stress-strain state of epoxy resin with variable moisture content under tensile creep performing viscoelastic analysis. The results indicate that stress-strain behaviour of the material in elastic and viscoelastic cases are generally similar.

Damage response and mechanisms of stitched composites under impact loading

K.T. Tan, N. Watanabe, H. Hoshi, Y. Iwahori

Impact damage response and failure mechanisms of stitched composites are investigated, with particular interest on the effect of stitch density and stitch thread thickness. Ultrasonic C-scan inspection, X-radiography and micro Computed Tomography are used to observe impact damage characteristics.

Stacking sequence optimization of composite laminates: Status and limitations

H. Ghiasi, D. Pasini, L. Lessard

An overview of research on optimal design of stacking sequences of laminated composites. Design problems are divided into 2 distinct categories: constant stiffness laminate design and variable stiffness fiber path design. The benefits of using different design optimization techniques are discussed.

15:20

Effect of the environmental degradation on the viscoelastic response of nano modified epoxies and CFRPs

N.M. Barkoula, G. Gkikas, A. Makri, T.E. Matikas, A. Paipetis

The viscoelastic performance of carbon-nanotube reinforced epoxies (CNT-EPs) and CNT modified carbon fibre reinforced plastics (CNT-CFRP) was evaluated in dynamic three-point bending after exposure of the materials in extreme environments (hydrothermal and cryogenic loading).

Ultra-high-speed in-situ observation of tensile fracture process of two-dimensional UD model composite

M. Tanaka, T. Hama, K. Ohta, T. Hondo, H. Kusano, Y. Hirano, Y. Aoki, H. Saito, I. Kimpara

We aimed to develop the in-situ observation method of the ultra-high-speed fracture process of multi-filamentary UD model composite using boron fibers and transparent vinyl-ester resin, in order to realize a detailed direct observation of the ultra-high-speed internal fracture process.

Design and numerical models of a structural component in composite material

L.Vergani, C. Colombo

The attention is focussed on a pillar that is the main frame of a bus cabin. Three shapes for the pillar section are proposed and two materials considered for the composite. To verify mechanical properties and pillars stiffness, experimental static tests and numerical simulations are carried out.

14:40

Novel approaches to improve composites' performance in high temperature and flame retardancy applications

W. Voigt, M. Sommer, G. La Delfa

The paper discusses the use of cyanate esters and aromatic diamines for traditional and new composite applications requiring superior thermal resistance and enhanced flame retardancy in the view of increasing performance demands on passenger safety in public transportation.

Fatigue and oxidation resistance of C/C composites modified with polysiloxane-derived ceramics

T. Gumula

Fibrous C/C/ceramic composites obtained at 1000°C, 1500°C and 1700°C were investigated. The best fatigue properties represents C/C/ceramic composite heat treated at 1000°C. The best oxidation resistance represents C/C/ceramic composite heat treated at 1700°C.

R-CLD constant life diagram formulation for FRP composite materials

A.P. Vassilopoulos, B.D. Manshadi, T. Keller

A new constant life diagram formulation is introduced in this paper, developed based on a non-linear regression on the stress ratio (R)-stress amplitude (σ_a) plane. The advantage of the new model is the accuracy of the derived CLD even when only a limited amount of data is available.

15:00

Underground heat storage utilizing Centrifugal Winding FRP pipe

K. Eto, K. Yoneda, **S. Tamura,** Y. Nishino,Y. Kataoka, T. Shimosakon

We have developed CW FRP pipes of API standard using our original Centrifugal Winding method, which is stronger than steel pipes. Setting air circulation between underground this pipes and living rooms, we can reduce energy for air conditioning. We analyzed for several situations by simulations.

Static indentation and low velocity impact damage of a SiC/SiC ceramic matrix composite

V. Herb, G. Couégnat, E. Martin, J. Lamon

Foreign object damage tolerance of Ceramic Matrix Composites needs to be evaluated with a view to structural applications. For this purpose, thin plates of SiC/SiC composite were subjected to static indentation and low energy impact tests at ambient temperature.

Investigation of stiffener run-out failure

S. Psarras, S.T. Pinho, B.G. Falzon

In this study, the effect of the runout geometry on the mechanical response of stiffener run-outs was investigated. The runout geometry was optimised numerically, and the selected configurations were manufactured and tested. The experimental and numerical results were compared.

15:20

Development of high speed rotation disk made of carbon fiber reinforced three-dimensional composites

J. Yoshimura, N. Hiroshima, H. Hatta, K. Goto, Y. Kogo

A new approach using 3-dimensional carbon-fiber-reinforced composites was proposed for the development of a high speed rotation flywheel. An design for high-speed rotation was determined based on finite element calculations. Then, a prototype disk was fabricated, and the burst speed was obtained.

Damage characterisation of a textile reinforced cement composite material under low velocity impact loading

J. Van Ackeren, J. Blom, D. Kakogiannis, J. Wastiels, D. Van Hemelrijck, S. Palanivelu, W. Van Paepegem, J. Degrieck, J. Vantomme • This paper presents experimental results of the impact behaviour of a glass textile reinforced inorganic phosphate cement composite. Measurements of force and displacement were studied together with high speed images.

Constitutive model for unidirectional composite materials including hydrostatic pressure effects and non-linear kinematic hardening

G.M. Vyas, S.T. Pinho, P. Robinson

An elasto-plastic constitutive model representing the full non-linear mechanical response of unidirectional composites is developed. The model accounts for hydrostatic pressure effects on both the elastic and non-elastic material response and is integrated with the LaRC05 failure criteria.

15:40

Seawater ageing of composites for ocean energy conversion systems : Influence of glass fibre type

A. Boisseau, P. Davies, D. Choqueuse, L. Peters, R. Nickel, G. Adolphs, C. Renaud, F. Thiebaud, D. Perreux

Composite components are an essential part of ocean energy devices and their long term durability in seawater must be guaranteed, but few data exist to design structures subjected to both cyclic loads and seawater immersion. In this study the influence of glass fibre type has been quantified.

Self-sensing of compression loading damage of CFRP using electrical resistance change

A. Todoroki, K. Suzuki, R. Matsuzaki, Y. Mizutani

The paper measures the electrical resistance (ER) change of CFRP during compression tests. The results reveal that the ER decreases during elastic loading and the gage factor of compression loading is the same as that of the tension. It is revealed that the compression damages cause ER increase.

Low velocity impact behaviour of Al-Nomex sandwich panels

A. Manes, M. Giglio

In order to asses the low velocity impact behaviour of a sandwich structure actually used on a real helicopter frame, an experimental-numerical activity has been executed. FE models has been developed to simulate the tests with particular attention to the material characterization with encouranging results.

16:00

Kinetic modelling of PETI-330 thermal ageing

Y. Tang, **X. Colin,** B. Laine, D. Leveque

Thermal degradation mechanisms of neat PETI-330 matrix were elucidated between 280 and 380°C by PTR-FTICR-MS and IR spectroscopies and ATG. A non empirical kinetic model was derived from these mechanisms. It simulates satisfyingly the general trends of the thermal ageing kinetics.

Effect of tube geometry on the energy absorption and crushing pattern of composite tubes under quasi-static and impact loading

W. Van Paepegem, S. Palanivelu, J. Degrieck, D. Kakogiannis, J. Van Ackeren, D. Van Hemelrijck, J. Wastiels, J. Vantomme • This paper presents the quasi-static and dynamic response of nine different geometries of composite tubes subject to axial crushing. The dependence of the specific energy absorption, crushing force and crushing pattern on the geometry is studied and conclusions on optimal shapes are drawn.

The development of structural aircraft components using a low cost, single vacuum bag, liquid resin infusion technique

D. Ben-Moshe, E. Feldman, **A.K. Green,** H. Leibovich, Y. Steckelman

The development of aircraft quality components by LRI at IAI is described. These components were developed within the framework of the EU FP6 Programme ALCAS. The use of a relatively simple infusion method is outlined, with the potential for significant manufacturing cost savings.

16:20

Relationship between mechanical loading, environment and geometry and its influence on the fatigue behaviour of short fibre reinforced thermoplastics

J. Hartmann, A. Büter

Dimensioning in the terms of structural durability, which is based on experimental simulation, ascertains single influences and continuative the interrelations to each other. Based on experiments the relationship between different parameters e.g. temperature and notches, should be presented.

Closing the loop: mechanical analysis and modeling of a multiscale recycled composite

S. Pimenta, S. T. Pinho, P. Robinson

The mechanical response of a short-fibre recycled CFRP is analysed experimentally, highlighting crack propagation mechanisms. An analytical model for fracture toughness prediction is developed; it accounts for the recyclate's complex microstructure, featuring fibre-bundles & dispersed broken fibres.

Continuous in-line production of sandwich panels with paper honeycomb core

M. Britzke, J.H. Herold, C. Korn, A. Wagenfuehr

The lab-scaled pilot plant, developed at the TU Dresden, allows the continuous in-line production of new lightweight, frameless sandwich panels with thin skin layers and paper honeycomb core with large weight and cost savings and the potential for a high output quantity.

15:40

Investigation of the mechanical behaviour of a wind rotor blade subcomponent during a four point bending test

D.S. Zarouchas, A. Makris, T. Vandenbergh, D.Van Hemelrijck

In the present study the mechanical behavior of four I-beams under four point bending loading is investigated. The I-beams represent a rescaled subcomponent of the internal structure of a blade, which mainly carries the bending and torsional loads. The I-beam consists of three different materials.

Metal matrix composites containing carbon nanotubes

J. Stein, B. Lenczowski

The sub-project CarboMetal from the Inno.CNT Initiative funded by the German government (No. 03X0057A) aims to develop new high-performance materials by combination of carbon nanomaterials with metallic matrices. The target is to improve material properties for light-weight applications.

Stochastic failure envelopes for composites design

M.B. Whiteside, S.T. Pinho, P. Robinson

Quasi-Monte Carlo simulation of the LaRC'05 failure criteria for uni-directional composite plies is used to propagate the uni-axial variability characterised from experiment into the bi-axial domain. Results are compared to the underlying deterministic theory and biaxial experimental results.

16:00

Long-term behavior of various glass-resin pultruded profiles for structural application in construction

S. Barboura, N. Kotelnikova, **J-F. Caron**

The paper details a study of the time dependent behavior of permanent bended glass pultruded profiles, the experimental procedures , the influences of 3 different resins, and of the temperature (10°C-50°C). The second part proposes an viscoelastic analysis of the results.

Fracture behaviour of metallic fibre reinforced ceramic composites

S.R. Pemberton, T.W. Clyne, L. Marston

The addition of metallic fibres has a dramatic effect on the toughness of ceramics. A model to predict the fracture toughness of a metal fibre reinforced ceramic composite will therefore be presented using experimental results from impact testing, fibre tensile testing and fibre pull-out testing.

Numerical modeling and simulation of fabrics in resin transfer molding

Y. Arimitsu, T. Hamamoto, Z.Q. Wu, Y. Sogabe

The authors propose a unified model of fabrics for two simulations; (1) tensile tests, to evaluate the properties of fabrics, which include non-linearities, (2) fabric shaping process of RTM, to evaluate formability of fabrics and orientation of yarns, which include slippage and contact problems.

16:20

Carbon nanotube based composites film heater for de-icing application

W-m. Zhao, M. Li,Z. Zhang, H-X. Peng

The MWNT sheet/Kevlar/epoxy laminate was manufactured by VARTM method. When conducting a current through an area of 24.6×20.7mm, the temperature could repeatedly reached the steady-state value (110°C) within 13 s by consuming a power density of 0.58W/in^2. This is promising for de-icing applications.

In-situ (TiBw+TiCp)/Ti_6Al_4V composites with a network reinforcement distribution

L.J. Huang, H.X. Peng, L. Geng

(TiBw+TiCp)/Ti_6Al_4V composites with a novel network microstructure were successfully fabricated by in-situ reaction hot pressing. TiBw and TiCp are in situ synthesized around the boundaries of the as-received Ti_6Al_4V particles, and subsequently formed into TiBw and TiCp hybrid network structure.

Modeling non-crimp fabric reinforced composites by a stiffness volume averaging approach

M. Zarrelli, A. Petriccione, D. Annicchiarico, M. Giordano, V. Antonucci • This paper provides details of a novel volume element based model to evaluate the mechanical performance of NCF composites.Using stiffness averaging method, the developed modelling procedure is able to simulate mechanical performance taking into account the effects of processing variables.

16:40 **Structure thickness and external load effects on the stress-dependent diffusion of moisture in organic matrix composites**

G. Youssef, **F. Jacquemin,** S. Fréour

The coupled effect, on the moisture penetration process, of the mechanical states experienced by organic matrix composite structures, is investigated through a scale transition model. The respective contributions of the internal and external loads on the diffusive behaviour are studied.

Numerical analysis of the single fibre fragmentation test using cohesive elements

E. Graciani, A. Blázquez, F. París, J. Varna

The failure of the fibre and the appearance and growth of a debond crack in the Single Fibre Fragmentation Test is analyzed employing a Finite Elements model using cohesive elements along crack paths. Numerical results are compared with previous analyses based on linear elastic fracture mechanics.

16:40 **Estimation of the inherent strength of fiber in natural fiber reinforced polymers**

K. Renner, J. Móczó, B. Pukánszky

The inherent properties of the natural fiber reinforcement may limit the improvement of composite strength. The goal of this study was to determine the inherent strength of reinforcement with the help acoustic emission measurements and to identify the dominating deformation process.

Long fibre reinforced composite materials with modified polysiloxane based matrix

Z. Chlup, M. Cerny, A. Strachota, V. Kozák

The main goal of the work is preparation of cost effective high temperature composite material. Fracture behaviour of the matrix prepared by pyrolysis of various modification of polysiloxane resin was under investigation and findings are summarised in this contribution.

Homogenization of the thermoelastic properties of pyrolytic carbon

T. Böhlke, R. Piat, T.-A. Langhoff, I. Tsukrov, S. Lin, M. Heizmann, B. Reznik. O. Deutschmann

First- and second-order bounds of the thermoelastic properties of pyrolytic carbon on the submicron scale are derived explicitly in terms of the one- and two-point correlation functions. The necessary statistical information is obtained based on image processing techniques applied to micrographs.

17:15 GALA DINNER IN LÁZÁR EQUESTRIAN PARK

Free of charge, organized transport, departure from the conference venue

We kindly invite you to Gala dinner to Lázár Equestarian Park close to Gödöllő Royal Palace (35 km from Budapest).

We hope that you will enjoy the beautiful landscape with horses, the best Hungarian dishes and wines complemented by excellent Hungarian hospitality in a great atmosphere with traditional music.

More information:
http://www.lazarlovaspark.hu

Wednesday 17:15-23:00

A Plenary lecture

Chair: L.P. Kollár

8:00 **Future processing techniques for cost effective high performance composites**

C. Weimer,
Eurocopter Deutschland GmbH

The presentation offers an informed overview on aerospace requirements on material and processing technologies for the next decades and also highlights some major achievements on automated frame manufacture as well as on automated rotor blade manufacture.

Lectures

A	Nanocomposites Chair: S. Yu	B	Recycling Chair: Gy. Marosi	C	Structural design Chair: Z. Major	NOTES

9:00 **New method to obtain unsaturated polyester resin / clay nanocomposites**
J.A. Rivera, A. Sanchez-Solis, **O. Manero**
In this work, nanocomposites were obtained by mixing an unsaturated polyester resin with sodium montmorillonite. It was found that with 5 phr water-suspended clay content, increases of 125 % in the flexural modulus, 60 % in the tension modulus and 24 % in the resistance to fracture were obtained.

Fire retardancy and reinforcement of plastic waste originating from different industrial sources
B. Bodzay, **A. Toldy,** M. Fejős, K. Madi, K. Bocz, F. Ronkay, Gy. Marosi • Plastic waste originating from different industries was separated to density fractions and analysed. Separation limits were determined to recover quite pure fractions. Test productions were performed by using flame retardant additives for upgrading with reinforcement, compatibilizer and stabilizer.

Natural fibre reinforced hollow core sandwich panels
D. Bhattacharyya, S. Rao, K. Jayaraman
Composite sheets using natural fibre-PP are manufactured in a twin screw extruder, followed by calendering. Hollow cores are manufactured by stacking and bonding thermoformed profiles. The mechanical and energy absorption properties of the reinforced products are vastly improved.

9:20 **Helium gas permeability of nanoparticle filled epoxy systems**
Z.L. Simon, C. Jogl, M. Sales
Helium permeability of neat epoxy resin and epoxy samples containing nanoparticles was measured. The diffusion process was evaluated using the one-dimensional analytical solution of Fick's law; both diffusivity and solubility were determined. Measured and calculated results were compared.

Development of recycled polymer blends for structural applications
A. Hugo, A. Hodzic, F.R. Jones, R. Dwyer-Joyce
High value applications are required to make polymer recycling economical. The mechanical properties of recycled polymer blends were optimised using different reinforcement solutions. Testing was completed within an industrial test protocol designed for load-bearing structural applications.

Creep response of sandwich beams with a viscoelastic soft core and composite laminates
E. Hamed
The viscoelastic creep behaviour of sandwich beams made with a viscoelastic soft core and composite face sheets is investigated. A theoretical model is developed, which combines the concepts of the linear Boltzman's principle of superposition with the concepts of the high-order sandwich theory.

9:40 **Fatigue life enhancement for GFRP by matrix modification with silica nanoparticles**
L. Böger, H. Hedemann, K. Schulte
Silica nanoparticles were used to modify the EP matrix for GF-composite materials. The influence of the matrix modification on the fatigue life of the hybrid composites was investigated. It was found that the nanoparticles have a positive influence on the durability of the material.

Design and testing of new composite from recycled GFRP
J. Kers, J. Majak, D. Goljandin, M. Saarna, A. Gregor, K. Tall
This study describes mechanical reprocessing of composite plastic wastes by disintegrator mills. Proceeding from the results of analysis of the milled powder (acrylic plastic with GFRP) particles size, shape and density the numerical algorithm for modelling new composite material is developed.

Effects of thermal and humidity treatment on mechanical properties of CFRP foam core sandwich structures
M. John, M. Rinker, P.C. Zahlen, R. Schäuble
CFRP foam core sandwich structures are stored under different environmental conditions like cyclic thermal loading, thermo-shock and humidity climate. The environmental influence on the mechanical properties was characterised and described after 4-point-bending test.

D Applications
Chair: J-F. Caron

E Adhesion and joining
Chair: M.A. Belcher

F Modelling and simulation
Chair: N. Carrere

NOTES

9:00

The production and properties of an over-moulded single polymer composite safety helmet
P.J. Hine, A.P. Unwin, I.M. Ward, L. Morgan, C. Hare
In this paper we assess the technique of overmoulding for incorporating a self reinforced polymer (SRP) insert within an injection moulded component. The chosen demonstrator component was a polyethylene safety and formed part of the recently completed FuturePlas project.

Fatigue behaviour of composite bonded joints under mixed-mode loading
P. Carraro, G. Meneghetti, M. Quaresimin, **M. Ricotta**
Aim of the present paper is to investigate the possibility of defining a fatigue model suitable to describe crack propagation in composite bonded joints under I+II mixed modes cyclic loading. The observed crack propagation rates were plotted as a function of the range of the total strain energy release rate.

Designing geocomposite using multi-axial warp knitted fabric and nonwoven mat
S.-Y. Jeon, M.S. Kim, W.-R. Yu
A geocomposite was designed using multi-axial warp knitted fabric (MAWKF) and nonwoven mats to ensure both the mechanical stiffness and water permeability for shore protection application using unit-cell modeling of the constituents and finite element analysis.

9:20

Static and fatigue tests on resin for wind turbine blades
E. Stammes, R.P.L. Nijssen, T. Westphal
Static and fatigue test results on a neat epoxy resin, typical for wind turbine blades, are presented. The results are compared with test results on the same matrix, reinforced with a wind turbine glass fabric. These data can be used for modelling of composites and understanding fatigue failure.

Evaluation of a novel lightweight metal-composite-joint technology
S. Ucsnik
A joint technology for FRP-metal joints is presented that builds an integrative fixation via form and material closure. CMT-welded pins penetrate fibre material, curing of infused resin builds the final bonding. Production of double-lap-shear specimen and tensile testing results will be presented.

Geometrical and meso-mechanical analysis of bias woven composites
M. Peerzada, **P. Potluri**
Fibre orientation in conventional woven fabrics is limited to 0/90 configuration. This paper presents the geometrical and mechanical analysis of bias woven composites, with the aid of x-ray tomography and mechanical testing. Influence of tow spacing on laminate performance has also been reported.

9:40

Parametric study of bistable hybrid laminates
S. Daynes, P.M. Weaver
Bistability occurs in 0/90 laminates due to the combination of geometric non-linearity and residual stresses. In this work 0/M/90 laminates are studied which have an inner isotropic metallic layer which induces large in-plane thermal loads increasing snap-through moments.

Experimental investigation on adhesively bonded and bolted FRP joints
T. Vallée, R. Meena, T. Tannert
For the purpose of comparison, experimental investigations on joints involving regular and prestressed bolted connections, bonded connections, and combinations of both were carried out to investigate the most appropriate type of joint for composite structures.

Coupled mechanical and heat and mass transfer numerical models for MDF hot pressing
Z. Kavazovic, J. Deteix, A. Cloutier, A. Fortin
The hot pressing process of medium density fiberboard mats is studied. Mechanical and heat and mass transfer phenomena are modeled by coupled numerical models based on the Finite Element Method. Calculations are carried out on a moving geometry and the mesh grid, which are updated at each time step.

A Nanocomposites
Chair: S. Yu

B Recycling
Chair: Gy. Marosi

C Structural design
Chair: Z. Major

NOTES

10:00

A new solvent-free method to functionalise the surface of carbon nanotubes
A. Menner, M. Shaffer, A. Bismarck

We report a versatile, rapid and solvent-free method for the large scale surface modification of carbon nanotubes. In an thermal activation step free radicals are formed on the surface of carbon nanotubes, which initiate the radical polymerisation of vinyl monomers away from the CNT surface.

Characterization of innovative sandwiches for civil applications made by industrial wastes recycling
V. Lopresto, **C. Leone,** I. De Iorio

New foamy materials obtained by adding industrial wastes from leather tanning process in epoxy and polyurethane matrix were fabricated. The addition of this material in the resins, resulted in a sensible decrease of the density without degradation of mechanical, acoustic and thermal properties.

Shape optimization of free vibrations for smart laminated composite structures
P. Kedziora

A new optimization problem for laminated multilayered structures having surface bounded piezoelectric (PZT) patches have been formulated and solved. The present formulation introduces boundaries of piezoelectric patches as new class of design variables.

10:20

Stress transfer in electrospun PVA nanocomposite fibres reinforced with carbon nanotubes
L. Deng, S. Eichhorn, R.J. Young

PVA/SWNT film and electrospun fibre has been characterized using Raman spectroscopy. The strain induced Raman band shift rate is angle dependent, and this behavior has been explained with a model considering both Poisson's contraction effect and the depolarization effect.

A multilevel approach for the prediction of skin/core debonding of foldcore sandwich structures
C. Cluzel, **E. Baranger,** F.R. El Mohammadi

This paper presents the characterisation and modelling of the skin/core bondline properties for an aramid paper folded core sandwich structure. A multilevel analysis is developed. The introduced modelling allows energy release rates predictions at macro scale on different folding patterns.

10:40 - 11:10 Coffee Break

D Applications
Chair: J-F. Caron

E Adhesion and joining
Chair: M.A. Belcher

F Modelling and simulation
Chair: N. Carrere

NOTES

10:00

FRP composites applications in civil infrastructure
I. Harik

A summary is presented on the deployment of FRP materials in bridges in Kentucky. The field applications include use of hybrid glass/carbon I-girders, FRP reinforcing bars, retrofitting bridges with CFRP fabric and laminates, and strengthening of steel girders with high modulus CFRP laminates.

Expanded and bonded bushings for metal composite assembly reinforcement
C. Bois, E. Le Goff, J.M. Quénisset, J.-C. Wahl, H. Wargnier

Fragile behaviour of CFRP leads to insert metallic bushings. The Expanded Bonded Bushing process (EB^2) was patented by CAPAERO company. A micro-encapsulated adhesive is deposited on the external diameter of the bushing. A expansion process breaks capsules and starts the polymerisation.

Analytical prediction of strain energy release rate for delamination of curved anisotropic beams
A.V. Amarra, E. Herencia, T. Edwards

This paper presents an analytical method to predict stress and strain energy release rate in an anisotropic curved beam with a delamination under unfolding loads. Due to its formulation, the method may be used for rapid sizing and optimisation in preliminary design of curved composite structures.

10:20

Structural analysis and design of a composite surface piercing propeller
M.S. Kiasat, L. Babaee, M. Rezai-Sangtabi

Surface Piercing Propellers (SPP) are marine propellers used for high speed crafts and subjected to severe hydrodynamic pressures. Designing a novel composite SPP is the basic purpose of this work. The mechanical loads considered are the hydrodynamic pressure, the centrifugal forces and the gravity.

FE modelling and validation of interacting cohesive zones in CFRP with high resolution imaging
A. Burke-Veliz, M. Mavrogordato, P. Wright, A. Moffat, I. Sinclair, S.M. Spearing • Damage growth in CFRP laminates has been monitored using synchrotron radiation computed tomography. Crack opening and shear displacements were recorded for characteristic matrix cracks and delaminations and compared to FE models simulating crack growth using cohesive zones.

10:40 - 11:10 Coffee Break

11:10

Finite element characterization of the size-dependent mechanical behavior in nanosystem

W. Gao, **S. Yu**

In the nano-materials, we need to investigate the size effects.The finite element method considering surface effect and size-dependent mechanical properties are deduced and discussed.Then the FEM formulation for plane strain and axisymmetric problem with surface elements are given.

Life cycle analysis of recycled polymers and composites based on performance characteristics

S. Rajendran, A. Hodzic, S. Hayes, C. Soutis, M. AlMa'adeed, R. Kahraman

This LCA study is focussed on end of life of plastics: Mechanical Recycling and Energy Recovery. All environmental impact categories are evaluated and converted to single score. This single score index is also adjusted according to the performance and level of degradation of recycled plastics.

Modelling of the mechanical behaviour of Nomex cores using tensile-shear tests under out of plane loadings

L. Gornet, S. Kamran-Ali, L. Sohier, S. Marguet, J.-Y. Cognard, H. Devaux

The purpose of this study is to better understand and model the mechanical behaviour of Nomex honeycomb cores used in sandwich structures constituting especially ocean racing yachts. Tests of out of plane tension / compression-shear have been developed using an ARCAN device.

11:30

Improvement of CNT dispersion and Al-C covalent bonds to Al-CNT composite for strong mechanical properties

K.P. So, C. Biswas, S.C. Lim, K.H. An, Y.H. Lee

We focus on the formation of strong Al-CNT covalent bonds on the CNT walls. The formation of Al-C bonds was confirmed by XRD and XPS. Charge transfer from CNTs to Al and generation of D-bands in Raman spectroscopy further confirmed the formation of Al-C bonds.

Life cycle analysis of aircraft composites and structures

L. Scelsi, A Hodzic, C. Soutis, C.W. Wilson, K. Ridgway

A cradle-to-grave life cycle analysis (LCA) of structural aircraft materials (e.g. carbon fibre reinforced polymers, Glare and aerospace grade aluminium alloy) was used to assess and compare the total emissions produced during manufacturing, use and disposal of aerospace materials and components.

Modelling of an aluminium skin and PP honeycomb core sandwich material under low energy impact

M. Olave, J. Iriondo, M. Aguirre

An aluminium skin and PP honeycomb core material has been tested under low velocity impacts at different energy levels. FE models have been also created using a commercial software (ANSYS). This work tries to cover the experimental, theoretical and FE modelling in order to obtain a good agreement.

11:50

Study on the creep behaviour and characterization of carbon fiber nano-composites

A.Yi-Luen Li, B.Wei-Jen Chen, C.Chin-Lung Chiang, D.Chen-Feng Kuan, E. Hsu-Chiang Kuan, F.Ming-Chuen Yip

Carbon nanotubes treated with oxidizing in organic acids generates functional groups on the surface of CNTs is a major investigation in this study to enhance mechanical properties. Creep behavior of thermosetting composites and stress is also concerned to be analyzed.

Recycling of plaster board by resin coating

K. Yoneda, K. Eto, S. Tamura, T. Egawa, Y. Nishino

We have developed recycle plaster board and applied it as a porous artificial fish-breeding reef.Resin coating technology of NBL enables to prevent harmful gas to leak out from the board. The porous pipe has feature of bringing prosperity of the seaweed and fishes.

Analysis for large local sandwich panel indentation

S.B. Sapozhnikov

Sandwich panel with composite skin and honeycomb core under low velocity impact was considered. Quite simple formula was derived to connect indentation load and skin deflection with elastic modules and thickness of skin and honeycomb postbuckling “yield” stress.

11:10

Structural power composites for energy storage devices

K.K.C. Ho, A. Javaid, A. Bismarck, E.S. Greenhalgh

The development of multifunctional materials in which two dissimilar components are combined together to produce a single coherent material that inherently can store the electrical energy required to power systems, whilst meeting the demands of the mechanical loading.

Thermomechanical properties of advanced epoxy composites

R. Shanks

Thermomechanometry of epoxy–fibre composites used static, dynamic, modulated force, and modulated temperature to reveal creep, storage and loss modulus, reversing and non-reversing properties. Cure, ageing, thermal expansion, creep, recovery, elasticity and damping are distinguished.

A progressive multiscale failure approach applied to high gradient structures: numerical issues and validation

N. Carrere, F. Laurin, L. Marcin, J.-F. Maire

This paper is aimed at proposing an approach is based on the physical phenomena observed in composite (matrix crack, fibre failure, delamination). The ply level is considered as the pertinent scale to describe these phenomena. The coupling between inter/intra ply failure is taken into account.

11:30

Optimal cross-sectional shapes of filament-wound toroids based on continuum lamination theory

L. Zu, S. Koussios, A. Beukers

This paper outlines the optimal design of the cross-sectional shapes for filament-wound toroids based on the continuum lamination theory. The influence of the axial load on the meridian profile is evaluated. The performance factors of the continuum-based optimal toroids are determined.

Analytical investigation of glass ceramic fibres

Z. Shamsudin, A. Hodzic, R. Hand, P.B. S Bailey, S. Hayes, C. Soutis, I.P. Bond • An appropriate E-modulus in fibre form is expected increase and this property is an essential requirement for development of outstanding materials. Results of crsyatllization kinetic studies that are related to the crystallization mechanism are presented for different crystallization temperature

Unit cell mesh generation for 3D woven composites

E. Potter, P. Robinson, S.T. Pinho, L. Iannucci, A. McMillan

An automated voxel meshing technique suitable for modelling failure in 3D woven composite unit cells has been developed. Application of a smoothing algorithm to tow/matrix interface voxels produces a suitable surface for modelling tow/matrix debonding, and improves representation of the stress field.

11:50

Numerical and experimental methodology for the design of composite attenuator of vehicle impact

S. Boria, G. Belingardi

The purpose of the present work is the numerical and experimental characterization of composite materials, such as CFRP, finalised to design impact attenuators. This can be done after a preliminary calibration of the material constitutive law through a fit procedure of experimental static tests.

Fibre fracture of carbon fibre laminates using ultra high resolution computed tomography

A.E. Scott, I. Sinclair, S.M. Spearing, M. Mavrogordato, P. Wright

High-resolution computed tomography results are presented for carbon/epoxy composites subject to in-situ loading. The images enable individual fibres breaks and clusters to be identified and quantified. Giving a unique physical insight into the failure process.

Evaluation of local strain profiles in a satin weave composite: experimental vs meso-Fe modelling

S. Daggumati

Current work focus on the evaluation of local strain profiles using different unit cell stacking configurations. Numerical local strains are validated using different experimental techniques such as, DIC on the surface of the laminate and the embedded FBG's in the laminate inner layers.

A Nanocomposites
Chair: O. Manero

B Recycling
Chair: Gy. Marosi

C Structural design
Chair: M. Tanoglu

NOTES

12:10 Carbon nanotube growth on high modulus carbon fibres and interfacial characterization

O. Boura, D. Gournis, D. Aggelis, N.-M Barkoula, A. S. Paipetis

Carbon nanotubes were synthesized on carbon fibers. Scanning electron microscopy, differential thermal analysis and Raman spectroscopy studies reveal their presence. Single-fiber composites were fabricated and fragmentation tests examined the interfacial shear strength of the modified fibers.

Multilayer flame retarded composites from recycled automotive shredder plastic waste

A. Toldy, B. Bodzay, **K. Bocz,** F. Ronkay, Gy. Marosi

Upcycling possibilities of waste polymers were studied, including compatibilization, stabilization, reinforcement and flame retardancy. Sandwich composites consisting of basalt or glass fibre reinforced core and flame retardant phosphorus-containing intumescent shell were prepared.

Resin absorption and deformation behaviour of foam core materials for high performance sandwich panels

R. Schlimper, M. Müller, F. Willner, M. Rinker, R. Schäuble

As the foam core material contributes to the performance of high loaded sandwich panels in lightweight applications X-ray tomography was used to investigate the morphology of the foam structure which influences e.g. resin absorption and deformation behaviour of closed cell rigid foam.

12:30 Effect of pristine layered silicate montmorillonite (MMT) on the properties of silane crosslinked LLDPE

H. Azizi, J. Morshedian, M. Barikani, M.H. Wagner

Effect of pristine layered silicate montmorillonite (MMT) on the properties of silane crosslinked LLDPE prepared by melt compounding are studied. For sample prepared by first grafting of silane and then incorporation of nanoclay gel content increased with increase of nanoclay concentration.

Mechanical performance of composite structures with embedded silica sensors: concept of monitoring patch

M. Torres, L. Crouzeix, F. Collombet, B. Douchin, Y-H. Grunevald

The study of sensor – structure duality is one of the main issues to analyze in composites in-core instrumentation. In this work, the concept of “monitoring patch” is proposed in order to reduce the variability effects produced by placing the sensor alone.

12:50 - 13:50 Lunch

12:10

New polymer/steel solution for automotive applications

R. Rahme, F. Avril, P. Cassagnau, D. Sage, D. Verchere, M. Doux

A key challenge when developing steel/polymer composite is to ensure a high steel/polymer adhesion level to face material processing and ageing.we have studied the influence of the conversion coating and ageing in humid environment on adhesion level,breaking mode and delaminating mechanisms.

New methods for monitoring structure evolution in composite fibers by X-ray scattering

N. Stribeck, U. Nöchel, A. Zeinolebadi

Straining and load-cycling experiments in oriented composites based on polypropylene are monitored by SAXS and WAXD in a synchrotron X-ray beam. Similarly, nanostructure gradients in fibers are resolved after tomographic reconstruction. Fast, automated methods for the data analysis are presented.

Size of the representative volume element in plastic and visco-plastic particulate composites

J. Cugnoni, M. Galli, J. Botsis

The RVE size represents an important material length scale in composites. In this work, the RVE size of particle reinforced composites is evaluated by parametric numerical homogenization for a wide range of elasto-plastic and elasto-visco plastic properties and reinforcement volume fraction.

12:30

Mechanical behaviour and thermal stability analysis of epoxy polymer mortars reinforced with metal oxide nanoparticles

M.C.S. Ribeiro, C.M.C. Pereira, A.J.M. Ferreira, A.T. Marques • Thermal stability improvement of an epoxy PM formulation, induced by polymer modification with metal oxide particles was analysed and quantified. Several series of PMs modified with different contents of Al_2O_3 nanopowders were manufactured and tested for fire reaction and mechanical strength.

On the fatigue life prediction of CFRPs using electrical resistance change method

A. Vavouliotis, A. Paipetis, V. Kostopoulos

The electromechanical response of quasi-isotropic CFRP under fatigue loading was studied.The influence of CNT matrix doping is also evaluated. The Critical Damage State was identified via the electrical response and used to predict the remaining life independently from the applied stress level.

Numerical model for FRP confined circular RC cross-sections under eccentric loading

B. Csuka, L.P. Kollár

Numerous experimental data and models exist on FRP confined axially loaded circular RC columns, however theoretical results under eccentric loading are rather limited. We present a new numerical model for calculating the load-bearing capacity under eccentric loading.

12:50 - 13:50 Lunch

13:50 **Flame retardancy of epoxy resins and their carbon fiber reinforced composites**
M. Döring, Y. Bykov, A. Schmidt, J. Krämer, V. Altstädt, B. Perret, B. Schartel
Fire retardant epoxy resin composites are required in the fields of electronic applications (e.g. printed circuit boards) as well as transportation (e.g. in the automotive sector). New strategies for gas phase active phosphorus flame retardants will be presented.

Energy absorption capability of structural composites consisted of intersecting FRP laminates
C. Zhang, S. Cauchi-Savona, **P.J. Hogg**
The current research is aimed at investigating the energy absorption of fibre reinforced plastic composites measured as a function of scale within weight-critical structures. The Intersecting Square Cell (ISC) composed of four intersecting composite laminates was thus investigated in this study.

General theory of thin walled composite beams
L.P. Kollár, A. Pluzsik
A new theory is presented for thin walled (anisotropic) composite beams, in which no kinematical assumption is applied, rather the properties are derived from the accurate (three dimensional) equations of (open or closed section) beams using limit transition.

14:10 **Predicting moisture effects in epoxy resin based composites**
J.P. Foreman, D. Porter, F.R. Jones
The effect moisture has on the thermomechanical properties of an amine cured epoxy resin blend is investigated using Group Interaction Modelling. Experimental thermal expansion coefficients and glass transition temperatures are used for validation and the mechanisms of water uptake are explored.

Study of the fatigue crack growth in thin composite skins made of woven plies
M. Bizeul, C. Bouvet, J.J. Barrau, R. Cuenca
The aim of this paper is to characterize the through-the-thickness crack propagation in thin woven glass fabric laminates loaded in tension-tension fatigue. The finite element modelling is based on the architecture of the fabric and on the fatigue behaviours of the matrix and the fibre.

An experimental study for designating the effect of CFRP type and arrangement on shear behavior
H.M. Tanarslan
This paper presents results of an experimental investigation on reinforced concrete (RC) beams strengthened with externally bonded carbon fiber-reinforced polymer (CFRP) strips. To evaluate the effect of anchorage usage on behavior and strength, anchorages were also adopted for two specimens.

14:30 **Novel phosphorous-based flame retardants for epoxy resins and their carbon fibre reinforced composites in automotive and aviation industry**
B. Perret, B. Schartel, J. Krämer, V. Altstädt, K. Stöss, J. Diederichs, M. Ciesielski, M. Döring • Pyrolysis and fire behaviour of epoxy resin carbon fibre (CF) composites containing DGEBA or TGMDA with phosphorus flame retardants (FR) were studied. The FRs decrease the fire risk. Condensed phase mechanism appears in one thermoset, flame inhibition occurs in both.

Compressive failure initiation of woven composites
N.V. De Carvalho, S.T. Pinho, P. Robinson
A novel experimental method is proposed enabling the detailed study of the effect of the internal architecture on the failure initiation in 2D woven composites under compression. The experimental findings are used to develop and validate physically-based numerical and analytical models.

Development of reinforced composite sandwich panels based on 3D fabrics
J.C. Velosa, R. Fangueiro, F.W. J. van Hattum, F. Soutinho, S. Marques
In this work the mechanical performance of sandwich composite panels based on sandwich knitted fabrics is presented and discussed. Different 3D sandwich knitted fabric performs have been produced varying the thickness. These panels have been produced using vacuum infusion technique.

13:50

Flame resistance of natural fiber reinforced polymers added by water glass

R. Schledjewski

Natural fiber reinforced composite materials offering many favorable properties. The aim of the research work presented here is to reduce the high flammability of natural fiber reinforced composites by a treatment of the matrix with environmental friendly sodium silicates (water glass).

Comparison of slamming wave impact of a rigid and deformable composite cylinder with numerical simulation and experimental validation

D. Van Nuffel, K.S. Vepa, I. De Baere, J. Degrieck, W. Van Paepegem, J. Vierendeels • In this study, the slamming wave impact on a full rigid cylinder and a hollow deformable composite cylinder with the same dimensions has been compared. Numerical simulations involving fluid structure interaction (FSI) are compared with experimental tests performed under the same conditions.

On the nonlinear evolution of the Poisson's ratio under quasi-static loading for a carbon fabric-reinforced thermoplastic

I. De Baere, W. Van Paepegem, J. Degrieck

This article studies the evolution of the Poisson's ratio as function of the longitudinal strain, which results in a peculiar hyperbolic shape. First, experiments are discussed to determine whether this behaviour is due to the material and then, a theoretical explanation is presented.

14:10

Tailored epoxy resin systems for the manufacture of high performance carbon fiber composites

M. Döring, **U. Arnold**

Among a wide variety of fiber-reinforced plastics, materials based on carbon fibers and epoxy resins show outstanding characteristics. Recent progress, especially the development of tailored resin systems and curing agents, e.g. for serial production or radiation curing, will be described.

Carbon nanotube based strain and damage sensing in glass fibre reinforced composites via electrical conductivity methods

C. Viets, L. Böger, M.H.G. Wichmann, K. Schulte

Electrically conductive networks of nanoparticles can be used in polymers to create a sensor material. The electrical resistance of these nanocomposites is sensitive to applied mechanical loads. This property can be used for stress/strain sensing. In this work, the electromechanical behaviour is investigated.

Reliability analysis of a composite blade structure using the model correction factor method

N. Dimitrov, C. Berggreen, P.F. Hansen

The reliability against failure of a GFRP composite blade structure is determined by use of the Model Correction Factor method (MCF). MCF is a type of response-surface technique that makes use of a simplified model that in a probabilistic sense is calibrated to an advanced, realistic model.

14:30

NDE for impact damage identification and evolution on GFRP

V. Lopresto, C. Leone, G. Caprino, G.M. Carlomagno, C. Meola

Infrared thermography was used to gain information on damage initiation and propagation in GFRP specimen, subjected to low velocity impact. By the recorded thermal images analysed it was possible to investigate the different in plane damages by comparing the thermal mapping to the energy level.

Evaluation of local strain distribution in a satin weave composite using fibre bragg gratings

E.J. Voet, S. Daggumati, G. Luyckx,W. Van Paepegem, J. Degrieck, J. Xu, S.V. Lomov, I. Verpoest • This paper presents the study on high strength coated FBGs which are mounted on the surface and embedded in thermo-plastic woven composite test specimens. Maximum and minimum strain envelopes from the FBG sensors, DIC strain readings and FE-modelling are presented till 0.5% strain.

Modelling the influence of stitching on woven fabric composite deformation behaviour

M. Duhovic, P. Mitschang, D. Bhattacharyya

In composite sheet forming processes the inclusion of stitching elements can have a major impact on in-plane deformation. The current work focuses on a robust FE modelling scheme to allow the prediction of fabric and composite deformation resulting from the placement of stitching seams and patterns.

14:50 **Methodology to study the thermal ageing of composite core used in aluminium electrical wires**

M. Serror, X. Colin, S. Barbeau

A methodology was developed to study a composite core durability. It is based on exposition in accelerated ageing conditions, followed by examinations by optical microscopy (superficial oxidised layer and cracking) and analysis by IR and DSC (degradation products and glass transition temperature).

Self-sensing of damage in composites

A. Rauf, R.J. Hand, S.A. Hayes

In-situ detection of barely visible damage, both post-hoc and in real-time, in a self-sensing composite is demonstrated. The self sensing elements, embedded by wet lay-up, use visible light and are based on E-glass reinforcing fibres in a modified version of an aerospace certified epoxy resin.

Mechanical and energy absorption behaviour of metal/polymer layered sandwich structures

M. Tanoglu, B. Bozkurt

The aim of the study is to investigate the mechanical and energy absorption behavior of Al/Al-foam/polymer composite based layered structures. The Al foams of different thicknesses in conjunction with skins composed of fibre-metal laminate (FML) were prepared in this work.

15:10 **A comparative study about the influence of severe environmental conditions on the behaviour of carbon fiber fabrics reinforced thermoplastic or thermosetting laminates**

B. Vieille, J. Aucher, L. Taleb

This study aims at comparing the influence of severe environmental conditions (Hygrothermal Aging and temperature) on the thermo-mechanical behavior of different carbon fiber fabrics reinforced polymers: thermoplastic-based (PPS and PEEK) or thermosetting-based (epoxy) composites.

Comparative study of the influence of the type of matrix in carbon-epoxy composites subjected to delamination under modes I, II and mixed I/II

J. Vina, A. Argüelles, J. Bonhomme, A. F. Canteli

The fracture behaviour in modes I, II and different types of mixed mode under static loading of two composites with the same carbon unidirectional reinforcement AS4 and two types of matrix, a modified epoxy resin 8552 and other epoxy resin 3501-6 has been studied.

Buckling behavior and minimum stiffness requirements of composite plates with edge reinforcment and elastic clamping

P. Weissgraeber, C. Mittelstedt, W. Becker

Composite plates with edge reinforcement are typical structural situations found in aerospace engineering, e.g. as stiffeners in the fuselage or the wings. In this work an explicit analysis of the buckling behavior is performed and a minimum stiffness criterion for the edge reinforcement is presented.

15:30 **Influence of ageing treatment on impact damage of pre-stressed isotropic composite laminates**

O. Sicot, J. Rousseau, D. Hearn

The aim of this study is to show the influence of ageing treatment on impact damage of pre-stressed isotropic composite laminates. Specimens were aged, then loaded and impacted. It was observed that the extent of damage increased with the tensile preload and depended on the ageing treatment.

Relationship between the fracture toughness of a composite and its matrix

B. Kumar, **C.T. Sun**

We propose an approach to relate the fracture toughness of the composite to that of the matrix. Fracture experiments were conducted using specially designed single-edge-cracked tension specimens. Apparent fracture toughness was predicted with a two-parameter fracture model.

Design of variable stiffness panels for maximum strength using lamination parameters

A. Khani, S.T. IJsselmuiden, M.M. Abdalla, Z. Gurdal • In this paper, the effect of fiber steering is investigated in improving the strength of rectangular composite panels with a circular hole in the center. The optimal spatial distribution of material strength is obtained by determining an independent set of lamination parameters at each node.

14:50

Hybrid effects on the interply composites reinforced with carbon fibre and stretched polypropylene

I. Taketa, L. Gorbatikh, S.V. Lomov, I. Verpoest

We propose a novel hybrid composite combined with carbon fiber reinforced polypropylene (CFRPP) and self-reinforced polypropylene (SRPP). SRPP tends to shrink under high temperature, accumulating compressive residual stress in CFRPP during consolidation and presumably improving tensile properties.

Out-of-plane coefficient of thermal expansion of CF/epoxy plain weave composite

S. Takahashi, N. Watanabe, H. Hoshi, Y. Iwahori

The out-of-plane coefficient of thermal expansion (CTE) of woven composite is not enough to investigate. The purpose of this study is to confirm that the out-of-plane CTE of CF/epoxy plain weave composite is larger than that of UD composite and to clarify its reason and mechanism.

Predicting low-velocity impact damage in stiffened composite panels using high-fidelity finite element modelling

B.G. Falzon, A. Faggiani

A detailed finite element model of a stiffened composite panel was developed which incorporated a comprehensive physically-based damage model. High Performance Computing (HPC) was used to simulated an impact event. The predicted damage corresponded well with experimental observations.

15:10

Novel carbon fiber reinforced composites for high impact strength

S.Y. Kim, S.J. Baek, J.R. Youn

Pre-treated carbon fiber reinforced thermoplastic polymer composites were prepared and mechanical properties of the prepared composites were investigated. Although mechanical properties of the composites were improved, film insert molding was introduced in order to improve impact strength.

Increasing modulus and impact strength of submicronised wollastonite / PP-H masterbatch compounds by injection moulding process

T. Auinger, W. Stadlbauer

Specimens of high filled submicronised wollastonite - PP masterbatches were compounded and injection moulded. Stiffness and toughness were increased with no use of surface modifier or coupling agent. Advantages of masterbatch processing with the emphasis on experimental results will be highlighted.

A hierarchical multiscale plate model for the efficient simulation of composite laminates

S.L. Angioni, A. Visrolia, M. Meo

Abstract Modeling and predicting the response and failure of laminated composite structures is a very challenging task. On one hand the designer is interested in the overall response of the structure, but on the other he is also interested in modeling phenomena such as damage which have a localized behavior.

15:30

Preparation and characterization of perovskite-polystyrene composites

D. Acierno, A. Corradi, C. Leonelli, A. Rizzuti, **P. Russo**

Composites prepared by melt blending of a commercial polystyrene and a synthetic micro sized powders of lanthanum-strontium based perovskite $La_{0.5}Sr_{0.5}MnO_3$ (PVK) were analyzed in terms of morphological, mechanical and magnetic properties. Preliminary results appear to be satisfactory.

IFSS Characterization in the nonlinear-matrix behavior using the single fiber fragmentation test

P.J. Herrera-Franco, A. Valadez-González, E. Pérez-Pacheco, J.I. Cauich-Cupul • The interfacial of a carbon fiber-epoxy composite for a hygrothermal environment was studied. The interface interactions were determined using XPS and FTIR. The stress-transfer capability was measured the SFFT and the use of an elastic matrix criteria was compared with the nonlinear matrix behavior.

Modelling and simulation of the elastic modulus of heterophasic polypropylene compounds

M. Jerabek, H. Herbst, S. Gastl, **Z. Major**

Micromechanics based simulations using the mean field homogenization methods and a novel software tool were applied for determining the linear elastic deformation behavior of various hard and soft and mixed particle filled PP(H) composites in the second this study.

15:50

A new approach to the subcritical cracking of ceramic fibers

M. Genet, P. Ladeveze

A model of subcritical propagation is presented that unifies classical and subcritical propagations, as well as reaction- and diffusion-controlled subcritical propagations, through a simple coupling between fracture mechanics and diffusion/reaction problems. It is validated on Hi-Nicalon fibers.

Determination of consistent single layer properties of laminated composites using a new approach based on an inverse laminate theory

R. Schaeuble, M. Rinker

An advanced approach for the determination of the single layer constants of laminated composites is presented. The method is based on the measuring of laminate constants and the subsequent calculation of basic layer constants using an inverse laminate theory also comprising scatter of parameters.

16:10

Multiscale methodology for matrix failure prediction in non-crimp fabric composites

E. Marklund, L.E. Asp

The aim of this work is to further contribute to the understanding of failure of non-crimp fabric composites. A combined analytical and finite element approach to determine transverse matrix failure parameters is suggested. The analysis is limited to failure within bundles in the structure.

Examination of local effects in sandwiches caused by gaps in the core

C. Warkotsch, **S. Dallmeier,** M. Bender, J. Feldhusen

The paper deals with the sub-problem of a divided core between intact faces. Size and geometry of different parameters such as thickness of the faces and the core are varied systematically in order to evaluate their influence. Different material combinations are considered as well.

16:40 - 17:00 Closure

D Polymer matrix composites
Chair: J. Karger-Kocsis

E Experimental techniques
Chair: R.A. Shanks

F Modelling and simulation
Chair: W-R. Yu

NOTES

15:50

Adhesive bonding of hybrid yarn textile-thermoplastic composites
J.-S. Pap, I. Jansen
Bonding techniques for multi-material design are being investigated. Atmospheric pressure plasma and laser radiation are used to pre-treat a GF/PP-based composite before joining with a commercial epoxy system. These samples are compared to samples bonded by low-energy substrate adhesives.

Structural polymer electrolyte for use in multifunctional energy storage devices
M. Wysocki, L. E. Asp, S. Ekstedt
The present contribution describes development of solid polymer electrolytes aimed for use as a matrix in structural composites. Two monomers, one highly conductive and one stiff are co-polymerised at different ratios, resulting in significant multifunctional improvement over homopolymeric systems.

Static design for the fibrous composite plates reinforced by curvilinearly shaped fibers
S. Honda, K. Owatari, Y. Narita
To improve the load-carrying capacity of fibrous composites, the locally anisotropic structures are designed optimally induced by the curvilinearly shaped reinforcement fibres and the present plates give lower stress concentration factors than conventional plates reinforced by parallel fibres.

16:10

The effects of MAPP loading on the performance of hybrid composites
A. Kalam, M.N.Berhan, H. Ismail
Polypropylene was blended with commercial masterbatch PPnanoclay to form PP/PPnanoclay compound. Pulverized OPFB fibre and MAPP were added into the compound at different weight fractions to form hybrid composites. The thermal, water uptake and mechanical properties of composites were investigated.

Identification of damage sources in thermoplastic composites (Carbon/PA12) through acoustic emission analyses based on pattern recognition
F.Philip, S. Deschanel, N. Godin, J. Courbon, JM. Leroy, F. Grosjean, R. Estevez • The objective of this study is to identify the acoustic emission signature of several damage mechanisms occurring in a continuous fibre composite carbon/polyamid 12, aged or not. The objective is the obtention of a library of labelled signals that could be used in real time to detect the critical mechanisms.

Modelling of the rheological behaviour in thermoplastic composite consolidation process
H. Wu, C. Binetruy, M. Deleglise, P. Krawczak
Many papers deal with the visco-plastic characteristic of the concentrated fibre suspension. Here, the rheological behaviour of the polymer/fibre mixture is predicted. The effect of fibre volume fraction on the rheological behaviour of composites and on the polymer pressure is investigated.

16:40 - 17:00 Closure

Posters
Chairs:
Monday:
T. Czvikovszky
J. Karger-Kocsis
Gy. Marosi
B. Pukánszky

Tuesday:
S.L. Ogin
R. Schledjewski
O.T. Thomsen
V. Kostopoulos

Posters

Preparation of composites reinforced with 'in situ' electrospun fibres

K. Molnár, L.M. Vas

In case on nanonfiber reinforced hybrid composites nanofibrous mats are usually placed between microfibrous layers. These very thin nanofibrous layers are hard to handle after the spinning process. A method which allows to produce the nanofibers 'in situ' onto the mould is described.

Polyethylene/synthetic boehmite alumina nanocomposites: structure, thermal and thermooxidative properties

J. Karger-Kocsis, R. Thomann, V.M. Khumalo • Synthetic (BA) has been incorporated up to 8 wt% (LDPE) and (HDPE), respectively, by melt compounding. The primary nominal particle size of these two BA grades was 40 and 60 nm, respectively. The dispersion of the BA in PE matrices was investigated by (SEM and TEM).

Kinetic analysis of the non-isothermal degradation of PEO nanocomposites

M. Erceg, J. Makric, T. Kovacic

The non-isothermal thermogravimetric and kinetic analysis of nanocomposites of poly(ethylene oxide) (PEO) and organically modified montmorillonite Cloisite30B (30B) was performed. Results show that the addition of 30B has beneficial influence on the thermal stability of PEO.

Study of synergism effect of montmorillonites on mechanical and rheological properties in low molecular silicone rubber mixtures

V. Rabová

This work deals with three-roll mill preparation of polydimethylsiloxane composites containing the combination of two clays. After the preparation the rheological properties (apparent viscosity)and mechanical properties (mechanical strength) were studied.

Electric and magnetic field orientation techniques for MWCNT/epoxy nanocomposites

G. Szebényi, G. Romhány

The aim of our research was to develop CNT orientation methods for CNT/epoxy nanocomposites upscalable for industrial use. Electric and magnetic field orientation techniques have been tested. The methods have been compared in terms of mechanical and thermal properties of the composites produced.

Crystallisation behaviour and kinetics of recycled PA6/organobentonites nanocomposites

K. Szustakiewicz, A. Kiersnowski, M. Gazinska, J. Pigłowski

The contribution presents result of research on recycled PA6 and organically modified bentonites. The fully exfoliated composites were obtained via masterbatch in twin – screw corotation extruder and characterized using XRD, DSC technique and tensile tests.

Properties of rigid polyurethane foams filled with nanoparticles of montmorillonites

V. Yakushin, T. Vlcek, J. Zelenka, U. Cabulis, U. Stirna

The influence of two types of montmorillonite nanoparticles with a special surface treatment on the properties of rigid polyurethane foams with density of about 50 and 75 kg/m^3 were investigated. The basic characteristics of filled and neat foams at compression and tension were compared.

Morphology and thermal characterization of modified clay-PMMA nanocomposite

D. Lerari, S. Peeterbroeck, S. Benali, A. Benaboura, P. Dubois

This work concern preparation and characterization of polymer-layered silicate nanocomposite based on new natural Algerian clay and PMMA.Thermal properties of the nanocomposite was investigated by TGA and DSC. The thermal stability was improved compared to virgin PMMA.

Crystallisation and melting properties of polypropylenes containing multiwall carbon nanotube

A. Ádámné Major, K. Belina

Isothermal and non isothermal crystallisations of multiwall carbon nanotube containing polypropylene composites were carried out. It was found that carbon nanotube has nucleating effect in the crystallisation process. Crystallisation rate constants were determined with the Avrami's quotient.

Nanostructure evolution and materials fatigue in strands of polymer composites studied in simultaneous load-cycling and SAXS experiments

A. Zeinolebadi, N. Stribeck, Z. Denchev

Fatigue behavior of nanocomposites was monitored by variation of SAXS pattern. The result of each pattern is a set of nanostructure parameters. Comparison of the structure evolution with the mechanical data shall extend the understanding of fatigue mechanisms in nanocomposites.

Homogenous properties of CNTs and nanocomposites with defects

M. Chwal

Atom vacancy defects and their influence on CNTs/nanocomposites properties are investigated. The identification method is based on the evaluation of eigenfrequencies and then material constants. The average mechanical properties are obtained with the use of the FEM and the theory of homogenisation.

Effect of PDMS-PEO clay masterbatch on the morphology and mechanical performance of PP based composite

M.L.Q. A. Kaneko, R.B. Romero, I.V.P. Yoshida, M.C. Gonçalves

The aim of this work is to report a polypropylene nanocomposite reinforced with an organically modified clay masterbatch, in which a low molar mass siloxane surfactant, poly(dimethylsiloxane-co-methylpropylethylene oxide siloxane, was used to modify the clay.

Preparation, structure and performance of layered silicate nanocomposites with polysiloxane matrix

S.P. Vasilakos, P.A. Tarantili

Nanocomposites of polysiloxane containing organically modified montmorillonite were prepared and characterized. The nanocomposites showed similar thermal characteristics, lower crystallinity and significant improvement in thermal stability and tensile properties, as compared with the unfilled matrix.

Effect of various shapes of zinc oxide nanoparticles on cotton fabric for UV-blocking and anti-bacterial properties

N. Neamjan, W. Sricharussin, P. Threepopnatkul

Effect of various shapes of ZnO on cotton fabric for UV-blocking and antibacterial properties has been studied. The shapes of ZnO show no considerable effect on the tensile strength and antibacterial properties. ZnO on cotton fabric can improve UV-blocking property.

Fabrication and characterization of aluminum-carbon nanotube powder and polycarbonate/aluminum-carbon nanotube composites

K.H. Yoon, D.Y. Lee, S.S. Jeong

Carbon nanotube reinforced aluminum powders (Al-CNT) were fabricated by ball-milling. Polycarbonate (PC)/Al-CNT nanocomposites were prepared by a twin screw extruder. The morphology, thermal, electrical, rheological and mechanical properties of PC/Al-CNT nanocomposite were investigated.

Carbon nanotube / polyvinyl acetate composites: structure and stress-strain characteristics

J. Bitenieks, R. Maksimov, T. Ivanova, R. Merijs Meri, J. Grabis

In the current research CNT/PVAc nanocomposites, obtained by latex route, are considered. Structural, mechanical and electrical properties of the nanocomposites are investigated. Results show that the nanocomposites possess increased mechanical properties and exceptionally low percolation threshold.

The effect of nanotube content on the mechanical properties of basalt fibre reinforced polyamide 6

L. Mészáros, I.M. Gali, T. Czigány, T. Czvikovszky

In this study 30 wt% BF and 0.5-2 wt% multiwall carbon nanotube containing polyamide 6 hybrid systems were prepared by extrusion.The results showed that the combination of macroscopic and nano-sized reinforcement improved the mechanical properties.

Thermal and rheological characterization of polyolefin compatibilizers grafted with itaconic acid and its monoesters for nanocomposites

G. Baser, N. Uyanik, A. Ezdesir

Itaconic acid and its monoesters were grafted onto low density polyethylene and isotactic polypropylene at 140°C by microwave irradiation in a xylene solution in the presence of dibenzoyl peroxide as an initiator to achieve polyolefin compatibilizers. Their thermal and rheological properties were investigated.

Synthesis and characterization of composites TiO_2/carbon nanotubes

V. Herman, G. Gonzalez, C. Albano, I. Boyer, A. Monsalbe, J. Prin

The objective of the present work was to synthesize TiO_2 nanoparticles on MWNTs functionalized. The synthesis of TiO_2 was by sol gel method.Nanocomposites TiO_2-MWNTs (yield 99%) were characterized by XRD, TEM, SEM, EDX, AFM and DSC-TGA. A good dispersion of TiO_2 on the MWNTs surface was observed.

Quantitative optical analysis of filler dispersion degree in nanocomposite

T. Glaskova, A. Aniskevich, M. Giordano, M. Zarrelli

A method of quantitative analysis was developed and applied first to quantify the dispersion efficiency of model solutions with good and bad dispersion of filler micro-particles and then of multi-wall carbon nanotubes in nanocomposite prepared by solution intercalation method.

Preparation of TiO_2-coated CNTs by sol-gel method and dielectric property measurement of their polymeric composites

J.W. Yi, J.B. Kim

An amorphous titanium oxide (TiO_2) thin layer was coated on the surface of carbon nano tube (CNT) using a sol-gel method and proper heat treatment with minimization of CNT damages was subsequently performed to convert amorphous TiO_2 into crystalline anatase.

Preparation and study of organoclay nanocomposites based on matrices of compatibilized polyolefin blends

G. Moraitis, P.A. Tarantili

Nanocomposites based on compatibilized blends of high density polyethylene and polypropylene and OMMT nanoparticles, were prepared using melt blending in a twin screw extruder. These nanocomposites present increase in crystallinity, temperature of thermal degradation, stiffness and decrease of MFI.

Crystallization behaviour, thermal and mechanical properties of PLLA in natural fillers/PLLA nanocomposite

C. Thongpin, S. Suttireungwong

This paper is aimed to study the nucleating efficiency of natural fillers such as nano-silica, calcium carbonate and titanium dioxide on thermal and mechanical properties of PLA in PLA)/natural filler nano-composite compounded via a twin-screw extruder and compression moulding for mechanical test.

Evaluation of different nanofillers in combination with traditional flame retardants in a PC/ABS blend: flame retardant behaviour and thermomechanical properties of the prepared nanocomposites

A. Brunetin, R. Sulcis, A. Ciappa, V. Vascotto • Synergism of resorcinol bis-(diphenyl-phosphate) with nano-fumed silica and nanoclay in PC/ABS was studied regarding flame retardancy, mechanical and thermal decomposition. ABS distribution within PC matrix was evaluated by optical microscopy; nanoclay filled samples were characterized by WAXRD.

Wear assessment of Al/B_4C surface nano-composite layers fabricated using friction stir processing

K. Jazaeri, S.F. Kashani-Bozorg

Al/B_4C surface nano-composite layers were fabricated on 7075Al alloy using friction stir processing. The surface nano-composite layer showed superior wear resistance; these are attributed to its greater micro hardness value due to the finer matrix grains and dispersion of nano-sized B_4C particles.

Crystallization, microhardness and flammability of HDPE-g-MA / organoclay nanocomposites: Effects of the preparation procedures

L. Minkova, M. Valcheva, S. Filippi

Nanocomposites of maleic anhydride-grafted HDPE and the organoclay have been prepared by melt-compounding, solution-blending and static annealing of polymer/clay mixtures. The crystallization behavior, microhardness and flammability of the composites have been studied.

Effect of carbon nanotubes on the damage development in fiber-reinforced composites

L.Gorbatikh, Y. Ding, D. Ivanov, N. De Greef, M. Karahan, A. Godara, L. Mezzo, S.V. Lomov, I. Verpoest • The focus of the present study is to investigate the effect of CNTs on the damage development in woven fiber reinforced composites (glass and carbon). The study employs acoustic emission registration and full-field strain measurements accompanied by X-ray tomographic inspection and SEM fractography.

Compounding condition-dependent properties of Nylon-66/clay nanocomposites

J.S. Seo, B.C. Kim

The effects of compounding conditions such as mixing rate (15 to 90 rpm) and mixing time (5 to 30 min) at a given temperature, on the dispersion state and physical properties of nylon-66/clay nanoparticles (5 wt%) were investigated on rheological basis.

Conductivity of high TiO_2 content nanocomposites by TUNA

J. Gutierrez, A. Tercjak, I. Mondragon

In present work, TiO_2/PS-b-PEO nanocomposites with high amount of inorganic component have been achieved without loosing the template nanostructure of the obtained inorganic/organic hybrids synthesized via sol-gel based on PS-b-PEO block copolymer and TiO_2 nanoparticles.

Polyimide composite film with thermally treated talc for increasing T_g

K. Fukukawa, W. Yamashita, S. Tamai

Thermal treatment of talc provided great enhancement to the property of polyimide composite film; especially increasing T_g significantly. $CaCO_3$ was found to play an important role through chemical transformation to CaO and $Ca(OH)_2$, as well as critical timing for the incorporation.

An investigation into the role of nano-sized calcium carbonate on tearing behaviour of a medium density polyethylene

M. Mazinani, S.M. Zebarjad, F. Hosseinabadi, V. Kiani • Effect of $CaCO_3$ nanoparticles on tearing behavior of MDPE in perforation test was studied. Results showed that presence of up to 5 wt.% $CaCO_3$ in composite samples increased maximum force and energy needed for test, but adding more than 5% resulted in particles agglomeration and then cracks formation.

Effect of multiwalled carbon nanotube filling on the properties of in situ polimerized PBT

G. Romhány, J. Vígh, J. Karger-Kocsis

Influence of carbon nanotube on the mechanical properties of in situ polymerized PBT was investigated. The components were mixed with planetary ball mill in order to achieve good dispersion. Strength, modulus and thougness improved at 0,25 weigth% nanotube content.

The effects of nickel chelate of aminopyridieneanilide combined with modified clay on flame retardance enhancement of polyethylene composites prepared by ultrasonic irradiation

M.A. Nour, M.S. Gaafar, A. Eid, A.A. El–Ebissy • The flame retardancy of polyethylene treated with Pyr-Ni of Aminopyridieneanilide and cloisite® 15A mixtures at different concentration have been prepared by ultrasonic irradiation technique. The prepared PE/OMC/Pyr-Ni composites have been investigated by TGA, AFM, XRD and cone calorimeter.

Thermal and eletrical conductivity of multi-walled carbon nanotubes/poly (vinyl cloride) composites

R.G. Araujo, G.M.O. Barra, A.T.N. Pires

The aim of this study is to obtain and evaluate the thermal and electrical conductivity properties of multi-walled carbon nanotube dispersed in poly(vinyl chloride) matrix. As expected, the presence of carbon nanotubes no induces change in thermo properties of the nanocomposites.

Effect of modification techniques of MMT on morphology, crystallization behavior and mechanical properties of MMT/HDPE nanocomposite

C. Kulawong, C. Thongpin • This research is aimed to chemically modify montmorrilonite (OMMT) via ion exchanging by using ultrasonic wave and subsequently grafting with silanes. HDPE was matrix. The composites obtained were also characterized to examine the morphology, crystallization and mechanical properties.

A comparative study on the mechanical properties of clay-modified epoxy adhesive by using different clay types

S.N. Surip, A.H. Ismail, R. Mohamed, H. Anuar

The result shows that the tensile strength was increase by using micron clay while shear and impact strength was increase by using nano clay.FESEM shows that the nano clay was well dispersed in the epoxy adhesive while micron sized clay was partially intercalated.

Fatigue crack growth in thermosetting polyurethanes. Effect of environmental conditions and network structure on the dynamic fatigue properties

M. Kempf, F. Fischer, V. Altstädt

This study focuses on the fatigue crack growth in different thermosetting polyurethanes suitable to be used as adhesives or matrices in fibre reinforced composites. The effect of changes in environmental conditions on the fatigue properties of the material are investigated.

Modelling of impact damage and permanent indentation on laminate composite plate

C. Bouvet, S. Rivallant, J.J. Barrau

This paper deals with impact damage and permanent indentation modelling. This model particularity is to account for the intralaminar damages thanks to interface finite elements which respect their discontinue character. These interface elements allows equally to simulate the permanent indentation.

Fracture behaviour of PP based composites reinforced with micro and nano-sized fillers

E. Pérez, C.J. Pérez, V. Alvarez, L. Famá, C. Bernal

Polypropylene (PP) composites with different nano and micro-sized fillers were prepared. The effect of the filler content and the incorporation of a coupling agent (PP-g-MA) in the composites formulation on the materials fracture behaviour was analysed.

Low velocity impact and compression after impact tests on thin carbon/epoxy laminates

D. Ghelli, G. Minak

The results of drop-weight impact tests, carried out on specimens of two different geometries, and Compression After Impact (CAI) tests on carbon/epoxy specimens are presented. Laminates of small thickness, that underwent global buckling during the CAI test, were considered.

Fracture behaviour of recyclable all-polypropylene composites composed of alpha and beta modifications

A. Stocchi, V. Pettarin, A. Izer, T. Bárány, C. Bernal, T. Czigány

"All-PP" composites are designed to compete with GF-PP. In this work, the fracture behaviour of all-PP composites was studied. Different Fracture Mechanics approaches (J_C and EWF) were applied. It was found that fracture toughness strongly decreased as consolidation quality increased.

Effect of consolidation degree on the failure behaviour of self-reinforced polypropylene composites as assessed by acoustic emission

A. Izer, A. Stocchi, T. Bárány, V. Pettarin, C. Bernal, T. Czigány

In this work, the failure behaviour of self-reinforced polypropylene composites (SRPPC) was studied by the acoustic emission (AE) technique.Correlations between the dominant failure mechanisms and AE events amplitude for model specimens were established.

Fatigue behaviour of carbon/epoxy composite

J. Bienias, M. Ostapiuk, B. Surowska

The objective of this study was to describe the fatigue behaviour (tensile-tensile fatigue test) of carbon/epoxy composite. The microstructure analysis (fractography) of composites was studied using a optical and scanning electron microscope and X-ray micro-CT scanner.

Mechanical durability of polyamide-stainless steel hybrids

M. Hoikkanen, J. Vuorinen

The effect of fibre loading on mechanical properties of injection moulded plastic-metal hybrids was studied. These hybrids were tested in pull-off and impact loading, and fracture surfaces and cross-sectional samples were studied also by optical microscopy.

Environmental effects on multiphase polymeric composite materials' thermal properties

D.L. Motoc, I. Curtu, M. Campean

The paper aims to approach a comparative study done on the thermal properties changes of multiphase composite material samples subjected to various environmental conditions. The experimental research is carried out using a DIL 402 PC dilatometer from Netschz(D). Theoretical predictions are added.

Prediction of overall heat transfer coefficient "U" in sandwich panels

A.P. Sartori, J.S. Crespo, P.R. Wander, M. Giovanela, R.C.R. Nunes

This work aimed at developing a non-destructive test for predicting the heat transfer global coefficient (U) in sandwich panels used in semi-trailers for transporting perishable food. Thermography was the tool employed for data acquisition designed to implement mathematical models.

Mechanical properties and physical aging of PCB FR4 composites for mechatronic

M. Le, J. Idrac, E. Font, A. Guillet, E. Dargent

In mechatronic, the behaviour of Printed Circuit Board Flame Retardant 4 are required. PCB FR4 is an epoxy matrix composite with 8-glass fiber woven. Mechanical and physical properties of as-received and thermal aged PCB FR4 were investigated at different temperatures and sampling directions.

Synergistic effects of zinc borate and aluminium trihydroxide on flammability behaviour of aerospace epoxy system

C. Formicola, A. De Fenzo, M. Zarrelli, A. Frache, M. Giordano, G. Camino • The flame retardancy of mono-component epoxy resin (RTM6), widely used for aerospace composites, treated with zinc borate (ZB), aluminium trihydroxide (ATH) and their mixtures at different concentrations have been investigated by morphological and thermal characterization.

Study on shear response of concrete beams reinforced by FRP

S. Motahari, H. Omranpour, S.A. Monemian, H. Saghafi

The aims of this study were to investigate the effect of composite layers number, installation method and roughness of concrete surface on shear strength of the beam. With regard to the results increase in composite layers and smoothness of concrete surface enhanced the shear strength significantly.

Microhardness of selected restorative composites after exposure in artificial saliva

K. Palka, A. Niewczas, J. Bienias

The study was conducted to evaluate the effect of 6 months storage period in artificial saliva of nano- and micro-filled restorative materials on its microhardness. Microhardness in every case significantly diminished during test period: 26% for microfiller materials and 12-19% for nanofiller ones.

Fatigue Crack Propagation behavior of CNT/Epoxy Composites

S. Matsuda, S. Utsumi, H. Kishi

Effect of carbon nanotube on fatigue crack propagation behaviour was investigated using three types of epoxy resin with different crosslink density. The fatigue crack propagation resistance was improved by 30% at maximum by adding 3 wt% of carbon nanotubes.

Mechanical properties of honeycomb preform sandwich composites

J-C. Chen, C-M. Wu, C-C. Yang, Y-A. Teng

The effects of core structures on the mechanical properties of sandwich composites have been studied in this paper. The three-dimensional multi-layer weaving technique was used to fabricate carbon and glass honeycomb preforms for sandwich composites core materials.

Multilayer flame retarded epoxy resin composites for aircraft applications

B. Szolnoki, Gy. Marosi, A. Toldy

The intumescence-hindering effect of the fibre reinforcement was overcome by forming a multilayer composite, consisting of reference composite core and intumescent epoxy resin coating layer, which resulted in simultaneous improvement of flame retardancy and mechanical properties of epoxy resins.

Effects of thickness variation on the buckling load in thin plates made of functionally graded materials

A.R. Tavana, M. Karimi Demneh

In this paper, a simply supported rectangular plate made of Functionally Graded Materials (FGM) with linearly varying thickness is considered. The equations are based on Love- kirchhoff hypothesis and the sanders non- liner strain – displacement relations.

The precision of pressing processes for details consisting of composite materials on rotary machines

I. Grinevichs, N. Mozga, G. Springis

The main object of research of composite material details' pressing processes on rotary machines is focused on how statistical characteristics are established for input and output of different technological operations taking into account the way of machining.

Two level microstructure-property relation for balsa-like porous materials

O. Shishkina, L. Gorbatikh, S.V. Lomov, I. Verpoest

The work introduces homogenisation method to predict elastic properties of porous materials with the balsa-like microstructure. The particular features of the microstructure include two families of pores, anisotropic matrix and dependence of matrix properties on balsa density.

High order damped vibration of composite sandwich shell with a viscoelastic soft core

S.M.R. Khalili, O. Rahmani, K. Malekzadeh

In this paper higher-order sandwich panel theory is developed to study the free damped vibration of sandwich cylindrical shell with a viscoelastic flexible core. The analysis determines the damped natural frequencies, loss factors, and local and global mode shapes of cylindrical shell panel.

Simulation and validation of 2K injection moulded PP-hemp reinforced PP products

G. Dogossy, E. Sági, Sz. Szalai, E. Andersen, I. Rácz

The presentation is focused on 2K injection moulding. Specimens were injected from pure PP as skin and from hemp fibre reinforced PP as core with simulated parameters. Quasi-static and dynamic mechanical properties were tested. Deflection of the specimens was compared with results of simulation.

Stability analysis of composite plates with restrained edges subjected to axial load

G. Tarján, L.P. Kollár

Approximate buckling analysis of short and long composite plates subjected to uniaxial compressive load is presented. All the four edges of the plate are elastically restrained by springs or stiffeners. Approximate formulas of the lowest buckling load are derived as a function of the plate length.

Wavelet collocation for laminated structures with layerwise theory

A.J.M. Ferreira, L.M.S. Castro, S. Bertoluzza, R.C. Batra, J.N. Reddy

This paper deals with the static analysis of sandwich plates in bending by a wavelet collocation method. A layerwise theory is used to model the kinematics of the laminated plate deformations.

Coating and processing technology for the production of prepreg-semi products by use of textile fibre compounds

A. Glawe, M.G. zu Eulenburg

The combination of carbon and glass fibres with epoxy resins for the use in reinforced plastics is gaining more importance. The design of specialized coating technologies and the effective treatment of the fibre materials for prepreg products present a number of mechanical engineering challenges.

Machining of composite materials
J. LÍŠKA
At the present time composite materials are used in many industrial areas. The main problems in the machining of composites are delamination of workpiece, durability and lifetime of cutting materials. The paper deals with above mentioned problematic in the machining of polymer composite materials.

Preforming quality assurance for high-performance fibre-reinforced composites
K. STARZYNSKI, J. KRÄMER, V. ALTSTÄDT, U. BEIER
In this study, various thermoplastic and thermoset materials suitable for the intended binder based preforming process were processed using various performing conditions in order to analyze the resulting perform quality as well as resulting overall mechanical properties of the final composite.

Effects of inlay fibres on the behaviour of dry knitted-fabrics and resulting composites
L. BALEA, G. DUSSERRE, G. BERNHART, N. DUMONT
Inserting inlay yarns in the knitted structure increases the mechanical properties of the resulting composite. The relationship between knitted structure and the composite tensile behaviour has been investigated experimentally by varying the number of inlays and fibre nature.

Effect of the conducting particles on the process and mechanical behavior of composite material
M. HASSAR, B. LASCOUP, Z. ABOURA, M.L. BENZEGGAGH
The purpose of the study is a technical solution leading to the production of composites panels including an electromagnetic shielding based on a conductive resin.The influence of introduction of conducting particles into a thermosetting resin has been investigated.

Effect of ring winding technology on NOL ring testing and accompanying characteristics
M. PÄSSLER, R. SCHLEDJEWSKI
Ring winding technology offers the possibility to increase the process efficiency. The influence of the varying number of crossover points depending on the winding pattern adjusted with multi feed-eye configuration on mechanical performance of filament wound laminates was systematically analyzed.

A polyborylborazine-based precursor for spinning into continuous BN fiber
Y. PENG, Y. CAO , S-T. LI , K. HAN, X. ZHAO, M. YU
We will report on molecular design, synthesis and characterization of a new BN fiber precursor. By test of melt spinning on a spinning machine, a continuous boron nitride fibre can be spinned from this new precursor, and by pyrolysis in NH_3, a crack and void free BN fibre can be obtained.

Influence of boron carbide proportion and grain size on PMC's Epoxi+B4C kinetics
J. ABENOJAR, M.A. MARTÍNEZ, N. ENCINAS, M. PANTOJA, J.C. DEL REAL
In this work the curing process of an epoxy filled with B4C is studied using an isothermal method at different temperatures (25, 35 and 50°C) through 180 min and a dynamic method is applied increasing temperature until 200°C to 5°C/min, achieving the necessary heat to the complete curing process.

Determination of duty cycle in thermoset pultrusion
W.A. KHAN
The economy of pultrusion depends on line speed which is currently around 0.35 m/min and can be increased to 0.5 m/min if the charge temperature is raised to 85°C. Duty cycle is monitored on the pultrusion line. Experimental results for duty cycle are in agreement with simulations result.

Validation and verification of a Finite Element computational model of a carbon-fibre-reinforced epoxy laminate
H. USABIAGA, U. SEGURAJAUREGI, G. FERNANDEZ
In this contribution the ASME recommendations for the verification and validation (V&V) of a computational model are put into practice in a FE dynamic model of a multilayer plate. The exercise involves pretest, verification, uncertainty analysis and model updating methods.

Schrinkage measurement of a textile reinforced composite at high temperature using a non contact method

J. Blom, J. Van Ackeren, B. Belkassem, J. Wastiels

The geometrical stability of inorganic phosphate cement is studied in this paper. The first method is the Thermal Mechanical Analysis. The second is based on digital image correlation. A good correlation was found with the thermal mechanical analysis results.

Surface characterization of composites used in the aircraft industry by AFM

M. Burón, J. Rams, J. Sánchez-Gómez, A. Sánchez Blázquez

The adhesion behaviour of composite surfaces in contact with several ancillary materials during the curing process has been characterized by intermolecular forces between the AFM tip and the composite surface. AFM results have been also compared with mechanical and XPS tests.

Study of the delamination in a composite carbon/epoxy under mode I fatigue loading subjected to different temperatures

A. Argüelles, J. Vina, P. Coronado, I. Vina, J. Bonhomme • In this work the influence of the thermal variations in the delamination of a composite has been analyzed. To be exact the fracture behaviour in mode I and under static and dynamic loading of a composite, made of a carbon and a modified epoxy resin has been studied to different temperatures.

Modelling the fluctuation of material properties of non-circular profile filament wound composite pipes along the perimeter of the cross section

G. Czél, T. Czigány

Periodic changes in the material properties of standard egg shape profile filament wound glassfiber reinforced unsaturated polyester composite sewer liner pipes were investigated and modelled around the perimeter of the section that has constant radii of curvatures in certain sections.

Ultrasonic inspection of composite materials using L2 norm deconvolution

A. Benammar, R. Drai, A. Guessoum

In this paper, the fast sequential algorithm for L2 deconvolution is used to estimate the reflectivity sequence. This algorithm performs a search of events by increasing order of importance with respect to a criterion which is described in detail.

Micromechanical measurement of mechanical properties in a carbon fiber as a transversely isotropic material

S. Ogihara, Y. Imafuku, R. Yamamoto, Y. Kogo

Few examples of direct measurements of the anisotropic elastic constants of carbon fibers is seen. In the present study, we made an attempt to evaluate the elastic constants in a carbon fiber as a transversely isotropic material by the tensile test and the torsion test.

Structure, thermal stability, and adsorption properties of beta-cyclodextrin-containing materials

I.M. Trofymchuk, V.V. Sydorchuk, L.A. Belyakova

The sol-gel synthesis of beta-cyclodextrin-containing silica materials is reported. These materials were characterized by IR spectroscopy, thermogravimetric analysis, and N_2 sorption experiments. Synthesized silicas are stable in aqueous medium and could be used in processes of pollutants removal.

Kinetic study of an anaerobic adhesive on silanized substrates using DSC technique

M. Pantoja, J. Abenojar, M.A. Martínez, N. Encinas, J.C. del Real

The urethane methacrilate adhesive curing process is studied using isothermal method at three temperatures (25, 10 and 0°C). The evolution is followed during 30 min and a dynamic method is applied increasing the temperature to 200°C to 5°C/min. The conversion degree is calculated combining methods.

FT-IR study of impregnated acrylic fibers with $KMnO_4$

K.A. Banaie, R.E. Farsani, E.N. Sabet

Modification of PAN fibers with $KMnO_4$ solution and under different times were studied by ATR/FT-IR spectroscopy. The result showed two new peaks in 2340 cm^{-1} and 1600 cm^{-1} and decrease of nitrile groups. Also, defined a new parameter for measuring of conversion percentage of chemical reaction.

Preparation and performances of a novel inorganic-organic hybrid phase-change material based on silica and n-octadecane through self-assembly

H. Zhang, X. Wang, D. Wu

A novel inorganic-organic hybrid phase change based on a n-octadecane core and an inorganic silica shell was designed to enhance thermal conductivity and phase-change performance, and then was synthesized by using TEOS as an inorganic source through self-assembly in a sol-gel process.

Testing and modelling the bending behaviour of flexible composite sheets

B. Al-Gaadi, M. Halász, L.M. Vas, P. Tamás

Flexible composite sheets are used for example for roofs or tents in the architecture, tanks or containers in the transport industry, etc. To examine the flexibility of composite sheets we measured their bending rigidity with optical bending test equipment.

Quantitative damage assessment of composite laminates using ultrasonics

D.G . Aggelis, N.M. Barkoula, T.E. Matikas, A.S. Paipetis

The acoustic activity of composites was monitored. AE parameters were employed to monitor damage modes (transverse cracking vs. delamination). Wave propagation studies revealed an increase in the relative amplitude of the propagated wave, attributed to delamination.

Viscoelastic behavior of carbon epoxy composites by creep tests

G. Marinucci

Creep and creep rupture test in constant load were performed in specimens of carbon-epoxy composites with fibers orientations at 90°, at temperatures of 25 and 70°C. Comparisons of creep compliance curves with a viscoelastic behavior prediction model based on Schapery equation were also performed

Measurement of void content and distribution in composite materials by quantitative microscopy

T.G. Cruz

The spatial distribution of voids is analyzed through contour maps of void count and area fraction, and by statistical technique that provides a quantitative measurement of homogeneity or clustering of the distribution. This study was carried out through image analysis method which images by C-scan.

TiO_2/SiO_2 inorganic barrier composites – from synthesis to application

K. Siwinska-Stefanska, T. Jesionowski A. Krysztafkiewicz, J. Sójka-Ledakowicz

TiO_2/SiO_2 hybrids were obtained in emulsion precipitation reaction from a solution of titanium(IV) sulphate(VI) using a sodium silicate solution. The works performed proved the possibility of manufacturing a new generation of textile TiO_2/SiO_2 composites with barrier properties against UV radiation.

Energy absorption of unidirectional CFRP plate under compression

M. Ueda, A. Hiraga, T. Nishimura

Progressive crushing tests of unidirectional CFRP plate were carried out. V-shaped trigger and pre-cracked trigger were proposed. A column-like part (pillar) was observed between fronds under crushing. It was revealed that the thickness of pillar was dominant factor on energy absorption of unidirectional CFRP.

The impact of blue inorganic pigments on the microwave electrical properties of polymer composites

L.C. Costa, F. Henry

We present the results of the measurement of the complex dielectric permittivity, in the microwave frequency region, on glass reinforced polybutylene terephtalate with blue inorganic pigments.The cavity resonant method had been used in order to obtain the complex permittivity at 2.7, 5 and 12 GHz.

Diagnosis of dynamic behaviour of ligno-cellulose composite plates

I. Curtu, M.D. Stanciu, D.L. Motoc

The paper presents the experimental evaluation method of dynamical behaviour of lignocelluloses plates.The structures were excited with a harmonic force using a mini-shaker. The signals were captured and processed by means of Pulse 12 system B&K. The results are displayed in numerous plots.

A strategy to identify a cohesive zone model coupled with intralaminar damage

T. Vandellos, N. Carrere, C. Huchette

Cohesive zone models (CZM) are used to model delamination. This study proposes a strategy to characterize and to model delamination with CZM coupled with intralaminar damage thanks to a new fracture test which permits a stable propagation of the delamination with an evolving mixed mode ratio.

Experimental analysis and numerical simulation of the macroscale impregnation of thermoplastic matrix composite

R. Gennaro, A. Greco, A. Maffezzoli

An experimental analysis of through thickness impregnation of a glass woven fabric with an amorphous polyethylene-terephthalate matrix was performed. The capillary rheometer was modified by substituting the capillary with a tool, capable of sustaining the reinforcement during impregnation.

Microencapsulation with melamine-formaldehyde resin

B. Alic, U. Šebenik, M. Krajnc

Encapsulation of decane with MF resin was carried out at different pH values and temperatures. The composition of microcapsules and the degree of cure of shell material were studied during and after the encapsulation process by DSC and SEM techniques.

In-plane mechanical characteristics of stitched fabrics with and without circular hole

A. Yudhanto, N. Watanabe, H. Hoshi, Y. Iwahori

In-plane mechanical properties of non-crimp fabrics (NCF) with Vectran stitch was studied using tensile and open-hole tension tests. Effects of hole and thickness on the notch strength were evaluated. Damage progression was identified, specifically at the edge and hole.

Strain rate influence on the failure stress of composite structure

M. Hassar, B. Lascoup

This work concerns a composite glass E vinylester resin produced by a low pressure process and submitted to tensile test in a wide range of strain rate (from 10-8 s^{-1} to 30 s^{-1}) and shows that the strain rate has an obvious influence on the failure stress and a smaller influence on the elastic modulus.

The quality inspection of a smart composite structure

B. Surowska, J. Bienias

The scope of research include the design by FEA method and manufacture of smart composite with embedded piezofibres between plies by autoclave method, the analysis of actuator connection with laminate by X-ray microtomograph and by supersonic inspection and elastic deformation under current pulse.

Correlations between fractographic measurements and fatigue parameters in NC2/RTM6 composites

M.Y. Shiino, L.M. De Camargo, M.O. H. Cioffi, H.C.J. Voorwald, M.C. Resende • This research is focused in quantitative analysis of hackles generated in fatigue tests by carrying out measurements in fractographs in order to know the influence in fatigue test parameters. As expected some responses towards fatigue parameters were well correlated with fractographic measurements.

Synthesis and surface characterization of amphiphilic diblock copolymers containing poly(n-n-dimethylacrylamide)

L. Gargallo, N. Becerra, D. Radic, M.V. Encinas, A. Valdebenito

In this work, we describe the surface behavior of the two ampliplilic diblock copolymers with different hydrophobic segments: poly(N,N-dimethylacrylamide)-b-poly(2-ethyl hexyl methacrylate) and poly(N,N-dimethylacrylamide)-b-poly(stearyl methacrylate).

Effect of Mg on producing metal oxide coating on SiC particles

A. Zulfia, T. Tatu, Mas'udah

Electroless plating are used to coat SiC. HNO_3, Al and different of Mg were used in solutions. The thin layer of SiC was rough with thickness was 27.3-123 nm. The reaction product at interface of SiC indicated that spinel phase of $MgAl_2O_4$ was formed on the surface of SiC beside SiO_2 and MgO.

Structure and properties of copper matrix composites reinforced with Cr and SiC particles via mechanical alloying

A.S. Prosviryakov, A. Aksenov

Microstructure and properties (hardness, electroconductivity, CTE) of dispersion-strengthened composite materials on basis of systems Cu-Cr (20-50 wt%) and Cu-SiC (15-35 wt%) prepared by mechanical alloying in the planetary ball mill were investigated.

Investigation of oxygen diffusion in st 707 Non-Evapoable Getter Material

S.R. Avdiaj, J. Šetina, B.Š. Batic

The oxygen diffusion and microstructure were investigated in samples of commercial NEG St 707 which is an alloy of ZrVFe by EDS, AES and XRD. To get observable amount of oxygen in the bulk material we have loaded the samples at 455°C with different amount of oxygen.

Investigation of foam aluminium produced from aluminium raw materials by mechanical alloying and method of mixing in a stream of gas

D.O. Ivanov, A.A. Aksenov

Foam aluminium was obtained by mechanical alloying and method of mixing in a stream of gas. Cutting raw of the composition $Al_6Mg_{0.7}Mn_{0.1}Ti$ was used as a matrix alloy and TiH_2 was used as a foaming agent. Using this methods foam aluminium was had pore size of 1–5 mm at a density of 1.50–0.70 g/cm^3.

Comparison of the thermal properties of aluminium-carbon fibres composites obtained by SPS and hot pressing by induction

G. Lalet, J.M. Heintz, A. Kawasaki, J.F. Silvain • This study will be focused on the comparison of the thermal properties of an aluminium matrix reinforced by 20 vol% carbon fibres composites elaborated by two methods of sintering: hot pressing by induction (HP) and spark plasma sintering (SPS) also know as pulsed electric current sintering.

Limiting the development of Al_4C_3 to prevent degradation of Al/SiCp composites processed by stir casting

H.S. Pour Fard, H. Baharvandi

The presence of Al_4C_3 phase in Al/SiC composites may activate degradation of the material by its interaction with water.The incorporation of 5 vol% SiCp powders which heat treated at 1100°C for 3.5 hrs before processing by stir casting prevents formation of Al_4C_3 at matrix-reinforcement interfaces.

Quantitative assessment of structural components distribution in mechanically alloyed composite materials

P. Bryantsev, M. Samoshina, A. Aksenov

It is important to achieve homogeneity of composite materials microstructure for high level of stability of its mechanical properties. In this work the technique of quantitative estimation on example of mechanically alloyed dispersion-strengthened composite material is offered.

Production and investigation of a metal matrix composite pipe

I.N. Orbulov, I. Kientzl, J.T. Blücher, J. Ginsztler, Á. Németh, J. Dobránszky

Metal matrix composites ensure outstanding possibilities in many industrial fields. In our work a composite pipe was produced by pressure infiltration. $AlSi_{12}$ alloy was used as matrix, the reinforcement was ~60 vol% carbon fibre. Microstructural investigations and bending tests were performed.

Filament-wound pressure vessels for high volume gas storage: Different approaches to optimize the structural performance

L. Sorrentino, L. Tersigni

The high mechanical performance and lightness of the pressure vessel have achieved great importance on the energy density (for examples in Unmanned Aerial Vehicle “UAV”). The aim of work is to show a tool for the optimization of the performance of pressure vessel.

Modeling of the inelastic response of metal-ceramic composites on the micro scale

R. Piat, Y. Sinchuk, T. Ziegler, A. Neubrand, S. Roy, A. Wanner

Material properties of metal-ceramic composites were identified on different length scales using micromechanical semi-analytical and FE methods. The both approaches consist of the two step homogenization procedures. Predicted material properties were compared with ultrasonic measurements.

Microstructure and wear behaviour of squeezed cast magnesium alloy reinforced with ZrB_2, C or hybrid of ZrB_2 and C particles

M.T. Abou El-khair, A. Daoud

An attempt has been made to investigate the microstructures and wear behavior of magnesium alloy reinforced with 7 vol. % of ZrB_2, C or hybrid of ZrB_2 and C particles. Optical microscopy, scanning electron microscopy and X-ray differactometer were used to study the microstructures of the composites.

Ultra-high-temperature nanocrystalline tantalum-hafnium and tantalum - zirconium mixed carbides

N. Kuznetsov, N. Ignatov, E. Simonenko, V. Sevastyanov, Yu. Ezhov

Aim of the research: low-temperature synthesis of nano-sized tantalum-hafnium and tantalum-zirconium mixed carbides (Ta_4HfC_5 and Ta_4ZrC_5) via sol-gel technique for advanced application as a part of ultra-high-temperature ceramic-matrix composites (UHT CMC).

Magnetic properties of Fe/$BaO_6Fe_2O_3$ nano-composite synthesized via mechanical alloying

A. Ataie

$BaO_6Fe_2O_3$ and Fe particles were mechanically alloyed. Effects of milling time and subsequent heat treatment were investigated. The results indicated that magnetic composite with enhanced magnetic properties, formed based on Fe phase while barium hexaferrite particles embedded within Fe particles.

Preparation of compositions containing heteropolycompounds in oxide matrices

V. Sydorchuk, S. Khalameida, J. Skubiszewska-Zieba, R. Leboda, V. Zazhigalov • Samples with 5-20% w/w of heteropolycompounds in oxide matrices prepared via sol-gel and mechanochemical methods possess micro-mesoporous or meso-macroporous structure. Compositions retain of Keggin-structure up to 500°C. They were proved as photocatalysts for degradation of days.

$CuO{\bullet}SiO_2$ oxide composites - synthesis, properties and applications

A. Modrzejewska-Sikorska, T. Jesionowski

The main aim of the study was to obtain inorganic blue pigment, the synthetic oxide composite $CuO{\bullet}SiO_2$, of a high degree of dispersion. The $CuO{\bullet}SiO_2$ oxide composite obtained was found to have satisfactory parameters, high refinement of particles (122-295 nm), large specific surface BET area of 417 m^2/g.

Investigation on bond behavior of glass multi-filaments yarn embedded in cementitious matrix

H. Aljewifi, X. B. Zhang

This paper will give a review investigation on fragile matrix reinforced by glass multi-filaments yarn. Mechanical behaviour depends on interface characteristics as though fiber-matrix. By Finite Element Method, a model will be simplify all complexes assuming along fiber / matrix interface.

Mechanically alloyed composite materials on the basis of aluminium alloys strengthened by oxides

M. Samoshina, A. Aksenov, P. Bryantsev

One of effective methods of introduction of disperse strengthening particles in a composite material can be their synthesizing during mechanical alloying. The influence of the magnesium amount on kinetics of oxidations of Al-Mg alloys during milling in controlled air atmosphere is investigated.

Mechanical properties of an amorphous alloy with nano-composite structure

A. Seifoddini, S. Heshmati-Manesh, M. Nili Ahmadabadi

A FeCoCrMoCBY alloy was suction cast in a water-cooled copper mold. Precipitation of nano sized particles occured during further annealing and thus a nano-structured composite was formed. Mechanical properties of the alloy were evaluated based on precipitates characteristics.

Antifrictional high temperature composite coating on basis SiC

V. E. Nizovtsev, B. Myktybekov, M. Zh. Zhumabayev, D. A. Klimov

CIAM conducts development of the technology producing for ceramic materials and coatings with antifriction, high temperature and antiwear properties ceramics and composition materials were created on the basis of dispersion-strengthened carbide, carbonitride and boride compounding with nanostructure.

Microstructural features and tensile behavior of Al-Mg-Si matrix nanocomposites produced by reactive mechanical alloying and hot extrusion

H. Asgharzadeh, A. Simchi

Nanostructured Al6063 matrix nanocomposites were synthesized by reactive mechanical alloying in Ar-O_2 atmosphere and hot extrusion. Al_2O_3 nanoparticles (~90 nm) were uniformly distributed in the Al matrix (~300 nm). Significant enhancement in the strength of the Al alloy was thus achieved.

Synthesis of nanosized zirconia – hafnia – yttria with optimized composition as component parts of high-temperature ceramic matrix composites (CMCs)

V. Sevastyanov, E. Simonenko, N. Simonenko, N. Kuznetsov • The goals of this work include the synthesis of stabilized nanosized oxides of optimized composition in the ZrO_2 – HfO_2 – Y_2O_3 system with the use of hydrolytically active solution of the corresponding alkoxoacetylacetonates, their certification and testing as components of high-temperature CMCs.

The influence of the metal component on the mechanical properties of the Al_2O_3+Al ceramics

A. Kaygorodov, S. Paranin, V. Khrustov, R. Nevmyvako, V. Loznykho • The combination of contents of the mixture (commercial Al_2O_3 and nanosized aluminium, obtained by the electrical explosion of the wires method) and the optimized synthesis regimes allowed us to obtain Al_2O_3+Al composite ceramics with submicron structure and high mechanical properties.

Development and characterization of novel metallic joint and heat sink for power electronic device

G. Lacombe, J.M. Heintz, J.F. Silvain

The development of new heat sink materials and novel metallic joints, in between DBC and heat sink, is a major challenge for high power electronic industries. Processing of a) Cu/C metal matrix composite heat sink and b) direct report using thin metal coating (tin, gold) are reported in this work.

Structural and mechanical properties of cement-bonded bauxite refractories in correlation with their production conditions and materials characteristics

I.D. Katsavou, M. Krokida, I. Ziomas

Density, porosity, shrinkage and compressive strength of bauxite specimens were investigated. Different grain size, water content, molding pressure and firing temperature were selected. Simple mathematical models were used to correlate the examined properties as functions of production conditions.

Dielectric and functional properties of polymer matrix/ZnO/$BaTiO_3$ hybrid composites

A. Patsidis, G. Ioannou, G.C. Psarras

Polymer composites incorporating ferro/piezo-electric crystal particles represent a novel class of materials.
Epoxy resin/ZnO/$BaTiO_3$ composites were prepared varying the filler concentration. Their dielectric response and functionality was studied via Broadband Dielectric Spectroscopy.

Binary inclusion complexes of gamma-cyclodextrin and polyesters: Synthesis and characterization

L. Carrasco, L. Gargallo, L.H. Tagle, D. Radic

The synthesis of binary inclusion complexes containing different polyesters, polythiocarbonates and e-caprolactone with gamma-cyclodextrin are reported. WAXD and thermal analysis showed different types of crystalline structures which are characteristics for gamma-CD indicating inclusion complex formation.

Theoretical and practical considerations of the effects of minor amounts of thermotropic liquid crystal polymer on the mechanical properties of polyethylene

I. Elksnite, I. Bochkov, J. Zicans, M. Kalnins, R. Maksimov • Polyethylene (PE)/liquid crystal polymer (LCP) blends are investigated. It is shown, that introduction of LCP in the PE matrix leads to the increase of mechanical and barrier properties of the composite. Besides it is theoretically proven that self-reinforcement of the blends have been achieved.

Modification of the electrical properties of PP and TPU by modified expanded graphites (EGs)

J. Pionteck, F. Piana, U. Schulze, M. Omastová

We analyzed the influence of EG on the conductivity of PP and TPU. The composites were prepared by melt compounding, from solution, or by in-situ polymerization. We discuss the influence of the preparation conditions on the morphologies, the percolation concentrations, and conductivities.

Elastic and strength properties of thermoplastic materials randomly reinforced by short carbon fibers

I.A. Rashkovan, Yu. G. Korabel'nikov, M. Kazakov

The randomly short fiber reinforced polymer composites are considered as the two-phase system, consisting of oriented strengthening fibers and matrix with inert filler. The two-stage fracture mechanism has been proposed to predict elastic-strength properties of composite.

Multihybrids project

A. Terenzi, D. Tabuani, J.M. Kenny, G. Camino

The main results of MULTIHYBRIDS FP6 project will be presented. The overall aim of this project is to develop an innovative processing technology for the preparation of advanced specialty multifunctional nanomaterials based on industrially important new polymer hybrids and nanocomposites.

High speed rheology of polymer melts in slit die mould

A. Szűcs, B. Károly, N. Schott

The main object of our research was to develop a new measuring technique for determination of viscosity of polymer melts. A special mould was designed for the measurements. It was found that there was not significantly different in measured flow curves compared to traditional capillary rheometer.

Synthesis and properties of novel asymmetric addition-type imide resins based on Kapton®-type structure

M. Miyauchi, Y. Ishida, T. Ogawasara, R, Yokota

Novel additive-type polyimide were synthesized. The oligomers were successfully converted to cross-linked structures after curing at 370°C. The thermal and rheological properties of cured resins were investigated by FT-IR, DSC, TGA and DMA measurement(T_g and ε_b(%) were found to be 360°C and >15%).

Fire retardancy of ammonium polyphosphate protected wood plastic composites

H. Seefeldt, A. Hofmann, U. Braun

The combination of a wood plastic composite and ammonium polyphosphate as a flame retardant was investigated by the use of thermogravimetry coupled with a Fourier transform infrared spectrometer and the cone calorimeter to study the thermal decomposition and the combustion behaviour of the material.

Physico-chemical characteristics of filled composites based on thermoplastic polymers

L.V. Ganina, Yu. B. Kalmykov, E.N. Macarova, Yu. M. Mikhailov

The thermo dynamical, mechanical and flow properties of plasticized thermoplastic polymeric binders and their filled composites we studied. Polymers consisted from blocks of divynil and methylstyrene or polyester and diisocyanate. The phtalate derivatives were used as plasticizers.

3D computational hierarchical model of wood: from microfibrils to annual rings

H. Qing, L. Mishnaevsky Jr.

Based on the structures of wood at several scale levels, a 3D hierarchical numerical-analytical model is developed, and the influence of microfibril angle, the shape of the cell and the wood density on the elastic properties is studied. Good agreement can be obtained compared with experimental data.

Some equation of cylindrical bodies

M. Zh. Zhumabayev, B. Myktybekov

The equations concerning radial and axial components of transference for obtained. They will be used in devising numerical-analytical method of task solution of tension-deformed condition of ortotropic, transversal-isotropic and isotropic cylinders.

Novel method to localize carbon nanotubes on polymer surface

M. Yamaguchi

Novel localization method of multi-walled carbon nanotubes (CNTs) on the surface of a polymer sheet was demonstrated using interphase CNT transfer from one polymer to another. Consequently, a conductive sheet is obtained with significantly small amounts of CNTs.

Lightweight of the twist beam rear axle in using composites materials

M. Chauvin, B. Lascoup

The aim of this study is to use materials composites in twist beam rear axle to realize this lightweight. We have realized the dimensioning and the making of this part in materials composites which we have permitted to win a mass gain over 50 percent.

Comparison of long term creep behaviour of PP and its glass fibre reinforced composite

P. Bakonyi, L.M. Vas, P. Nagy

In this paper results of creep tests of a PP and its glass fibre reinforced composites are compared and the differences are analysed. The creep behaviour of the materials is estimated by using the parameters of nonlinear variable transformations, which are compared to the usually used methods.

Synthesis, characterization and thermal and morphologic properties of soluble-polypyrrole/sodium-bentonite nanocomposites

M. Talu, E. Demirta, E. Uzluk

In this study, Polypyrrole/Na-bentonite composites were synthesized by oxidative polymerization of pyrrole containing dispersed Na-bentonite. By changing solvents and the concentration of pyrrole several polymer–clay nanocomposites were prepared. thermogravimetric analysis.

Adaptive neuro-fuzzy inference system in modelling damping behaviour of epoxy concrete

B. Raman

Polymer concrete materials have been seen as a replacement material for machine tool structures. Damping of epoxy concrete is evaluated in relation to its composition. Developed ANFIS model has appeared very effective in modeling damping behavior of epoxy concrete.

Theory of NMR line shape for polymeric composite systems

T.P. Kulagina, G.E. Karnaukch, L.P. Smirnov, P.S. Manikin

The theory of line shape of solid state NMR for polymeric composite systems is offered. Methods of detection of the crystallinity degree on experimental signals of spectra NMR are developed on the base of the theory. Good agreement between the theory and the experimental data of chitosan was shown.

Numerical simulations of embedded FBG sensors system behaviour near to damaged zones

D. Sans, J.A. Mayugo, M. Frövel, C. Gutiérrez

Simulation of spectral response of embedded FBG sensors and relate these responses to different damage types that appear by being simulated with numerical damage models. Depending on the damage mode the spectral response shows a characteristic shape that can be easily related to each damage mode.

Variable sampling homogenisation technique applied to a statistical analysis of variability transport in heterogeneous media: the mechanical behaviour of a ply in a laminate composite

P. Pineau, F. Dau

This work presents a multi-scale approach to analyse the variability of the behaviour of a ply in a laminate composite material due to variability at micro scale. The variability of the virtual plies mechanical properties are computed in a FEA considering the variability at the micro scale.

Numerical FEM analysis of aviation load carrying capacity structure constructed from composite materials

H. Debski

The paper presents numerical analysis thin walled structure with composites load carrying capacity of elements (rotor blade). Numerical calculation was made as a part of introduction to failure analysis composite materials according to Tsai-Hill's, Tsai-Wu and Azzi-Tsai-Hill's criterion.

Evaluation of glass fiber/epoxy interfacial failure criterion by the cruciform specimen method

A. Kashima, Y. Igarashi, K. Kato, T. Ueno, J. Kawai, J. Koyanagi, S. Kobayashi, S. Ogihara • The relation between the interfacial tensile stress and the interfacial shear stress at debonding initiation in a GF/epoxy model composite is examined. The initiation and propagation of interfacial debonding are experimentally clarified. Finite elament analysis is also conducted.

On the influence of the steady self-heating on natural vibrations of GFRP laminate rectangular plates

A. Katunin

This work presents results of theoretical modelling of temperature distribution caused by hysteretic energy dissipation in GFRP laminate rectangular plates and its influence on natural vibrations, in particular on its eigenmodes and eigenfrequencies.

Practical results for homogenization of CMO based on Hill lemma

R. Chermaneanu, F. Dau, L. Guillaumat

The general objective of this work is to rebuild randomly and physically reasonable the meso scale of a composite material and the prediction of its mechanical properties by taking into account the variability sources introduced at the elementary components scale.

Fast curing and toughened epoxy resin systems for automotive applications

A. Schmidt, M. Döring, U. Arnold, M. Henningsen, J. Krämer, V. Altstädt • A new type of latent accelerators based on ionic liquids was developed which show almost no cure at room temperature but a rapid reaction at elevated temperatures. These resins need to be toughened for automotive applications while retaining high glass transition temperatures and curing rate.

Experimental investigation of the structural behaviour of hybrid metal/composite thin walled box beams

G. Belingardi, A. Scattina

The aim of this work is the study of the structural behaviour of hybrid box beams by means of a series of experimental tests (e.g. bending test). The examined cross section are made in a hybrid way using steel for one part and fibre reinforced composite material for another part of the same beam.

Joints of power parts manufactured from composite materials, construction and technology to ensure their efficiency

D. Khominich

The analysis of constructive and technological solutions of joints of power parts of CM was carried out. Was conducted FEM analysis of most suitable bolted joints. As a result, the variant of constructive and technological updates for joints of power parts was proposed.

Design and manufacturing of composite load introductions

T. Havar

This paper focuses on the design philosophy of innovative composite load introduction structures for aircraft high lift devices. In a joint project the load introduction of composite high lift elements are investigated in detail and design principles for composite lugs and bearings are developed.

Reinforced thermoplastic elastomer with kenaf bast fibre for automotive component

H. Anuar, S.N. Surip

This paper compared mechanical properties of kenaf fibre (KF) composites in different matrix systems namely; TPNR based PP and PP/EPDM. It is suggested PP/EPDM with kenaf fibre has a potential to be applied as automotive component particularly where impact absorption is crucially important.

Experimental and numerical study of the energy absorption of composite tubes for sacrificial cladding structures under blast loading

S. Palanivelu, W. Van Paepegem, J. Degrieck, B. Reymen, J. Nadambi, J. Vantomme, D. Kakogiannis, J. Van Ackeren, D. Van Hemelrijck, J. Wastiels

This study deals about a close-range blast loading on cylindrical pultruded glass polyester composite tubes. The crushing performance and the corresponding deformation patterns of these composite tubes were studied in detail.

Advanced thermal barrier coatings for industrial gas turbine engines

B. Myktybekov

Thermal barrier coating ceramic top-coats made from Y_2O_3-stabilized ZrO_2 (YSZ) have been used successfully in GTE applications for more than 30 years.YSZ with new structure, for perspective GTE,possess low coefficient of heat conductivity and high working temperature in comparison with analogues.

Database filtration for the selection of components of multi-materials

S. Giaccobi, F.X. Kromm, H. Wargnier, M. Danis

This paper describes methods to deal with database filtration in the case of multi-materials design. The classical filtration in single material selection is extended to cases with several geometric parameters and to multi-materials design with undefined number of components and geometric parameters.

Hemp fiber reinforced castor oil-based polyurethane biocomposites

J. Park, N. Lee

Polycaprolactone was mixed with castor oil to control the mechanical properties of polyurethane film. Hemp fiber reinforced was reacted with MDI (4,4-Diphenyl Diisocyanate) to improve interfacial adhesion with matrix. The fractured surface of the composite was examined by FE-SEM.

Functionalization of wood by-products and their application in polymer composites

G. Shulga, B. Neiberte, A. Verovkins, M. Laka, S. Chernayvsaya, V. Shapovalov, A. Valenkov, M. Tavroginskaya • The functionalized lignocellulosic by-products and modified technical lignins were used as a filler to obtain wood-polypropylene composites. It is found that modified lignins and lignocellulosic products significantly improves the physico-mechanical properties of the composite materials.

The wetting properties and topography of bamboo fibres (Guadua angustifolia)

C.A. Fuentes, L.Q. Tran, C. Dupont-Gillain, W. Vanderlinden, A.W. Van Vuure, I. Verpoest

The wetting behaviour bamboo fibres is characterized through the Wilhelmy technique; surface topography is examined by AFM and surface chemical components are identified using XPS. Additionally, the molecular-kinetic theory of wetting was used to interpret the dynamic contact angle experimental data.

Composites of cellulose acetate with short fiber of curauá

M.I. Felisberti, M-A De Paoli, M. Chavez

Composites of cellulose acetate with pristine short curauá fibers and fibers subjected to extraction with acetone or NaOH solutions were prepared by extrusion. SEM showed no significant fibrillation of untreated fibers. Fibrillation as well as better mechanical properties was observed after extraction.

Wool keratin-based composite materials

L. Conzatti, F. Giunco, P. Stagnaro, A. Aluigi, A. Patrucco, E. Marsano, C. Marano, M. Rink

PP-based composites were prepared by adding increasing amounts of keratin fibres obtained from wool. PPs grafted with different amounts of maleic anhydride were used as compatibilizers. Morphology, thermal and mechanical properties of the composites were investigated.

Impact fracture behaviour of biomass ash thermoplastic composites

S.G. Pardo, C. Bernal, M.J. Abad, J. Cano, J. Aurrekoetxea, A. Agirregomezkorta

Impact fracture behaviour of PP/ash composites with ash was studied. The impact fracture toughness was studied too. The effect of a silane treatment on ash particles and the introduction of an olefin-block copolymer (OBC) in the composites formulation on the fracture behaviour were also analysed.

Biodegradable poly(L-lactide)/polyhedral oligomeric silsesquioxanes nanocomposites: enhanced crystallization, mechanical properties and hydrolytic degradation

Z. Qiu • Biodegradable PLLA/POSS nanocomposites were prepared. POSS were nicely dispersed in the PLLA matrix. The overall crystallization rate, the storage modulus and the hydrolytic degradation rate of PLLA have been enhanced obviously in the PLLA/POSS nanocomposites with respect to neat PLLA.

Modification of interfacial interactions in wood flour filled PLA composite

G. Faludi, A. Sudár, K. Renner, J. Móczó, B. Pukánszky

Recently the interest in PLA increased enormously for various reasons. One of its main applications is its use in natural fiber reinforced composites as matrix polymer. In our study the filler was characterized by several techniques. Interfacial adhesion was modified by various coupling strategies.

Migration and leaching of the plasticizer from plasticized poly(L-lactide)/olive stone flour composites

S. Perinovic, B. Andricic, T. Kovacic

Migration and leaching of plasticizer molecules from polymers is a critical issue that determines material's usable lifetime. In this work PLLA was blended with various amounts of TBAC as a plasticizer and OSF as a filler. Stability of these composites was analyzed.

Composite films based on polymeric matrices and cellulose fibers

M. Pereda, I. Rácz, N.E. Marcovich

The goal of this work is to produce and characterize fully biodegradable composite films using sodium caseinate as polymeric matrix and microcrystalline cellulose as reinforcement. The intended use of material is packaging, especially in the food industry.

Water uptake of cellulose reinforced polypropylene matrix composites

C. Burgstaller, W. Stadlbauer

This work investigates the water absorption mechanisms in polymer matrix composites reinforced with wood particles and cellulose fibres in regard to composite morphology. Influences like the geometry and the share of the reinforcement are evaluated with a mathematical model.

Preparation and characterization of starch/biodegradable polymer/clay nanocomposites

J. Abbot, K. Doty, Z.Y. Al-Saigh

Six nanocomposites containing starch/polymers/clay were prepared and characterized using DSC, TGA, and Tensile strength. All appeared flaky, brittle in appearance and showed no stiffness properties. The tensile strength of all six clay nanocomposites ranged from 0.36-0.87 N.

Structure of biodegradable polymer matrix/organomontmorillonite composites

M. Gazinska, A. Kiersnowski, K. Szustakiewicz, J. Piglowski

This contribution reports research on polymer/organomontmorillonite nanocomposites based on biodegradable physical blends and copolyesters of poly(butylene terephthalate) (PBT) and poly(tetramethylene succinate) (PTMS) or poly(e-caprolactone) (PCL).

Investigation of structure and mechanical properties of poly(vinyl alcohol) and poly(vinyl acetate) blend films

N. Jelinska, M. Kalnins, V. Tupureina, A. Dzene

PVA/PVAc films with broad range of tensile strength-deformation characteristics: elastic modulus: 0,3 – 2,2 GPa, maximum stress: 9 – 106 MPa, yield stress: 8 – 73 MPa, ultimate stress: 11 - 42 MPa, elongation at break: 0,32 – 2,07 can be obtained by variation of component ratio in mixture.

Characterisation of the transverse thermoelastic properties of natural fibres used in composites

F. Gentles, J. Anderson, J. Thomason

An understanding of the thermoelastic properties of natural fibres is important for defining their performance in potential composite applications. The thermoelastic properties of the sisal and flax where determined through a combination of experimental measurements and micromechanical modelling.

Wetting behaviour and surface characteristics of coconut (coir) fibres used as reinforcement for composites

L.Q.N. Tran, C.A. Fuentes, C. Dupont, A.W. Van Vuure, I. Verpoest

The surface energy of Vietnamese coconut fibre is calculated using Owens/Wendt theory, surface chemistry studied by XPS, and wetting is investigated by measuring contact angles. The results indicate that coconut fibre does not seem to be very hydrophilic in comparison with other natural fibres.

Chitosan-modified clay and its application in coatings

J. Nantana, R. Wanchalerm

CMC was used in water-based coatings.The XRD profiles of CMC showed exfoliated structure. Physical properties and antibacterial ability of the film were studied.The results showed the excellent in hardness and antibacteria of the film at 4 phr of CMC-coating film provided the best bacteria reduction.

Mechanical properties and micromechanics of nano fibrillated cellulose sheets

S. Tanpichai, W.W. Sampson, S.J. Eichhorn

Cellulose nanofibrils can be separated from cellulose fibres using chemical or mechanical treatments. In this work, lyocell fibres were fibrillated using a homogeniser with different times to make fibrillated lyocell sheets. The physical and mechanical properties of the nanofibres were investigated.

Material properties of PDMS elastomers stored in simulated skin secretions

P.N. Eleni, M. Krokida, G. Polyzois

Facial prostheses deteriorate in a service environment primary due to exposition to various environmental factors, including sebaceous oils (sebum) and perspiration. This study investigated physical properties of 3 PDMS, after immersion for 6 months in simulated sebum and perspiration at 37°C.

Biofilm formation on silicone nanocomposites containing various antimicrobial agents

S. Atarijabarzadeh, E. Strömberg, S. Karlsson

Biofilm formation on antimicrobial silicone nanocomposites In this study, antimicrobial silicone nanocomposites were prepared with different antimicrobial agents and clay nanoparticles. The materials were analysed for changes in the different properties before and after biological growth test.

An experimental and 3-D numerical investigation of the Wallis interspinus implant

S.P. Zaoutsos, V. Iakovakis

The wallis device is an interspinous implant that is used for dynamic lumbar stabilization. In the current study, a numerical analysis of the wallis is presented and its response under this loading is investigated. The results are encouraging in the use of wallis in the proposed biomedical application.

Cyclodextrine containing composite materials for removal of xenobiotics from cleaned water

E. Andersen, I. Rácz, É. Fenyvesi, L. Szente

Human body is continuously exposed to endocrine disrupting, reprotoxic, mutagenic agents, primarily to residues of pharmaceuticals and pesticides through surface- and ground water as well as drinking water. More and more efforts are made to eliminate them from drinking water.

Biodegradable thermoplastic starch and carbon nanotubes composites

L. Famá, V. Pettarin, S. Goyanes, C. Bernal

In this work, novel nanocomposites based in tapioca starch polymer reinforced with multi-walled carbon nanotubes (MWCNTs) were developed. An aqueous solution of starch-iodine complex was used to wrap the filler before adding it to the polymer.

Biomimetic composites on the basis of interpenetrating polymer networks with copper ions

G.A. Bektenova, N.S. Chinibayeva

Biomimetic systems imitating the enzyme catalases on the basis of complexes of interpenetrating polymer networks of agar-agar and polyacrylic acid and polyethyleneimine with the chlorides of copper (II) have been obtained and their catalytic activity have been studied.

Thermal analysis of sisal/polyurethane based castor oil composites

A.C. Milanese, M.O.H. Cioffi, H.J.C. Voorwald

Natural fibers as reinforcing polymers composites are being considered to application as reinforcement of timber structures improvement. Polymers composites reinforced with sisal and glass woven fabrics were characterized by thermogravimetric analysis-TG/DTG and differential scanning calorimetry-DSC.

Anti-microbial and anti-oxidant conducting polymer composites

A.J. Easteal, R.P. Cooney, S. Ray, M. Gizdavic-Nikolaidis

A composites technology is presented based on thermoplastics combined with polyaniline-related polymers that have antimicrobial, antiviral, antifungal and antioxidant properties. The bioactive polymers are insoluble in water, stable to 250-300°C, and support the growth of mammalian cells.

Thermo-mechanical properties of glass-reinforced epoxy matrix composites

M. Worzakowska

This work describes the possibility of utilization of glass wastes e.g. soda-lime glass powder obtained by milling of glass window scrap as fillers using for production of epoxy matrix composites based on unsaturated (epoxy) polyesters useful for different applications.

Technological aspects for obtaining of mineral fillers for polymer composites from waste phosphogypsum

Y.G. Denev, B.I. Bogdanov, G.D. Denev, A.N. Popov • The phosphogypsum is a solid by-product from the wet phosphoric acid production process. The conversion of phosphogypsum from waste in effective bright mineral filler is one of the options for its utilization. Through minor technological costs it can become effective filler polymer materials.

Effects of silane coating on the properties of glass fibre and glass fibre reinforced epoxy resin

S.P. Reilly, J. Thomason

Single fibre tensile testing and microbond testing were used to benchmark the influence of silane coupling agents on the performance of glass fibre for reinforced epoxy resin composites. This poster will focus on the fibre surface sizing and on the critical role of the silane used in these sizings.

Recycling of automotive plastic waste with glass fibre reinforcing

F. Ronkay

A promising solution for the polymer waste-problem can be the transformation of waste to materials for engineering purposes, as modified composites or blends. This can be the way which provides a quality increase instead of the quality deterioration (down-cycling) experienced in recycling.

Synthesis and characterization of polymer composite from modified waste pulp and polyoxalate

T. Oishi, K. Yamabuki, K. Onimura

Waste pulp, which is one of the biomass resources, was modified with saturated fatty acid to obtain the esterificated waste pulps (EPs). The blended films were prepared from EPs and polyoxalate (POX). The physical and mechanical properties and biodegradability of the blended films were studied.

Boron nitride coatings on polypropylene surfaces by atmospheric pressure plasma torch treatment

N. Encinas, J. Abenojar, M. Pantoja, M.A. Martínez

The aim of this work is the achievement of a ceramic coating onto a polypropylene surface to improve wear using a pressure plasma device prior to its coating with a mixture of a natural adhesive and BN powder. Surface characterization will be done by contact angle measurements, SEM, FTIR-ATR or TGA.

Composite materials based on polyolefins wastes

S. Patachia, A. Moldovan, R. Buican, C. Vasile, R. Darie, M. Tierean

Polyolefins wastes have been characterized aiming to use them as matrix for composite materials with different types of fibres as fillers. The results of this analysis could offer information about potential applications of these composite materials, and also a recycling solution for polyolefins wastes.

Recycled PP/wood composites adhesion and micromechanical deformations

A. Sudár, K. Renner, C. Burgstaller, G. Faludi, B. Pukánszky

Recycled car bumper material reinforced with wood fibers could open up new possibilities for the automotive industry. Since this system consists of at least four components the investigation of the effect of composition on composite structure and properties is essential.

Corn cob filled PVC composites: interfacial interactions and micromechanical deformations

Cs. Kenyó, J. Móczó, K. Renner, B. Pukánszky

The goal of this study was to obtain information about deformation behavior of corn cob filled PVC composites. Micromechanical deformations were studied with acoustic emission and volume strain measurements and an attempt was made to identify the main process causing the failure of the composites.

Interphases and matrices

Dynamic mechanical thermal properties of polypropylene/mica composites with modified inter-phase by a novel p-phenylen-bis maleamic grafted atactic polypropylene as interfacial agent

J.M. García-Martínez, E.P. Collar

This work shows the great improve in the dynamic mechanical behaviour of polypropylene/mica composites caused by a novel interfacial modifier (obtained from industrial wastes) consisting in an atactic polypropylene with 15% ($5 \cdot 10^{-4}$ mol/g) of p-phenylen-bis-maleamic acic grafted groups (aPP-pPBM).

Interfacial adhesion, micromechanical deformations and performance in PLA/$CaSO_4$ composites

B. Imre, K. Molnár, J. Móczó, M. Murariu, P. Dubois, B. Pukánszky

Composites were prepared from poly(lactic acid) and a calcium sulphate filler to study the developed structure and the interactions. Good mechanical properties were achieved with the uncoated filler, but surface modification with stearic acid resulted in a drastic change of deformation behavior.

Surface modification of white fillers and its influence on tensile behaviour of rubber/filler compounds

V. Frýželka, M. Betík, J. Malác

Modification of white fillers is a common procedure used to increase rubber/filler interactions and improve performance of rubber compounds. In our work it is shown that modification of filler's surface by dimethyl sulphone improves tensile and vulcanization characteristics of rubber samples.

Wettability and modification of cellulosic fibers with organosilanes for reinforced phenolic composites

E. Rojo, M.V. Alonso, J.C. Domínguez, M. Oliet, F. Rodríguez

The wettability properties of 3 thermosetting phenolic matrices and viscose cellulosic fibers coming from eucalyptus wood have been investigated. The surface modification of these fibers was carried out using organosilanes as coupling agents for the subsequent production of composite materials.

Interfaces and interphases in PP/layered silicate composites

J. Hári, Z. Dominkovics, K. Renner, E. Fekete, B. Pukánszky

The aim of the present research was to study interaction/structure/property correlations in PP/OMMT, PP/MAPP/OMMT and PP/NaMMT composites. We used OMMT and NaMMT fillers with different particle size and size distribution for the preparation of composites with varying compositions.

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