BOOK OF ABSTRACTS

CCFA 8

The 8th International Conference on Composites: Characterization, Fabrication and Application

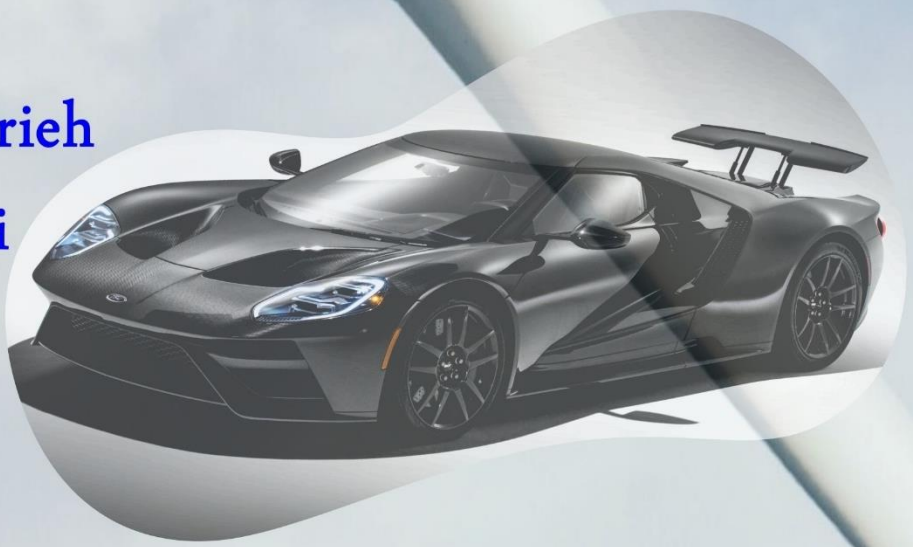
December 20-21, 2022

Iran University of Science and Technology, Tehran, Iran

Co-chairs:

M. M. Shokrieh

A. Zeinedini



In The Name Of Allah

The 8th International Conference on Composites: Characterization, Fabrication and Application

CCFA8

The 8th International Conference on Composites: Characterization, Fabrication and Application (CCFA-8)

20-21 Dec. 2022

School of Mechanical Engineering

Iran University of Science and Technology

Tehran, Iran

Iran University of Science and Technology

Islamic Azad University, Kermanshah Branch

Kermanshah University of Technology

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Iran Composites Scientific Association

Preface

The ***eighth International Conference on Composites: Characterization, Fabrication, and Application (CCFA-8)*** was held on December Dec. 20-21, 2022 in Tehran-Iran and successfully brought together both engineers and researchers of the field to review and discuss the recent practical and theoretical methods/approaches to address composite characteristics and manufacturing processes. The conference focused on the state-of-the-art in material science and mechanics of composites and nanocomposites. The present conference (CCFA-8) was organized with the cooperation of the Iran University of Science and Technology, Islamic Azad University Kermanshah Branch, and Kermanshah University of Technology.

Applications of composites are progressively growing in various industries. The extensive use of engineering composites over a such range of applications, plus the cost involved with manufacturing processes, has resulted in an increasing awareness of the importance of research in composite materials. Different applications of composites expose them to different environments and service conditions. Each service condition dictates several technical requirements and questions, which might be answered by engineers. All these complexities change the science and technology of composites revolutionarily. New methods of design, manufacturing and material characterization of composites are needed to enable us to find new reliable solutions for new questions.

Of about 100 submissions, the present proceedings present two-page extended abstracts accepted in *CCFA-8*. This book includes different subjects of Microstructures, Physical and Mechanical Properties, Deformation, Deflection and Damage, Creep, Thermal Effect and Properties, Buckling and Plate Deformation Theory, Vibrational Analysis, Dynamic Response, Concrete, Modeling, Simulation, Optimization, Fatigue and Fracture, Nanocomposites, Impact, Environment, Recycle and Waste, Numerical Analysis, Design and Fabrication, and Composite Applications.

The Organizing Committee of *CCFA-8* wishes to thank the members of the international and national advisory committees for their great involvement in reviewing papers. Many thanks go to the national and private sectors for their support. Support through Islamic World Science Citation Center (ISC) and Regional Information Center for Science and Technology (RICeST) is highly appreciated.

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The 8th International Conference on Composites: Characterization, Fabrication and Application

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8th International Conference on Composites: Characterization, Fabrication and Application (CCFA-8)

December 20-21, 2022, Iran University of Science and Technology, Tehran, Iran

Final Program

December 20, 2022					
09:00-09:15	**Opening Talk:**	**Prof. M.M. Shokrieh**			
09:15-10:00	**Keynote Speaker:**	**Dr. E. Ghavanloo,** *School of Mechanical Engineering, Shiraz University, Shiraz, Iran* Mechanics of Fullerene and Fullerene Reinforced Nanocomposites			
10:00-10:45	**Keynote Speaker:**	**Dr. Mohammad Heidari-Rarani,** *Department of Mechanical Engineering, University of Isfahan, Isfahan, Iran* The recent research activities of the composites research group at the University of Isfahan			
Sessions	**Room 1**		**Room 2**	**Room 3**	**Room 4**
10:45-12:15	Oral Presentations		Oral Presentations	Oral Presentations	Oral Presentations
12:15-14:00	**Break**				
14:00-17:00	Oral Presentations		Oral Presentations	Oral Presentations	Oral Presentations
	Main Room				
17:00-18:00	**Workshop:**	**Mr. Shahsavari** Analysis and optimization of stacking sequence of thin-walled composite pressure vessel - Part I			
December 21, 2022					
Sessions	**Room 1**		**Room 2**	**Room 3**	**Room 4**
09:00-12:00	Oral Presentations		Oral Presentations	Oral Presentations	Oral Presentations
12:00-14:00	**Break**				
14:00-16:30	Oral Presentations		Oral Presentations	Oral Presentations	Oral Presentations
	Main Room				
16:30-17:00	**Closing Talk:**	**Dr. A. Zeinedini**			
17:00-18:00	**Workshop:**	**Mr. Shahsavari** Analysis and optimization of stacking sequence of thin-walled composite pressure vessel - Part II			

Room 1 (December 20, 2022)		
Session Chairs: Dr. Safarabadi		
10:45-11:15	A-10-1764-1	**Composite lithium-ion battery panels to be used as electric and hybrid car bodies** **Gorji, P.**, Haghighi-Yazdi, M., and Ghahramani, M. *University of Tehran*
11:15-11:45	A-10-1777-1	**Iron and Magnesium Nanoparticles Adorned on Mesoporous Zeolites: Investigation of Nanocomposite Catalytic Properties** **Jafari, F.** ,Ghamari kargar, P. and Bagherzade, G. *University of Birjand*
11:45-12:15	A-10-1787-1	**Effects of Shot-peening on the mechanical properties of extruded Mg/2.5%HA biocomposite** Negahban, A., **Shamsi, M.**, and Sedighi, M. *Iran University of Science and Technology*
Break (12:15-14:00)		
Session Chairs: Dr. Ashrafi		
14:00-14:30	A-10-1791-1	**Effect of interlayer dry area extent and interlaminar delamination on the tensile strength of composite plates manufactured by vacuum infusion process** Sajedi, H., **Hedayati, R.** and Sadighi, M. *Amirkabir University of Technology*
14:30-15:00	A-10-1796-1	**Piezoelectric Effects of Bone Scaffolds of Poly (L-lactic Acid) and Gelatin with Carbon Nanotubes** **Negaresh, H.**, Bahrami, H., Haghbin Nazarpak, M. and Mehrjoo, M. *Amirkabir University of Technology*
15:00-15:30	A-10-1761-1	**An analytical solution for nonlinear static bending of a functionally graded Timoshenko beam** **Mousavi, S.M.H.**, Geshani, M.S., and Eshraghi, I. *University of Tehran*

15:30-16:00	A-10-1791-2	**The effect of the presence of bubbles inside resin on the tensile strength of composites manufactured by vacuum infusion process** Sajedi, H, Sadighi, M., Jafari Khalafloo, K., and **Hedayati, R.** *Amirkabir University of Technology*
16:00-16:30	A-10-1579-30	**Modeling, analysis, and fabrication of a composite propeller of an ultralight aircraft** Rajabi, H., **Nayyeri, A.A.**, Shokrieh, M.M. *Iran University of Science and Technology*
16:30-17:00	A-10-1786-1	**Investigating effect of nanofillers alignment on conductivity of polymer/CNT nanocomposites** Mazaheri, M. and **Payandehpeyman, J.** *Hamedan University of Technology*

Room 2 (December 20, 2022)		
Session Chairs:Dr. Heshmati		
10:45-11:15	A-10-1771-1	**The Effect of Water Immersion Ageing on Low and High-Velocity Impact Behavior of Marine Sandwich Panels with Different Skins** **Najafi, M.**, Alaei, M.H. and Eskandari Jam, J. *Malek Ashtar University of Technology*
11:15-11:45	A-10-1783-1	**The effect of chitosan/silk film loaded with Anti-inflammatory, Antibiotic, and Angiogenic drugs in chronic wound healing** **Mohammadi, F.**, Kazemi, M., Soltani, L., Abbasi, S.H. and Gorgin Karaji, Z. *Kermanshah University of Technology*
11:45-12:15	A-10-1781-2	**In-situ Synthesized nanocomposite Containing Copper/Silver Nanoparticles with Red Cabbage extract** **Pormohammad, E.** , Ghamari kargar, P. and Bagherzade, G. *University of Birjand*
Break (12:15-14:00)		
Session Chairs: Dr. Daneshjoo		
14:00-14:30	A-10-1579-29	**Comparing UAV composite wing stress analysis with one-way and two-way coupled fluid-solid interaction methods** **Nayyeri, A.A.**, Shokrieh, M.M. *Iran University of Science and Technology*
14:30-15:00	A-10-1807-1	**Simulation of mixed-mode I/II delamination growth in laminated composites considering fracture process zone** **Bazzazian, H.**, Daneshjoo, Z. *Shahid Beheshti University*
15:00-15:30	A-10-1579-28	**Fatigue modeling of laminated composites using new strain-based failure criteria** **Mirzaei, A.H.**, Shokrieh, M.M. *Iran University of Science and Technology*
15:30-16:00		**Residual strain measurement of polymeric composite materials using the FBG sensor**

	A-10-1579-31	**Pashaei, R.**, Mirzaei, A.H., Vahedi, M., Shokrieh, M.M. *Iran University of Science and Technology*
16:00-16:30	A-10-1744-3	**Investigating the effect of PVC and nanoclay on impact ability and mechanical properties of polyester nanocomposites** Mirzaei Alavijeh, J. , **Bisheh, A.** , Karevan, M. , Behrooz, R. and Eslami, O. *Isfahan University of Technology*
16:30-17:00	A-10-1770-1	**The influence of annealing heat treatment on the interface evolution of Al 1050/Mg AZ31B bilayer sheet** **Raisie, F.**, Rouzbeh, A., and Sedighi, M. *Iran university of science and technology*

Room 3 (December 20, 2022)		
Session Chairs: Dr. Niknam		
10:45-11:15	A-10-1762-2	**4D printing utilizing bending thermal deformation of 3D printed PLA specimens** **Ansaripour, A.**, Heidari-Rarani, M., Mahshid, R., and Bodaghi, M. *University of Isfahan, Isfahan*
11:15-11:45	A-10-1744-2	**Performance of rotary jet melt spun polypropylene fiber reinforced polyester composites** Safaeinejad, M. , Karevan, M. , Safavi, M. and **Bisheh, A.** *Isfahan University of Technology*
11:45-12:15	A-10-1794-1	**Mechanical response of honeycomb and chiral meta-structures under axial compression loading** **Rahimi-Lenji A.**, Heidari-Rarani M., Mirkhalaf S.M., and Mirkhalaf-Valashani M. *University of Isfahan*
Break (12:15-14:00)		
Session Chairs: Dr. Kazemirad		
14:00-14:30	A-10-1812-1	**The effect of water absorption on the shear properties of glass-Epoxy laminates include woven fabric with different areal density** Tarahomi, M., **Amirian, Y.**, Kiasat, M.S. *Shahid Chamran University of Ahvaz*
14:30-15:00	A-10-1810-1	**Numerical analysis of the face material effect on the bending behavior of honeycomb sandwich structure** **Mollazadeh, Z.**, Zamani, M.R., Barzegari, M.M. *Malek Ashtar University of technology*
15:00-15:30	A-10-1813-1	**Comparison of first-order and higher-order basic theories in calculating critical buckling load of marine sandwich panels** **Orooji, J.** and Kiasat, M.S. *Amirkabir University of Technology*
15:30-16:00	A-10-1780-2	**A proposal for a composite hand cane using the analytical solution and numerical simulation of coaxial orthotropic cylinder** **Obohat, M.A.**, Amirinia, M.S. *Iran University of Science and Technology*

16:00-16:30	A-10-1811-1	**Re-use of thermoplastic polymeric composites reinforced with glass fibers as fillers in the manufacture of epoxy flooring** **Haidari, F.**, Mostafaei, M.A., Hosseini Monazzah, A. *Shahid Beheshti University*
16:30-17:00	A-10-1579-34	**An investigation of the mechanical properties of synthetic leather made of PVC with organic and inorganic pigments** **Zamani, M.**, Shokrieh, M.M., and Rahimian-Koloor, S.M. *Iran University of Science and Technology*

Room 4 (December 20, 2022)		
Session Chairs: Dr. Mosalmani		
10:45-11:15	A-10-1745-3	**Modeling and analysis of thermoplastic composite pipe under tensile loading** **Bahrami, Gh. M.**, Mosalmani, R., Shishesaz, M. *Shahid Chamran University of Ahvaz*
11:15-11:45	A-10-1797-1	**Numerical permeability measurements of a woven fabric preform for different clear-fluid and porous medium interface conditions** **Asiaban, N.**, Tahani, M. and Rouhi, M. *Ferdowsi University of Mashhad*
11:45-12:15	A-10-1579-21	**Effect of woven fabrics harness on the dynamic tensile mechanical properties of woven fabric composites** **Aghaei, M.**, Shokrieh, M.M., and Mosalmani, R. *Iran University of Science and Technology*
Break (12:15-14:00)		
Session Chairs: Dr. Taheri		
14:00-14:30	A-10-1578-2	**Influence of GNPs debonding on mode I fracture toughness of polymeric nanocomposites** **E. Moradi,** M.H. Yas and A. Zeinedini *Razi University*
14:30-15:00	A-10-1579-33	**Analytical modeling of polymer composites reinforced with SMA in creep phenomenon** **Talebi, B.**, Shokrieh, M.M. and Saeedi, A. *Iran University of Science and Technology*
15:00-15:30	A-10-1771-2	**Investigating the Effect of Fiber and Core Type on the Bending and Buckling Behavior of Bio-Based/Green Sandwich Structures** Aminian, F., **Najafi, M.**, and Alijani, A. *Malek Ashtar University of Technology*
15:30-16:00	A-10-1804-2	**Investigation of thermal behavior of epoxy coatings containing surface-modified hollow glass microspheres** **Kiyanara, F.**, Ranjbar, Z., Arabi, A.M., Montazeri, S., Ramezani, M. and Hashemizadeh, M,H. *Institute for Color Science and Technology*

16:00-16:30	A-10-1579-24	**Theoretical prediction of equivalent stiffness of anode and cathode coatings in lithium-ion batteries** **Haghighatfar, Y.**, Taheri, F., and Shokrieh, M.M. *Iran University of Science and Technology*
16:30-17:00	A-10-1579-25	**An overall Analysis of a Composite Sewer Manhole Cover** **Malekpour, F.**, Shokrieh, M.M., Farahifar, S. *Iran University of Science and Technology*

Room 1 (December 21, 2022)		
Session Chairs: Dr. Khoramishad		
09:00-09:30	A-10-1756-1	**The effect of different solvents on the dispersion quality of MWCNT-Fe3O4 hybrid nanofillers in nanocomposites** Fatolahi, A.R., **Ghanbari, Y**., and Khoramishad, H. *Iran University of Science and Technology*
09:30-10:00	A-10-1773-1	**A magnetic nanocomposite based on gelatin-chitosan hydrogel containing Zinc chromite as a novel nanostructure for water treatment** **Sadat, Z.**, Eivazzadeh-Keihan, R., and Maleki, A. *Iran University of Science and Technology*
10:00-10:30	A-10-1782-1	**Surface Functionalization of Di-Nuclear Schiff base with Ag and Ni Nanoparticles as a Novel Bio-nanocomposite** **Mirshekar, A.** Ghamari kargar, P. and Bagherzade, G. *University of Birjand*
10:30-11:00	A-10-1774-2	**Study of a composite thermal fin performance with uncertain parameters** **Eslami, Gh.**, Zeinali, M. *Ahar Branch, Islamic Azad University*
11:00-11:30	A-10-1763-3	**A deep learning approach to estimate the contact force of a fiber metal laminate: a finite element analysis** **Nikzad, M.H.**, Momenzadeh-Kholenjani, A. *University of Isfahan*
11:30-12:00	A-10-1757-1	**Experimental and numerical investigation of the strain energy release rate of composite adhesively bonded joints under mode II loading** **Fatolahi, A.R.**, Khoramishad, H. *Iran University of Science and Technology*
Break (12:00-14:00)		

Session Chairs: Dr. Talebi		
14:00-14:30	A-10-1749-1	**Fabrication and characterization of ZnO quantum dots heterojunction structures for photocatalytic treatment of pharmaceutical wastewater** **Akbari Kohnesari ,A.** , Ebrahimian Pirbazari,A. , Esmaeili Khalil Saraei, F. *University of Tehran*
14:30-15:00	A-10-1739-8	**On the Mixed Mode I/II/III Translaminar Fracture Toughness of E-glass/Epoxy Laminated Composites** **Taghibeigi, H.** and Zeinedini, A. *Islamic Azad University of Kermanshah Branch*
15:00-15:30	A-10-1755-1	**Hydrothermal growth of CuCo2O4 spinel nanoparticles on TiO2 nanosheets for photocatalytic degradation of tetracycline** **Arian Gharehbaba, A.**, Ebrahimian Pirbazari,A. and Esmaeili Khalil Saraei, F. *University of Tehran*
15:30-16:00	A-10-1817-2	**Effect of Friction stir process (FSP) and surface compositing on tribological properties of pure copper** **M. RAZAZI BOROUJENI**, AHMED SABAH KH. A. And A. ABJADI *Islamic Azad University*
16:00-16:30	A-10-1772-2	**Effect of sewing on the strength of foamy core composite sandwich panels** Al-Dresat, W.A.S., and **Akbari, A.** *Kermanshah Branch, Islamic Azad University*

Room 2 (December 21, 2022)		
Session Chairs:Dr. Kazemirad, Dr. Heidari-Rarani		
09:00-09:30	A-10-1763-1	**Effect of nozzle temperature on the mechanical properties of FDM 3D-printed PLA materials** **Nikzad, M.H.**, Heidari-Rarani, M., and Rahmati A. *University of Isfahan*
09:30-10:00	A-10-1744-1	**Effect of Nano/Micro Reinforcement Type on Mechanical and Physical Response of Polyurethane based Micro-nanocomposites** **Bisheh, A.** , Behrooz, R. , and Karevan, M. *Isfahan University of Technology*
10:00-10:30	A-10-1771-3	**Investigating the Effect of Fabric Surface Texture in the Tensile Properties of Hemp/PLA Bio-Composites** Aminian, F., **Najafi, M.**, and Alijani, A. *Malek Ashtar University of Technology*
10:30-11:00	A-10-1579-32	**Detection of delamination damage in cross-ply laminated composites by wave propagation and machine learning, Numerical and experimental investigations** **Ramezani, H.**, Kazemirad, S., Shokrieh, M.M. *Iran University of Science and Technology*
11:00-11:30	A-10-1806-1	**Toughened Biodegradable PLA: Comparison Between the Mechanical Performance of EPDM and PBR** **Rajabifar, N.**, Jalali-arani, A. *Amirkabir University of Technology*
11:30-12:00	A-10-1579-22	**Assessment of the effect of matrix cracking density in GFRPs on the time response of surface-mounted FBG sensors under Lamb wave propagation** **Asadi, F.**, Kazemirad, S., Shokrieh, M.M. *Iran University of Science and Technology*
Break (12:00-14:00)		

Session Chairs: Dr. Daneshjoo, Dr. Safarabadi		
14:00-14:30	A-10-1750-1	**Finding transient angle in tension for unidirectional composites** Safarabadi, M., **Shahrokhi, M.** *University of Tehran*
14:30-15:00	A-10-1746-1	**CeO2 nanocubes@TiO2 core-shell nanocomposite: Synthesis, structural and morphological characterization** **Moradi, M.**, Ebrahimian Pirbazari, A., and Esmaeili Khalil Saraei, F. *University of Tehran*
15:00-15:30	A-10-1753-1	**Glass/Epoxy laminates with Novel Core Layers Under Quasi-Static Indentation: A Comparative Experimental and Numerical Study on Using Chopped Natural and Synthetic Fibers as a Core Layer** **Montazeri, A.** and Safarabadi, M. *University of Tehran*
15:30-16:00	A-10-1754-1	**Prediction of impact and fatigue life behavior of FML by finite element and mathematical simulation** Sedaghat ,A. , Rajabi, H. , **Porkar, J.** *University Islamic Azad of Lahijan*
16:00-16:30	A-10-1753-2	**Damage Mechanism of Glass/Epoxy Laminates with a Novel Core Layer under Quasi-Static Indentation: A Comparative Study on Using Kenaf, Glass, and their Hybrids as Laminate Skins** **Montazeri, A.** and Rahmani, A. and Safarabadi, M. *University of Tehran*

Room 3 (December 21, 2022)		
Session Chairs: Dr. Akbari		
09:00-09:30	A-10-1815-1	**Numerical analysis of vibration behavior of sandwich composite structure with three different types of core** Zamani, M.R., **Zaretabar.M.**, Mohammadi, H. *Malek Ashtar University of Technology*
09:30-10:00	A-10-1776-2	**Investigating the Biological Properties of Metal Nanocomposite Synthesized with Alhagi Plant extract** **Khajavi, R.**, Ghamari kargar, P. and Bagherzade, G. *University of Birjand*
10:00-10:30	A-10-1763-2	**Prediction of mechanical properties of Al-C nanocomposite: a machine learning approach** **Nikzad, M.H**., Momenzadeh-Kholenjani, A. *University of Isfahan*
10:30-11:00	A-10-1765-1	**Numerical modeling for thermographic inspection of subsurface defects in fiber-reinforced polymer composites** **Pourbafrani, H.** and Ghasemi, A.R. *University of Kashan*
11:00-11:30	A-10-1789-1	**Wear Behavior and Microstructure Characteristics of A356/ZrO2+Al2O3 Hybrid Composite** Farahany, S. , **Salehloo M.R.**, Khalesi Hamedani, M. *Iran University of Science and Technology*
11:30-12:00	A-10-1730-2	**Simulation of solidification process of in-situ 6061 alloy metal matrix composite** **Peimaei, Y** and Khademian, N. *Islamic Azad University of south Tehran Branch*
Break (12:00-14:00)		

Session Chairs: Dr. Jamali		
14:00-14:30	A-10-1747-1	**Influence of initial crack length on mode III delamination in composite materials by MSCB method** **Pourkazem, A.** , Khoshravan Azar, M.R. *University of Tabriz*
14:30-15:00	A-10-1752-1	**Mass-specific flexural properties of a mycelium-based biocomposite** **Kaffash, A.**, Janpoor, J., Safaeian, P., Yousefsani, S.A., and Tahani, M. *Ferdowsi University of Mashhad*
15:00-15:30	A-10-1792-1	**Magnetic gelatin-chitosan hydrogel incorporated with graphene oxide as an effective nanocomposite for methylene blue adsorption** **Naderi, N.**, Lalebeigi, F., Eivazzadeh-Keihan, R., and Maleki, A., *Iran University of Science and Technology*
15:30-16:00	A-10-1760-1	**An abaqus plugin for homogenization of woven composite fabric** **Kamal, A.** and Dibajian, S.H. *Shahid Beheshti University*
16:00-16:30	A-10-1775-1	**Dielectric Characterization of Polymer Composite Materials for Antenna Radome Applications** **Nayyeri, A.A.** and Sedighy, S.H. *Iran University of Science and Technology*

Room 4 (December 21, 2022)		
Session Chairs: Dr. Zeinedini		
09:00-09:30	A-10-1533-4	**Prediction of damage in composite bolted joints under creep loading** **Akbari, A.**, Mosalmani, R. and Shishesaz, M. *Shahid Chamran University of Ahvaz*
09:30-10:00	A-10-1799-1	**Improvement of the electrochemical behavior of polymer electrolyte using covalent organic frameworks nanofiller** **Shokrieh, A.**, Mao, L., and Wei, Z *National Center for Nanoscience and Technology*
10:00-10:30	A-10-1800-1	**Evaluating the effect of standing waves on morphological properties of spinodal topologies** **Ghadamyari, A.**, Golnari, F., Asghari, M. *Sharif University of Technology*
10:30-11:00	A-10-1817-1	**Fabrication of metal matrix composite on A516 steel and investigation the effect of powder composition on microhardness** **Razazi B.M.**, Mohsin, M.K.M. , Abjadi, A. *Islamic Azad University*
11:00-11:30	A-10-1816-1	**Developing an Empirical Model for Predicting Short Fibers Alignment Angle** **Zal, V.** and Yasaee, M. *Qom University of Technology*
11:30-12:00	A-10-1533-5	**Developing a micromechanical model to predict the elastic properties of plain weave composites** **Ghanavaty, A. M.**, Mosalmani, R., Shishesaz, M. *Shahid Chamran University of Ahvaz*
Break (12:00-14:00)		

Session Chairs: Dr. Taheri		
14:00-14:30	A-10-1579-27	**Introduction and applications of shape memory alloy** **Malekpour, F.**, Shokrieh, M.M., Farahifar, S. *Iran University of Science and Technology*
14:30-15:00	A-10-1579-23	**On the optimum RVE size of the aligned-short fiber composites with random distribution** **Dianati, A.**, Shokrieh, M.M., Moshrefzadeh-Sani, H. *Iran University of Science and Technology*
15:00-15:30	A-10-1579-26	**Investigation on the application of restrained recovery of pre-strained SMA wires embedded in self-healing composites** **Malekpour, F.**, Shokrieh, M.M., Farahifar, S. *Iran University of Science and Technology*
15:30-16:00	A-10-1752-2	**Effect of pre-pressure on compressive behavior of a natural biocomposite** **Kaffash, A.**, Janpoor, J., Safaeian, P., Yousefsani, S.A., and Tahani, M. *Ferdowsi University of Mashhad*
16:00-16:30	A-10-1736-1	**Weld nugget zone composite of Al 1060-Copper subjected to uniaxial fatigue loading cycles** Hassanifard, S. Alipour, H., and **Varvani-Farahani, A.** *Toronto Metropolitan University*

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A-10-1533-4

Prediction of damage in composite bolted joints under creep loading

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Abstract

Choosing the proper connection method between composite parts is very important for making composite structures. One of the common methods for connecting composite parts is bolted joints. Due to the ease of installation and disassembly of parts, bolted joints are widely used in the industry. However, long-term loads on the structure can cause damage to the joint. Therefore, it is necessary to study the damage to composite bolted joints under creep loading. In this research, a micromechanical model has been developed to determine stresses and time-dependent deformations in composite joints. For this purpose, first, with the help of Abaqus software, a composite bolted joint was modeled under static load, then its creep behavior was investigated. The results show that the amount of loading and the angle of the fiber have an effect on the strength of the composite.

Keywords: Creep, Composite, Bolted joint, Damage, Finite Element.

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A-10-1533-5

Developing a micromechanical model to predict the elastic properties of plain weave composites

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Abstract

This research presents a micromechanical model for predicting the elastic properties of plain weave composites. In this regard, a multi-scale micromechanical model is presented by choosing a representative volume element and performing discretization and homogenization processes according to the problem's physics. In this model, the assumptions of equal in-plane strains and equal out-of-plane stresses have been used to homogenize the representative volume element, which has been modified compared to the previous models. The set of these assumptions for the homogenization of the plain weave composites increases the accuracy of predicting the elastic properties due to the satisfaction of the equilibrium and displacement continuity conditions between the discrete components that make up the representative volume element. In addition, good agreement was obtained between the results of the present model and the available experimental results.

Keywords: Plain weave composite, Micromechanics, Representative volume element, Elastic properties, Homogenization.

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A-10-1578-2

Influence of GNPs debonding on mode I fracture toughness of polymeric nanocomposites

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Abstract

One of the most attractive topics related to the modification of polymer nanocomposites is to improve the fracture toughness even at low nanofiller volume fractions. It was proved in the literature that occurring some damage mechanisms at the nanoscale are related to this improvement. Meanwhile, nanoparticle debonding can play an important role either as its own mechanism or as a trigger for the other damage mechanisms. Hence, in the present work, the debonding of graphene nanoplates (GNPs) from the surrounding matrix was investigated theoretically. A multiscale model was developed in order to model the GNPs debonding mechanism. Therefore, a representative volume element containing a graphene nanoplatelet, its surrounding resin, and the interphase was selected. The effect of different variables on the mode I fracture toughness of GNPs-reinforced composites were evaluated.

Keywords: Graphene nanoplates, nanocomposites, fracture toughness, debonding, multiscale modeling

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A-10-1579-21

Effect of woven fabrics harness on the dynamic tensile mechanical properties of woven fabric composites

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Abstract

Woven composites are widely used in the composites industry. However, the type of woven fabric affects the mechanical behavior of woven composites. Therefore, in this study, the tensile testing of glass/epoxy woven composites reinforced with three different types of glass woven fabric (harnesses of 2, 5, and 8) has been carried out at medium strain rates from 1×10-5 s^{-1} to 70 s^{-1} using a hydro-pneumatic dynamic testing machine. The experimental results showed that the tensile strength, tensile modulus, and fracture strain of woven composites with different harnesses increased by (60.1%-60.3%), (24.01%-25.19%), and (28.18%-28.24%), respectively. The result showed that although increasing the strain rate has increased the mechanical properties of the composite with different harnesses, the effect of changing the strain rate on the mechanical properties of different harnesses is almost constant.

Keywords: Woven composite; Harnesses; Dynamic loading; Tension; Mechanical properties.

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A-10-1579-22

Assessment of the effect of matrix cracking density in GFRPs on the time response of surface-mounted FBG sensors under Lamb wave propagation

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Abstract

In the present study, to investigate the effect of matrix cracking density in a GFRP model, a laminated composite with $[0_2/90_6]_s$ lay-up under asymmetric guided Lamb wave propagation was simulated by using the finite element method in the ABAQUS software. The time-response diagrams of the reflected spectrum of the surface-mounted FBGs sensor were obtained using the FBG-SIMUL software. The stress and strain fields for a pre-defined path in the model obtained using the finite element analysis were used as the inputs of the model developed in FBG-SIMUL. The obtained time-response diagrams included the Bragg wavelength shift and peak width variation of the reflected spectrum. The results showed that by increasing the matrix cracking density, the Bragg wavelength shift, and peak width variation decreased. It was observed that the sensitivity of the FBG sensors to detect matrix cracking was higher than other methods presented in previous studies.

Keywords: Composite materials; Matrix cracking; Guided Lamb waves; FBG sensor; Time response.

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A-10-1579-23

On the optimum RVE size of the aligned-short fiber composites with random distribution

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Abstract

To model short fiber-reinforced composites on the micro-scale, the cost of calculations is one of the essential limitations. Therefore, many researchers prefer to use representative volume elements (RVEs) in their modeling. This RVE must have the same mechanical properties as the original composites on a macro scale. It is clear that the biggest RVE is physically closer to real conditions, but it encounters a huge amount of numerical calculations. The primary purpose of this research is to find the best dimensions of the RVE of short fiber-reinforced composites by using the finite element simulation. In this regard, several RVEs, including some aligned short fibers with random distribution in a polymer matrix have been constructed. In these models, the effects of some parameters such as the aspect ratio of RVE, and volume fraction of the short fibers on the elastic modulus of the composite were studied to find the optimum size of RVE.

Keywords: Representative volume element; Elastic modulus; Random aligned short fibers; Finite element method.

A-10-1579-24

Theoretical prediction of equivalent stiffness of anode and cathode coatings in lithium-ion batteries

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Abstract

Anode and cathode in flexible lithium-ion batteries (LIBS) are built by coating aluminum and copper substrates, respectively. These coatings have two parts, matrix, and nanoparticles. Adding nano-particles to the matrix change the overall stiffness of the matrix. Understanding the nanocomposite coating behavior in bending can help researchers to predict LIBS's failure mechanisms. The present research investigates the equivalent stiffness of nanocomposite coating via developing a code in MATLAB with four different homogenization methods. Results show that the modified differential scheme is the best approach to predict the equivalent stiffness of nanocomposite coating with high nanoparticle volume fractions in comparison with other methods.

Keywords: Nanocomposites; Lithium-ion battery; Equivalent stiffness; Modified differential scheme.

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A-10-1579-25

An overall Analysis of a Composite Sewer Manhole Cover

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Abstract

In a world where business rivals are widely ongoing, different factors, such as quality, total cost, marketing, manufacturing methods, and environmental issues play important roles. Composite materials have successfully passed their mission in various fields; now there is an ideal opportunity for these materials to step up and get into philanthropic usage. Their long-lasting resistance against corrosion and humidity as well as their high strength make them a noble solution to be used in sewerage. Therefore, many pipes, manholes, covers, and containers were manufactured utilizing composite materials and replaced by old metallic equipment recently. One main problem is the cost of sales that should be competitive on a large scale. In this study, a comparison between different types of composite sewage manhole covers versus cast iron ones has been made by the FEM method. Ease in manufacturing also makes it possible to examine different types of geometries. Finally, it was concluded due to many factors composite manhole covers are preferred to cast iron covers.

Keywords: Composite manhole cover; Sewer manhole cover; Manufacturing process; Maintenance; Optimization

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A-10-1579-26

Investigation on the application of restrained recovery of pre-strained SMA wires embedded in self-healing composites

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Abstract

Energy absorbance is a key factor for structures exposed to impact loading. Although polymer-based composites can absorb a good amount of energy, since their matrix is too brittle, they cannot be used over and over. One solution is to use a self-healing matrix that can repair its cracks in presence of compressive force in the determined temperature. The following studies show that embedding pre-strain SMA wires and activating them induces a large compressive force in polymer-based composite samples. This compressive force is used in terms of a resistance moment against impact load and on the other hand as a compressive actuator to start the healing process of the self-healing matrix after the matrix cracking.

Keywords: Polymer-based Composites; Self-healing; SMA; Pre-strain; Induced force.

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Introduction and applications of shape memory alloy

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Abstract

Nowadays, smart behaviors of materials are noticed more than at any time in the history of material science. A material is considered to be smart if at least it shows a reaction in form of a change in color, shape, size, sound, electric pulse, and other forms of diagnosable changes. These changes are since something has been changed in its circumstance; therefore, it will comprehend its surroundings. Shape memory alloy (SMA) is a type of smart material that in the proper conditions shows a contracting reaction as a response to temperature rise. If this reaction is managed properly, it could be a beneficial capability to use for many tasks. The present paper is an introduction to the history of SMA that in most cases considered as Nitinol and a review of its vast applications. The present research discusses the capabilities of this material, especially in comparison to traditional materials.

Keywords: Smart materials; Mechanical characteristics; SMA; Actuator; Biomedics.

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A-10-1579-28

Fatigue modeling of laminated composites using new strain-based failure criteria

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Abstract

There are various modeling approaches to simulate the fatigue behavior of fiber-reinforced laminated composites. The stress-based failure criteria are often used in the available approaches. Due to the nature of stress-based failure criteria, it is necessary to characterize the mechanical properties of the unidirectional ply, including stiffness and strength as functions of the stress ratio and the number of cycles. The characterization of strength degradation of the unidirectional ply under fatigue loading is costly and time-consuming. In the present study, to reduce the number of experiments, strain-based failure criteria were used. Using the static failure strain as a measure of failure, a series of strain-based failure criteria for the unidirectional ply under fatigue loading was presented. In this way, the need for strength degradation tests was eliminated, and the number of total tests was reduced by about 50%. The present criteria were used in the Shokrieh-Lessard progressive damage model to investigate the fatigue behavior of laminated composites under different fatigue loading conditions. The results of the model were validated using independent experimental data. The use of the present strain-based criteria decreased the number of characterization experiments and improved the accuracy of the progressive damage model by up to 24%.

Keywords: Progressive fatigue damage model; Composite laminates; Cyclic loading; Strain-based failure criteria.

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A-10-1579-29

Comparing UAV composite wing stress analysis with one-way and two-way coupled fluid-solid interaction methods

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Abstract

Unmanned aerial vehicle has been extensively used in the military and civil industries these days. Using composites in these structures, due to their high strength-to-weight ratio, is crucial. The optimized design of composite components of the aerial vehicle is important among researchers in these industries. In the present research, an stress analysis of the UAV composite wing was performed with one-way and two-way FSI methods. Stress analysis of a composite wing is performed using the FSI method. The result shows that despite the high precision of the two-way FSI method in comparison with the one-way method, the computational process is time-consuming. So, the one-way FSI method is recommended as a faster method according to the negligible calculated difference between its result in comparison with the two-way method.

Keywords: UAV; Composite materials; Wing; Fluid-solid interaction.

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A-10-1579-30

Modeling, analysis, and fabrication of a composite propeller of an ultralight aircraft

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Abstract

Nowadays, ultralight airplanes use composite propellers to create propulsion due to their high strength and low weight. This paper is about the process of modeling, analysis, and fabrication of a composite propeller based on an actual sample. The first step is to have that propeller's point cloud file. A 3D model of the cloud of points was obtained using CAD software. In the analysis of finite elements according to the movement of a structure in the fluid, the one-way coupling of fluid-solid interaction (FSI) has been used. Finally, the safety factor of the propeller after performing the basic analysis based on the Tsai-Wu theory was obtained as 1.373. Then, to improve the propeller in terms of mass or price, by changing the characteristics such as the number of layers, the material of the layers, the material of the core, etc., the results of other modes were examined. After making the prototype with 3D printing, the designed mold was made of aluminum metal, and preparations were made for making the propeller with the hand-layup method.

Keywords: Propeller; composite propeller; point cloud; fluid-solid interaction.

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A-10-1579-31

Residual strain measurement of polymeric composite materials using the FBG sensor

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Abstract

Various techniques, such as using a strain gauge and/or digital image correlation technique, have been utilized to measure the residual stress of polymeric composite materials by the hole drilling or slitting methods. However, they have some disadvantages including being destructive, and inaccuracy of the data due to measuring the strain values from the surface of specimens. Optical fiber sensors (OFSs) are the best candidates for measuring residual strain due to their significant advantages such as compact size, simple operation, remote sensing, quasi-distributed sensing, etc. The present paper utilized the capabilities of the fiber Bragg grating (FBG) sensors, as promising OFSs, for residual strain measurement of polymeric composite materials. FBGs can easily adhere to and between laminated specimens without affecting the sample's mechanical properties, which enables them to measure the exact residual strain created between layers of composite laminates during the curing cycle. In this paper, the uniform FBG sensor successfully measured strain between different layers of cross-ply T300/LY5052 composite specimen.

Keywords: Residual strain; FBG sensor; Polymeric composite, wavelength shift.

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A-10-1579-32

Detection of delamination damage in cross-ply laminated composites by wave propagation and machine learning, Numerical and experimental investigations

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Abstract

The application of Lamb wave propagation and machine learning methods for health monitoring and damage detection in composite materials has been growing. This study aimed to investigate the interaction of Lamb waves with the delamination damage in cross-ply laminated composites with a $[0_2, 90_6]_s$ lay-up. The mechanical properties of the specimen were obtained experimentally, and then the Lamb wave propagation in the sample was numerically modeled using the finite element method. It was observed that the delamination damage had a constant effect on the Lamb wave characteristics in different propagation directions. The results obtained from the numerical model were generalized to the area using the ellipse probability. A machine learning model based on the multilayer perceptron with the Marquardt-Lonberg algorithm was consequently trained using the results obtained from the numerical model. The model was able to detect the location and size of the damage.

Keywords: Composite materials; Damage detection; propagation of Lamb waves; Machine learning; Artificial neural networks.

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A-10-1579-33

Analytical modeling of creep phenomenon of epoxy polymer reinforced with SMA

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Abstract

Zeolites are inorganic materials with thermal, chemical and mechanical stability and have been widely used as industrial catalysts, ion exchangers and adsorbents. Recently, the use of ultrasonic irradiation has been extensively studied for formation different types of materials, as a new source of energy and environmentally compatible. Also, nickel ferrite and palladium powders have been considered for many applications such as high density magnetic storage media, MRI contrast agents, color imaging, ferro-fluids, high frequency devices, magnetic refrigerators, catalysts and microwave devices. In this paper, we report effective, useful and environmental compatible ultrasound method for the synthesis of zeolite Y/Palladium/Nickel ferrite nano composite. This nano composite was characterized by powder x-ray diffraction (XRD), scanning electron microscopy (SEM) and fourier transform infrared spectroscopy analysis (FT-IR).

Keywords: Polymer composites; Shape memory alloy; Creep strain; Micromechanics; Pre-strain.

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A-10-1579-34

An investigation of the mechanical properties of synthetic leather made of PVC with organic and inorganic pigments

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Abstract

Organic and inorganic pigments are widely used in the synthetic leather industry. However, limited research works have been conducted on the effect of pigments on the mechanical properties of synthetic leather. Therefore, the present research studied the influence of various percentages of inorganic and organic pigment in PVC matrix. The results show that the presence of pigment improves the mechanical properties of synthetic leather. According to the results, the optimal amount of organic pigment is 1 Phr, which increases the elastic modulus and ultimate tensile strength by 8% and 9%, respectively, with no significant change in rupture strains. It has been found that 1.5 Phr of inorganic pigment is the optimal amount that increases elastic modulus, rupture strain, and ultimate tensile strength by 6%, 5%, and 5%, respectively. Observation of these results indicates a better van der Waals interaction between organic pigments and the PVC.

Keywords: Synthetic leather, Plasticized PVC, Organic and inorganic pigment, Mechanical properties.

A-10-1730-2

Simulation of solidification process of in-situ 6061 alloy metal matrix composite

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Abstract

In situ composites are a class of composite materials in which the reinforcement is formed within the matrix by reaction during the processing. In situ method of composite synthesis has been widely followed by researchers because of several advantages over conventional stir casting such as fine particle size, clean interface, and good wettability of the reinforcement with the matrix and homogeneous distribution of the reinforcement compared to other processes. Commonly used reinforcements for Al and its alloys which can be produced in situ are Al12Mg17 , Al2O3 and Mg2Si. In this article, the casting simulation of aluminum alloy 6061 was done with ProCast software and the possibility of forming an in situ composite structure was investigated.

Keywords: Metal matrix composites, Solidification simulation, Aluminum alloy

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Weld nugget zone composite of Al 1060-Copper subjected to uniaxial fatigue loading cycles

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Abstract

This study evaluates fatigue response of aluminum 1060 joints as copper foils introduced into the nugget zone (NZ) during Friction Stir Welding (FSW) operation to form an alloyed (composite) weld NZ in the faying surfaces of joints. Fatigue tests were conducted on joint samples to characterize the stiffness, tensile strength, and fatigue behavior of alloyed joints. Cyclic tests were carried out under the load-controlled condition with a stress ratio of R=0.1. It was observed that the copper foil located in the middle of joint plates impacted the hardness values even beyond the weld seam. The average hardness value in the nugget zone for joints alloyed with 100 and 200 μm copper foils and as-welded joints were 47.8, 46.2, and 40.2 HV, respectively. The insertion of copper foils in the stirred zones, enhanced fatigue strength of joints noticeably. Fatigue lives of the composite NZ were modified as copper foils inserted.

Keywords: Friction stir spot welding; Alumina particles; Fatigue response.

A-10-1739-8

On the Mixed Mode I/II/III Translaminar Fracture Toughness of E-glass/Epoxy Laminated Composites

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Abstract

In this paper, the mixed mode I/II/III translaminar fracture of glass fiber reinforced composites system was investigated. Compact shear tension (CTS) was utilized to measure translaminar critical strain energy release rate (TCSERR). The samples were made of epoxy resin and fabric E-glass fibers. The CTS specimens were loaded by a novel test setup. In addition to pure modes I, II and III TCSERR of E-glass/epoxy system, a full series of mixed mode tests were conducted. Finite element analysis was also carried out to calculate the calibration factors related to the TCSERR formulations. It was resulted that by increasing the mode II or III contribution, the TCERR of E-glass/epoxy laminated composites is decreased.

Keywords: Translaminar fracture, E-glass/epoxy composites, mixed mode I/II/III, experimental study

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Effect of printing parameters on the tensile properties of 3D-printed PLA material

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Abstract

Fused Depositional Modeling (FDM) is one of the common methods for 3D printing of polymers. The mechanical properties of 3D printed parts strongly depend on the selection of processing parameters. In this paper, the effect of two important parameters, i.e., infill density and infill pattern, were investigated on the tensile properties of the PLA material. Hence, the tensile specimens with three infill densities of 25, 50 and 75% were printed. Besides, some infill patterns such as honeycomb, grid and rectilinear were considered in order to evaluate its effect on the tensile properties of PLA specimens under quasi-static loading. It was resulted that the specimen with the rectilinear pattern and infill density of 75%has the highest tensile stiffness and strength.

Keywords: Infill density, infill pattern, 3D Printing, tensile properties, PLA

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Effect of short natural fibers length and weight fraction on the mode I fracture toughness of epoxy-based composites

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Abstract

In this research, Kenaf short fibers were used to reinforce the epoxy-based composites. The effect of fiber length and the weight fraction of fibers on the mode I fracture toughness of the Kenaf short fiber reinforced composites were investigated. Five values of fiber length of 5, 15 and 25 mm and three amounts of weight fraction of 10, 20 and 30% were considered. The results displayed that at any certain fiber length, by increasing the weight fraction, the mode I fracture toughness is enhanced. It must be mentioned that the with increasing the weight fraction from 10 to 20%, the mode I fracture toughness is increased significantly. Whereas, less improvement was obtained as the fiber weight fraction enhanced from 20 to 30%. The most improvement in fracture toughness (around 270%) was resulted for the sample reinforced by the Kenaf fiber with the length of 15mm and the weight fraction of 30%.

Keywords: Short fiber, epoxy, mode I fracture toughness, Kenaf.

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Effect of Nano/Micro Reinforcement Type on Mechanical and Physical Response of Polyurethane based Micro-nanocomposites

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Abstract

Polymer nanocomposites include a polymer matrix, filled with nano-reinforcements. The weight percentage of reinforcements can be effective on thermal, physical, and mechanical properties. This research aims to investigate the effect of micro and nano-reinforcements on the mechanical and physicalproperties of modified polyurethane elastomers. Polyurethane with a shore hardness of 70 has been used as the base polymer filled with aerosil, talc, TiO_2, and nanoclay reinforcements with 8 wt%. Tensile tests, densitometry, pH test, DSC, and water angle were employed to assess the said properties. The results showed that the specimens reinforced with talc exhibited the highest mechanical properties. The lowest pH changes were revealed in the case of nanoclay-loaded parts. The highest density corresponds to the case of 8 wt% of TiO_2. The pure samples and the specimens reinforced with nanoclay led to the highest hydrophobicity, whilst 8 wt% aerosil reported the lowest enthalpy and density and highest Tg.

Keywords: Microcomposite, Polyurethane elastomer, aerosil, talc, TiO2, nanoclay

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Performance of rotary jet melt spun polypropylene fiber reinforced polyester composites

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Abstract

Nowadays, in many engineering applications, it is not possible to use one type of material that can satisfy all the desired properties. The composite industry solves the mentioned problem by using several components at the same time. Finding materials that can improve the properties of composites is very important. This study investigated the effect of adding polypropylene (PP) sheets to the polyester resin. At first, PP fibers were made from PP granules by rotary jet melt spinning machine and produced fibers compacted into polymer sheets by roller mixer. Next, to produce PP composite, polyester resin, cobalt and hardener were added to PP polymer by manual mixing. Finally, the composite's mechanical properties such as bending strength and impact resistance were measured. The results of the present study showed that in the presence of resin, the mechanical properties of the composite are significantly improved compared to non-composite plates.

Keywords: Composite, Polyester, Polypropylene, Fibers, Bending strength, Impact resistance

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Investigating the effect of PVC and nanoclay on impact ability and mechanical properties of polyester nanocomposites

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Abstract

PVC and nanoclay particles have a significant effect on strengthening the mechanical properties of polymer composites. In this research, unsaturated polyester nanocomposites based on the presence of spherical microparticles of polyvinyl chloride (PVC) and planar clay nanoparticles and in different percentages of 0, 5, 10, 20, and 30 PVC particles and weight percentages of 1, 5, And 8 total nanoparticles were produced in two separate and hybrid stages with the help of a sonicator stirrer. After mixing, the compounds were molded, and composite samples were formed after a few hours by adding a hardener. Finally, different samples were prepared to perform different mechanical tests such as tension, bending, and impact. The results of the tests showed that with the increase in the presence of PVC particles, the tensile strength decreases. Also, the results show that spherical particles have better mechanical properties compared to flat particles.

Keywords: Microcomposite, Hybrid composite, Polyester, Impact strength, PVC, nanoclay

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Modeling and analysis of thermoplastic composite pipe under tensile loading

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Abstract

Thermoplastic composite pipes (TCPs) are becoming viable alternatives to steel pipes for transporting oil, gas, and other fluids, as well as tubes for coil tubing equipment, due to their superior properties, such as corrosion resistance, lightweight, high-pressure rating, and high strength. TCPs typically have a cross-section consisting of three layers: inner liner, composite laminate, and outer jacket. Because the load-bearing layer is a composite laminate, the load-bearing capabilities of this composite should be investigated. In this study, the software ANSYS was used to develop FEA models to predict the stress distribution of the Pipe. Tsai-Wu failure criteria were utilized to estimate the Pipe's maximum tensile loading. On the tensile loading of TCPs, the effects of crucial parameters, such as the number of composite layers, were studied. Analytical and finite element analysis methodologies yielded conclusions consistent with each other and supported by available experimental data.

Keywords: TCP, Analysis, FEA, Tsai-Wu, Tensile loading, Pipe

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CeO_2 nanocubes@TiO_2 core-shell nanocomposite: Synthesis, structural and morphological characterization

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Abstract

This study synthesized CeO_2 nanocubes, TiO_2 nanoparticles, and CeO_2 nanocube@TiO_2 core-shell nanocomposite via a facile hydrothermal approach assisted by the Stöber method. The surface morphologies, crystal plane, and textural properties of the prepared samples were investigated via X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive analysis of x-ray (EDAX), and elemental mapping and nitrogen physisorption (according to BET isotherm) techniques. The XRD patterns showed that all diffractions of the CeO_2 nanocubes can be indexed to the pure cubic fluorite structure (JCPDF #04-0593) and confirmed the pure anatase phase of the obtained TiO_2 nanoparticles (JCPDS #21-1272). The SEM images indicated the cubic morphology for CeO_2 and core-shell structure for CeO_2 nanocube@TiO_2 nanocomposite. The EDAX patterns showed the presence of Ce, O, and Ti atoms in the samples. The results indicated that TiO_2 nanoparticles were dispersed on the outer surface of the CeO_2 nanocubes and formed the core-shell nanostructure.

Keywords: Core-shell structure, CeO_2 Nanocubes, TiO_2 nanoparticle, Synthesis, Characterization.

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Influence of initial crack length on mode III delamination in composite materials by MSCB method

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Abstract

Delamination of composite materials in Mode III has been investigated using modified split cantilever beam (MSCB) method. Woven glass/epoxy resin was used. In this method, the ratio of energy released in the third mode to the total energy released is higher than other methods and is one of the most appropriate methods for measuring the failure energy in the third mode. The compliance of the samples was investigated using the compliance calibration method. The energy released in the third failure mode calculated by the lazy calibration method showed that the no linearization criterion gives more conservative and reasonable values than the maximum point criterion. Examining the ratio of failure energy in the third mode to total energy showed that more than 93% of the failure energy is related to the failure energy in the third mode. Therefore, the fixture used can be very useful for creating a third mode.

Keywords: Composite laminates, initial crack length, Strain energy release rate, Mode III fracture, MSCB test

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Fabrication and characterization of ZnO quantum dots heterojunction structures for photocatalytic treatment of pharmaceutical wastewater

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Abstract

In this research, ZnO quantum dots (ZnO QDs), ZnO QDs heterojunction structures containing graphene oxide (ZnO QDs/GO), and CuO (ZnO QDs/CuO) have been synthesized and characterized by XRD and FESEM/EDS analyses. The XRD patterns confirmed the formation of the wurtzite structure of ZnO QDs (JCPDS79-0207) and the presence of CuO nanoparticles (JCPDS89-5895) in the prepared samples. In addition, the XRD patterns verified that no phase change occurred in the wurtzite structure of ZnO QDs during the formation of heterojunction structures. The synthesized ZnO QDs and heterojunction structures have been used for the photodegradation of tetracycline (TC) antibiotics in synthetic wastewater under visible light irradiation. As a result, pure ZnO QDs, ZnO QDs/GO, and ZnO QDs/CuO degraded 100%,81%, and 60% of TC within 180 minutes under visible light.

Keywords: ZnO quantum dots; Graphene oxide; CuO nanoparticles; Photodegradation; Tetracycline

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Finding transient angle in tension for unidirectional composites

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Abstract

In unidirectional composite laminates, the magnitude of ultimate tensile strength decreases suddenly and sharply, when the on-axis part changes to off-axis specimen with a small angle. This angle is called “transient angle” in which the failure mode changes from fiber breakage to matrix cracking. In present study, this angle is determined experimentally. For this purpose, 21 glass/epoxy specimens were made and tested with 0, 4, 8, 12 and90 degrees fiber orientations. It was observed that in samples with 4 degrees orientation, the ultimate tensile strength decreases 16%, while in parts with 8 degrees, a considerable drop is occurred equal to 59% with respect to 0degree specimens. There is not any significant decrease in strength of 12 degrees specimens in comparison with 8 degrees pieces (only 10%) and it is similar to the strength of 90 degrees samples. So, the transient angle can be predicted equal to 8 degrees.

Keywords: transient angle, unidirectional composite, tensile test

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Mass-specific flexural properties of a mycelium-based biocomposite

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Abstract. Over the past few years, development of technology at the intersection of material sciences and biology has led to introduction of new generations of eco-friendly, engineered materials composed of biocompatible and biodegradable natural components. Mycelium-based biocomposites made of wood fibers embedded in a dense fungal matrix exhibit physical and mechanical properties comparable to their synthetic counterparts like Polystyrene foams which are widely used in packaging, thermal/acoustic insulation, and construction industries. In this study, two prismatic samples of a mycelium-based biocomposite were fabricated by controlled growth of a fungal mycelium species forming the binding matrix within wood fiber substrates made of chopped leaf sheaths of date palm with different sizes. Both samples were tested under quasi-static displacement-controlled three-point bending, and their mass-specific flexural properties were measured. Results showed that the sample with larger fibers exhibits less strength, where larger empty spaces in the fibrous network prevent the growing matrix from consolidation.

Keywords: Biocomposite material; natural fibers; fungal matrix; flexural properties

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Effect of pre-pressure on compressive behavior of a natural biocomposite

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Abstract

The unbridled growth of bio-hazardous waste generation is a global environmental challenge that has attracted researchers' attention to the development of new generations of engineered biocompatible and biodegradable materials. Fully natural biocomposites made of wood fibers extracted from agricultural residues and bound together by sustainable growth of fungal network matrix are widely under investigation over the last few years as potential alternatives to synthetic foams. In this study, three cylindrical samples of a mycelium-based biocomposite with identical composition and dimensions but different pre-pressures were fabricated, and their mass-specific compressive properties were studied at different compression levels. This biocomposite material consists of a natural substrate of shredded leaf sheaths of date palm, as the reinforcement fibers, within a network of *Pleurotus*, a fungal mycelium species, as the binding matrix. Results showed that compressive strength varies with pre-loading and ranges from 0.34 to 4.55 MPa, which is comparable with synthetic packaging foams.

Keywords: Biocomposite; wood fibers; fungal matrix; compressive properties

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Glass/Epoxy laminates with Novel Core Layers Under Quasi-Static Indentation: A Comparative Experimental and Numerical Study on Using Chopped Natural and Synthetic Fibers as a Core Layer

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Abstract

Implementation of natural fibers like kenaf in composite laminates has been the focus of researchers. This work compares the mechanical characteristics of composite laminates composed of kenaf and glass chopped fibers and epoxy as a core and investigates the effect of hybridizing the mentioned chopped fibers as the core of a laminate. Three types of laminates with different core materials were fabricated to do this research. The results showed that among the laminates with the same weight, kenaf core laminate has the highest resistance against indentation and has the best performance in terms of absorbed energy, peak load, and damaged region. Using chopped kenaf fiber instead of chopped glass fiber can increase the absorbed energy and the peak load by 36% and 17%, respectively. Also, hybridizing the mentioned chopped fibers has not maximized the properties of the composite laminate during the QSI test. Numerical outputs agree with experimental results.

Keywords: Chopped fiber, Glass, Kenaf, Quasi-static indentation

A-10-1753-2

Damage Mechanism of Glass/Epoxy Laminates with a Novel Core Layer under Quasi-Static Indentation: A Comparative Study on Using Kenaf, Glass, and their Hybrids as Laminate Skins

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Abstract

There is a rising demand for using natural/synthetic hybrid composites to enhance the mechanical performance of natural fiber and reduce the environmental impact compared to synthetic materials. The stacking sequence of composite laminates has considerable effects on the properties of composites and on the types of damages that occur to composites. The present study investigated the quasi-static indentation properties and the damage progression of three types of composite laminates with different stacking sequences (full glass, full kenaf, and hybrid), all having a novel core layer consisting of chopped kenaf fibers. Results of the indentation assessment of the developed composites showed that the hybrid skin laminates have the best performance under indentation, while composites with full kenaf skin perform the worst failure mode among the three types of laminates. The main failure modes on the specimen during the penetration were matrix cracking, fiber breakage, core failure, delamination, and fiber splitting.

Keywords: Damage, Failure, Hybridization, Quasi-static indentation

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Prediction of impact and fatigue life behavior of FML by finite element and mathematical simulation

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Abstract

In this research, a mechanical model of nonlinear mass-spring and corresponding differential equations of motion derived from it, as well as the simulation of finite element method (FEM) of the dynamic effect of low energy impact on 4 types of GLARE were performed, and the results obtained from the mathematical model and simulation of finite element were compared with the experimental results. Comparison of mathematical model, finite element simulation results with experimental data, showed that the low energy impact response of these methods is in good agreement with experimental data.

Keywords: Hybrid composite, Damage, Hybrid composite, Damage, Experimental test, Finite element

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Hydrothermal growth of $CuCo_2O_4$ spinel nanoparticles on TiO_2 nanosheets for photocatalytic degradation of tetracycline

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Abstract

This study synthesized TiO_2 nanosheets (TNs) using hydrothermal method and spinel $CuCo_2O_4$ nanoparticles were grown hydrothermally on TNs to prepare $CuCo_2O_4$/TNs nanocomposite. The synthesized samples were identified by X-ray diffraction (XRD), scanning electron microscopy/energy dispersive analysis of X-ray (FESEM/EDAX), and surface area analyses. According to XRD results, the diffraction peaks could be indexed to anatase-phase TiO_2 (JCPDS No. 21-1272) and spinel phase of $CuCo_2O_4$ (JCPDS card No: 01–1155) in the prepared samples. Nanoflower morphology of $CuCo_2O_4$ spinel was characterized by FESEM analysis in the synthesized $CuCo_2O_4$ and $CuCo_2O_4$/TNs nanocomposite. EDAX proved the presence of O, Cu, Co, and Ti atoms in the synthesized samples. The surface area of TNs, $CuCo_2O_4$, and $CuCo_2O_4$/TNs nanocomposite were obtained 95.114(m^2g^{-1}), 48.245(m^2g^{-1}), and 83.543(m^2g^{-1}), respectively according to BET model. Pure TNs, $CuCo_2O_4$, and $CuCo_2O_4$/TNs nanocomposite degraded 60%, 84%, and 92% of tetracycline (TC) within 100 minutes under visible irradiation.

Keywords: TiO2 nanosheets, spinel CuCo2O4, Hydrothermal growth, Tetracycline.

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The effect of different solvents on the dispersion quality of MWCNT-Fe_3O_4 hybrid nanofillers in nanocomposites

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Abstract

The dispersion quality of nanofillers in nanocomposites has an important effect on improving the mechanical properties of polymers. In this research, the reinforced polymeric composite specimens made of epoxy and MWCNT-Fe_3O_4 were fabricated using three different organic solvents including acetone, ethanol, and Tetrahydrofuran (THF). For manufacturing the nanocomposite samples, 0.6 wt% of hybrid MWCNT- Fe_3O_4 nanofillers were used. The tensile strength of nanocomposites was obtained from a tensile test using a bulk dumbbell-shaped specimen according to ASTM D638. Moreover, the dispersion of hybrid nanoparticles with different solvents in epoxy resin was evaluated using scanning electron microscopic (SEM). The results showed a significant improvement in the tensile strength and distribution of nanofillers compared to the nanocomposites made without solvents.

Keywords: dispersion, hybrid nanofiller, nanocomposite, tensile strength

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Experimental and numerical investigation of the strain energy release rate of composite adhesively bonded joints under mode II loading

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Abstract

In this paper, the strain energy release rate (SERR) and its critical value, i.e. the fracture energy, of the glass/epoxy composite adhesively bonded joints were determined using an end notch flexure (ENF) specimen. In order to obtain SERR, the corrected beam theory (CBT) and compliance based beam method (CBBM) were used and the results were compared. The advantage of CBBM over the CBT is that it is not necessary to measure the crack length during propagation that can be challenging and may introduce a non-negligible error on the fracture energy measurement. Moreover, the CBBM can account for the fracture process zone (FPZ) effects that can be considerable when a ductile adhesive is used. Also the experimental and numerical R-curves were compared.

Keywords: adhesively bonded joints; end notch flexure (ENF); fracture toughness; strain energy release rate (SERR)

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An abaqus plugin for homogenization of woven composite fabric

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Abstract

The mechanical properties of a woven composite are affected by the mechanical and geometric properties of its components. In a large-scale analysis, considering the parameters related to the components will increase the time and cost of the analysis. In order to avoid these conditions, the mechanical properties of the composite material are homogenized by considering the characteristics of the components. In this article, a woven composite parameters is determined by homogenization of its component properties using the finite element method in Abaqus software. In this method, a representative volume element is modeled according to the geometric and mechanical characteristics of the warp, weft and matrix. Then, by using 9 steps of simulation of simple tension and simple shear test, the energy stored in the element and the 9 components of the stiffness matrix of the composite material is calculated. This algorithm is integrated and present in an abaqus plugin.

Keywords: Homogenization; Finite element method; RVE; Abaqus

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An analytical solution for nonlinear static bending of a functionally graded Timoshenko beam

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Abstract

This paper presents an analytical solution for the deformation and stress fields in a functionally graded beam subjected to transverse loading. Mechanical properties are assumed to vary due to a power law relation across the beam thickness. First-order shear deformation theory along with nonlinear Von-Karman strain-displacement relations are used to derive static equilibrium equations employing the minimum total potential energy principle. Considering different boundary conditions at the two ends of the beam, analytical expressions are derived for the deformation and stress fields of the beam. Numerical results are presented for different values of the power law index and various load magnitudes and are compared to the linear solution.

Keywords: functionally graded beam, static bending, nonlinear deformation, first-order shear deformation theory

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4D printing utilizing bending thermal deformation of 3D printed PLA specimens

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Abstract

Four-dimensional (4D) printing is a combination of three-dimensional (3D) printing and time which is able to manufacture a smart structure with the merge of smart materials and stimuli in the process of 3D printing throughout the time. In this study, the effect of print orientations is investigated on the bending thermal deformation of 3D printed Poly lactic acid (PLA) specimens. Four different layups, i.e., $[0]_{18}$, $[90]_{18}$, $[0_9/90_9]$ and $[90_9/0_9]$ were tested above the glass transition temperature (*Tg*) of PLA, i.e., 60 °C at the oven. The experimental results illustrated that by changing the stacking sequence of printing angle, the deformation can be controlled in certain orientations. Among different layups, $[0_9/90_9]$ layup suggests the most bending deformation.

Keywords: 3D printing, 4D printing, Bending deformation, PLA

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A-10-1763-1

Effect of nozzle temperature on the mechanical properties of FDM 3D-printed PLA materials

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Abstract

Fused deposition modeling is one of the most common method utilized in the additive manufacturing process of polymers. In this research, the influence of various nozzle temperatures, i.e., 200, 210, and 220 ℃ is studied on the elastic modulus and ultimate tensile strength of poly lactic acid (PLA). Other constant parameters are: The layer thickness of 0.3 mm, the printing speed of 45 mm/s, infill density 100 %, printing angle of 90 degree. The experimental results indicated that in the three angles, mentioned as constant parameters, by increasing the nozzle temperature from 200 to 220 ℃, both elastic modulus and ultimate tensile stress significantly increase. Furthermore, no order was seen in the changing of failure strain by increasing the nozzle temperature.

Keywords: Fused deposition modeling, Poly lactic acid, Elastic modulus, Ultimate tensile stress

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Prediction of mechanical properties of Al-C nanocomposite: a machine learning approach

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Abstract

Nowadays, investigating the properties of nanocomposites and finding their optimal properties pave the way for a better use of them. In this study, the main purpose is the prediction of mechanical properties of aluminum-carbon (Al-C) nanocomposite being elastic modulus and ultimate tensile stress with a machine learning algorithm. The Random Forest Regression (RFR) algorithm has been utilized in this research. Furthermore, the independent variables of T, S, and C illustrating ambient temperature, strain rate, and the content of carbon used in aluminum, respectively, and dependent variables of E and UTS indicating elastic modulus and ultimate tensile stress obtained from molecular dynamics simulation have been utilized to train the algorithm to predict the mentioned mechanical properties. The results represent that the prediction accuracies of 81.2 % and 93.1 % derived from RFR algorithm for elastic modulus and ultimate tensile stress have been obtained, respectively.

Keywords: Machine learning, Mechanical properties, Molecular dynamics, Nanocomposite

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A deep learning approach to estimate the contact force of a fiber metal laminate: a finite element analysis

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Abstract

Fiber–metal laminates (FMLs) are high-performance hybrid structures based on alternating stacked arrangements of fiber-reinforced plastic (FRP) plies and metal alloy layers. In this paper, the multi-layer perceptron regression (MLP) algorithm, which is based on neural network in deep learning, has been utilized to estimate the prediction accuracy of contact force obtained from finite element analysis between an impactor and a FML under low-velocity impact. The independent variables of m and v showing mass and velocity of impactor, respectively, and dependent variable of F which indicates the contact force have been used to train the algorithm. The results display that the prediction accuracy of 96 % was obtained for contact force by using MLP algorithm that shows it is an appropriate algorithm for this research.

Keywords: Contact force, Deep learning, Fiber metal laminate, Finite element analysis

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Composite lithium-ion battery panels to be used as electric and hybrid car bodies

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Abstract

Lithium-ion batteries have been widely used for various purposes such as electric gadgets and applications like those in electric vehicle industries. Centralized battery package systems in conventional electric cars are gigantic and heavy which can add more weight to electric cars in addition to heavy steel-based car bodies. Light-weight hybrid composite panels are designed to mitigate this issue. Thanks to this technology, centralized battery packages have been eliminated and combined with car bodies. To investigate the mechanical behavior of these multifunctional structural battery panels, they have been exposed to a three-point bending mechanical simulation test. The simulations have been conducted in COMSOL Multiphysics finite elements software, which provides a capability of coupled-physics modeling including electrical and mechanical models. The results illustrate that these structural batteries can be utilized in future vehicle body panels.

Keywords: Composite panel, Structural lithium-ion battery, Electric car body, Light-weight structures

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Numerical modeling for thermographic inspection of subsurface defects in fiber-reinforced polymer composites

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Abstract

The ability to characterize subsurface defects in composite materials through a non-destructive inspection technique is becoming a critical research area. Infrared thermography (IT) is a safe non-destructive testing technique that has a fast inspection rate. In active IT, an external heat source is used to stimulate the material being inspected in order to generate a thermal contrast between the feature of interest and the background. In this research, Finite Element Method (FEM) is used to simulate the pulsed thermography experiment. A thermal–numerical model based on the 3D transient heat conduction for heterogeneous media is proposed to model the thermal response of the composite medium when a thermal pulse is applied to its surface. Numerical results have been compared with experimental data. The results of this research displayed a good agreement with experimental results.

Keywords: Non-Destructive Test, Damage Detection, Infrared Thermography, Polymer Composites

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The influence of annealing heat treatment on the interface evolution of Al 1050/Mg AZ31B bilayer sheet

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Abstract

In this study, special attention has been paid to effect of annealing time on the microstructure and interface of Al1050/MgAZ31B laminated metal composite. This composite consists of 2mm Aluminum and 1.5mm Magnesium sheets which has been preheated at 400°C for 20 minutes before single pass rolling performed with the reduction ratio of 40% to fabricate bilayer composite; Then annealing for 1, 3 and 6 hours at temperature of 225°C was carried out. The results indicate that according to SEM analysis, no new phases were observed in the interface and X-shaped distribution of elements along with the interface show atomic diffusion. Further, by increasing annealing time, due to increase of diffusion rate, the thickness of interface was increased. In addition, the hardness values of Al, interface and Mg, after increase of anneal holding time, decreased.

Keywords: Laminated metal composite; Interface; Annealing; Aluminum alloy; Magnesium alloy

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The Effect of Water Immersion Ageing on Low and High-Velocity Impact Behavior of Marine Sandwich Panels with Different Skins

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Abstract

The susceptibility of sandwich structures to accidental impacts is one of the main concerns in design of marine crafts as it severely affects the structural integrity and safety of the structure. Thus, in this paper the effect of skin type on impact behavior of marine sandwich panels was experimentally evaluated. For this purpose, two different balsa core sandwich panels with glass fiber/epoxy (GE) and fiber metal laminate (FML) skins were subjected to water immersion ageing followed by instrumented low and high-velocity impact testing. The results showed that the skin properties have an important effect on the impact response of both the studied sandwich systems. Accordingly, the reduction of Charpy impact strength due to moisture aging in GE and FML sandwich specimens with open edges were 29.27% and 22.60%, respectively, and the reduction of high-velocity impact energy absorption were found to be 13.15% and 2.13% for GE and FML specimens, respectively.

Keywords: Sandwich Panel, Balsa, Fiber Metal Laminate (FML), Water Immersion Ageing, Impact Behavior.

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Investigating the Effect of Fiber and Core Type on the Bending and Buckling Behavior of Bio-Based/Green Sandwich Structures

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Abstract

Green sandwich structures have received widespread attention due to their unique features in terms of mechanical properties and degradability. In these structures, the selection of the core material is very crucial due to the resistance of shear and buckling loads. The skin type is also important because of the protection of the core, as well as bearing the bending and impact loads. In this paper, the bending and buckling behavior of bio-based/green sandwich structures was experimentally studied. The whole sandwich structures were manufactured using bio-based materials including Polylactic Acid (PLA) as the matrix, basalt, and hemp fibers as reinforcements as well as balsa and agglomerated cork as core materials. In the next stage, different types of sandwich structures with various skins and cores were subjected to bending and axial compressive loading and the effect of the core and skin type on the structural behavior of these structures was evaluated.

Keywords: Bio-based/green sandwich structures; Agglomerate cork; Balsa; Basalt fiber; Hemp fiber.

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A-10-1771-3

Investigating the Effect of Fabric Surface Texture in the Tensile Properties of Hemp/PLA Bio-Composites

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Abstract

Nowadays, the use of biocomposites as a worthy alternative to traditional synthetic fiber-reinforced plastics is increasing dramatically. Despite this, the high dependence of the material properties on different parameters is considered as one of the greatest challenges of using these composites in real industrial applications. The characteristics of bio-composites are influenced by a number of variables including the type of fibers, fabric surface texture, environmental conditions, manufacturing methods, etc. In this study, the tensile properties of three different types of woven hemp fabric reinforced Poly Lactic Acid (PLA) composites were experimentally studied. The results show that the physical properties of natural reinforcement such as fabric surface texture can significantly affect the mechanical properties of these bio-composites. In addition, it was found that the tensile properties of hemp/PLA bio-composites increase with the increased fineness of the fabric surface texture.

Keywords: Biocomposites, Hemp fibers, Polylactic acid, Fabric surface texture, Tensile properties

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Effect of sewing on the strength of foamy core composite sandwich panels

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Abstract

In this research, a sandwich panel made of polystyrene foam core with fiberglass composite skins is studied. The main purpose of the paper is to investigate the effect of core sewing with polyester yarn on mechanical properties of sandwich panel. Thereby, a polystyrene foam core with a thickness of 10 mm and two fiber glass composite skins are used for the fabrication of the sandwich panel. The size of the samples is 150mm×32mm×12mm, which have been sewed by polyester yarn with different sewing arrangements, and experimentally examined under the three-point bending test. The sewing arrangements are named N, M, W, V according to the form of bindings. According to the obtained results, sewing of the core increases the shear stiffness of the core, but it can damage the core and reduce the strength of the sandwich panel. Among different sewing format, N sewing showed the highest strength and maximum core stiffness.

Keywords: composite sandwich panel, sewed core, shear stiffness

A-10-1773-1

A magnetic nanocomposite based on gelatin-chitosan hydrogel containing Zinc chromite as a novel nanostructure for water treatment

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Abstract

Today, magnetic nanocomposites based on hydrogels has opened a new window to advanced and green technology in order to help the environment due to their amazing properties in separation science and technology. Therefore, in this study, a magnetic nanocomposite based on gelatin-chitosan hydrogel combined with $ZnCr_2O_4$ metal oxide nanoparticles as a green absorber (GE-CS hydrogel/$ZnCr_2O_4$/Fe_3O_4) was introduced. This nanocomposite is characterized and evaluated as a strong adsorbent in the absorption process of methylene blue pigment, which in optimal conditions, the highest efficiency adsorption reported for methylene blue was 99.16%.

Keywords: Magnetic nanocomposite, Natural hydrogel, Adsorption, Methylene blue dye.

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A-10-1774-2

Study of a composite thermal fin performance with uncertain parameters

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Abstract

As a fact, the mathematical models of physical phenomena are based on the exact principles. However, the real world is the world of uncertainties. Particularly, thermos-physical properties of materials, often, are not precisely known due to their experimental nature. Therefore, practically, the effect of uncertain input parameters should be considered. In this study, the heat transfer and thermal performance of a straight composite fin is investigated under uncertain thermos-physical parameters. The uncertainties are modeled with triangular fuzzy numbers. In contrast to the most of common methods, by using fuzzy numbers it is possible to take into account the "expert opinion" on the uncertain parameter via the concept of membership degree. Some of the results of the present study are compared with the results of Monte Carlo method, showing good agreement.

Keywords: Uncertainty, Composite thermal fin, Fuzzy numbers, Granular computing

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A-10-1775-1

Dielectric Characterization of Polymer Composite Materials for Antenna Radome Applications

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Abstract

Radomes can protect antennas from environmental circumstances with minimized electromagnetic attenuation. Radomes should have suitable dielectric and loss tangent coefficients as well as good enough mechanical specifications. In this work, suitable polymer composite materials are considered to apply in antenna radomes. The proposed specimens are made of the mat, woven E-glass fibers, and four kinds of resin such as vinyl ester resins, epoxy ml506, epoxy ly5052, and ker828, respectively. These samples are prepared for dielectric permittivity measurement from 8 to 12 GHz. The results prove that mat fibers and vinyl ester resin achieve the best dielectric properties at RF frequencies. Also, finite element analysis results depict that these composite materials can be used to protect antennas with a high safety factor, also.

Keywords: Radome, Composite materials, Antenna, Dielectric properties

A-10-1776-2

Investigating the Biological Properties of Metal Nanocomposite Synthesized with *Alhagi* Plant extract

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Abstract

Today, one of the most considered methods researchers is production of metal nanoparticles using organisms. Among these organisms' plants seem to be the best candidates and they are suitable for large-scale biosynthesis of nanoparticles. Thus, the use of plant extract for nanoparticles synthesis is a rapid, cost-effective, eco-friendly method. Silver nanoparticles are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physicochemical properties. Nanocomposites have better performance than composites because of the unique properties of nanoparticles. Being environmentally friendly, applications of nanocomposites propose new technology and business opportunities for several sectors of the aerospace, automotive, electronics and biotechnology industries. To realize the above requirements, silver nanoparticles were prepared by *Alhagi* plant extract, and on the salen metal complex as a thin and robust coating for synthesis bio-nanocomposite in order to introduce a novel catalyst with a biological nature.

Keywords: *Alhagi maurorum*, Nanocomposite, Silver, Nanoparticles

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Iron and Magnesium Nanoparticles Adorned on Mesoporous Zeolites: Investigation of Nanocomposite Catalytic Properties

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Abstract

Among the porous inorganic materials, zeolites are greatly contributing to the heterogeneous catalytic reactions. Zeolites have a charge localized surface due to the presence of isolated heteroatoms such as Al, Sn, V, and Ti that are covalently surrounded by crystalline microporous silicon oxide framework. Zeolites are microporous compounds have the ability to modify the surface with nanoparticles due to their high absorption, ion exchange, thermal stability, their specific surface area and higher surface reaction speed. Nowadays, due to their size and morphology nanoparticles have new properties compared to larger particles that the presence of several nanoparticles together causes the formation of nanocomposite. The purpose of preparing nanocomposites is to improve mechanical properties such as strength, stiffness, toughness and efficiency at high temperature. Thus, the main aim of this study was to synthesize a functional-form of Zeoilite@Fe/Mg nanocomposite through the modified two-step Sol-Gel method for enhanced investigate the catalytic properties.

Keywords: Nanocomposite, Nanoparticles, Zeolite, Sol-Gel

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Study the effects of reinforcing elements on the flank wear when milling Al520-MMC

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Abstract

Amongst commercial composites, special attention is paid to metal matrix composites (MMCs). According to the literature, the fabrication process of such materials with additive particles is still the subject of additional studies. Furthermore, limited studies were reported on the effects of reinforcing elements on the machinability of Al-MMC. Therefore, the effects of reinforcing elements, including silicon carbide (SiC), bismuth (Bi), and tin (Sn) particles on the tool flank wear under lubricated and dry milling of Al520-MMC are presented in this work. According to experimental observations, the use of Bi and Sn in the matrix structure of the work part led to an almost 50% reduction in the tool flank wear when machining Al520 + 10% SiC. Despite the reinforcing elements used, higher flank wear was observed under dry machining than those recorded in lubricated mode.

Keywords: Metal matrix composites (MMCs), Al-MMC, Machinability, Tool flank wear, Reinforcing elements

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An investigation into the fabrication of reinforced Al-MMC with the stir-casting process

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Abstract

Metal matrix composites (MMCs) are lightweight materials with various applications in numerous industries and products. However, the composition and the weight of reinforcing particles significantly affect the structural and functional properties of fabricated MMCs. To this end, multiple technologies and approaches were developed to fabricate these materials, and many research works are currently in progress. In this work, the adequacy of the stir casting method to fabricate the Al-MMCS was assessed. The surface and subsurface topography evaluations were then performed to investigate the porosity and homogeneity of the fabricated parts. The experimental results confirm that the matrix structure uniformly dispersed the silicon carbide (SiC) elements. The fabricated parts were then undergone machining operations with coated and non-coated tools under various experimental and lubrication conditions. However, the machining results are beyond this work's scope and will be presented in upcoming articles.

Keywords: Metal matrix composites (MMCs); Al-MMC;Stir casting; Porosity; Topography; Homogeneity

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Definition of Transition Time in Machining Titanium Metal Matrix Composites (Ti-MMCs)

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Abstract

Titanium metal matrix composites (Ti-MMCs) have broad applications in the biomedical and aerospace industries. Although reinforcing elements in MMCs matrix improves the physical, mechanical, and thermal properties; however, rapid tool wear and deteriorated surface finish are the common observations in machining MMCs. In addition, the interaction between the tool and abrasive reinforcing particles induces complex deformation in the MMC structure. Initial wear, steady wear, and rapid wear are three wear zones. In this regard, a comprehensive understanding of the estimated total time spent in each state called sojourn time, and the transition times between each zone are helpful to achieve a better tool life. This work will study the transition time in machining Ti-MMC under different cutting conditions and cutting tools.

Keywords: Metal matrix composites (MMCs); Ti-MMC, Flank wear; Transition Time; Machining

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A proposal for a composite hand cane using the analytical solution and numerical simulation of coaxial orthotropic cylinder

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Abstract

A hand cane is one of the most widely used medical devices, especially for disabled and elderly people. The currently available hand canes in the market are generally made of wood or light metals, but due to the importance of weight and dimensions, a competitive product can be proposed which uses composite. In this paper, an analytical method is used to calculate stresses through the wall thickness of a multi-layered composite cylinder made of orthotropic material to present a proposal for a composite hand cane. This method permits accurate stress analysis of thick-walled composite cylinders subjected to axial load, torsional load, and bending moment. Also, a numerical model is simulated for a composite cylinder subjected to bending moment with a compression axial load. Different stacking sequences and diameters were considered and the stresses of each case were calculated. Finally, the failure criteria are used to evaluate the optimum case.

Keywords: Composite material; Hand cane; Orthotropic cylinder; Finite element; Design.

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In-situ Synthesized nanocomposite Containing Copper/Silver Nanoparticles with *Red Cabbage* extract

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Abstract

In the last decade, nanotechnology and production of the materials in nanometer dimension have attracted a lot of attention. Nanocomposites have gained great importance as one of the branches of the scientific due to their special properties such as high strength, low weight, and excellent durability. One of the methods syntheses of the nanocomposites is the usage of plant extracts, which is called green nanotechnology due to the reduction of cost, energy and time, it has priority over physical and chemical methods. Also, the use of metal nanoparticles, such as copper nanoparticles, due to their cheap price and non-toxicity, has been considered for synthesis of the nanocomposite. Based on this, Schiff base ligand was synthesized and its surface was adorned with copper nanoparticles prepared from *red cabbage* extract and Ag nanoparticles, in order to investigate its biological properties as a novel bio-nanocomposite.

Keywords: Red cabbage, Copper, Silver, Bio-nanocomposite

A-10-1782-1

Surface Functionalization of Di-Nuclear Schiff base with Ag and Ni Nanoparticles as a Novel Bio-nanocomposite

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Abstract

Nanocomposites contain multiphase materials with at least one component in dimensions less than 100 nm. When one of the phases reaches nano dimensions, the properties of nanocomposites of the same phases change compared to normal composites. Today, environmentally friendly methods for the synthesis of nanoparticles, including the use of plants, have been widely used. Silver nanoparticles are the most widely used nanoparticles that show a wide range of biological activities and physicochemical properties such as chemical stability, and catalytic activity. The presence of these nanoparticles next to another metal as a part of nanocomposite components on synthesized organic compounds has made these compounds to be introduced as nanocomposite and show better performance. Finally, the design and preparation of functionalized nanocomposite adsorbent materials are of key importance for wide environmental fields. This study demonstrates a new route to fabricate bio-nanocomposite by encapsulating Schiff base linker with silver nanoparticles and nickel.

Keywords: Di-Nuclear Schiff base, Bio-Nanocomposite, Nanoparticle, Silver.

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The effect of chitosan/silk film loaded with Anti-inflammatory, Antibiotic, and Angiogenic drugs in chronic wound healing

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Abstract

Nowadays, treating chronic wounds using different methods is of interest to many researchers, and using biocomposites with healing properties can be one of these methods. The purpose of this research is to use chitosan (CS) and silk fibroin (SF) along with loads of drugs such as vancomycin (VAN), hydrocortisone (HD), and deferoxamine (DFO) as a new biopolymer composite to heal chronic wounds. In this research found that the presence of CS provided good antibacterial properties. Also, adding SF increased the tensile strength of the biofilm from about 50 to about 70 MPa. In addition, it was found that adding drugs with specific healing properties improves the wound healing process by providing more optimal conditions for cell growth and proliferation. Eventually, the mentioned wound dressing with excellent healing properties and improved mechanical properties can provide a potential therapeutic approach for chronic wounds.

Keywords: Wound healing, Antibacterial properties, Biofilm, Anti-inflammatory, Deferoxamine, Vancomycin, Hydrocortisone, Chronic wound, Drug delivery

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Investigating effect of nanofillers alignment on conductivity of polymer/CNT nanocomposites

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Abstract

In this paper, we have investigated the electrical properties of conductive polymer/CNT nanocomposites with aligned filler using the mean field theory. For this purpose, the effect of diameter and length of the CNT nanoparticle as well as the interphase region on the electrical properties and percolation threshold of the conductive polymer-CNT nanocomposites are studied. The particles in this model are placed in one direction and the conductivity of the particles is calculated in two main directions. The results show that increasing the length of CNT and decreasing its diameter, not only increases the conductivity of the nanocomposite but also reduces the electrical percolation. In other words, the adhesion of the CNT particles to each other reduces the aspect ratio and thus reduces the performance of the conductive polymer. Also, aligning the particles in one direction causes a significant increase in conductivity and a decrease in percolation threshold in polymer/CNT nanocomposites.

Keywords: Conductive nanocomposites; Filler alignment; Mean filed theory; Percolation threshold; Polymer/CNT composites

A-10-1787-1

Effects of Shot-peening on the mechanical properties of extruded Mg/2.5%HA biocomposite

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Abstract

Magnesium is an appropriate material to use in biomedical applications due to its similar properties to human bone and its biocompatibility. Shot-peening can enhance the mechanical properties of magnesium-based materials, including their surface hardness. In this research, the extruded 2.5% Hydroxyapatite reinforced Mg composite samples were shot-peened by 400 µm glass beads at 0.5 mmN Almen arc height. The effect of shot-peening on the surface hardness and roughness was studied. Furthermore, the tensile and compressive properties of the shot-peened Mg/2.5%HA composites were evaluated. The results revealed that shot-peening increases surface hardness and roughness. Furthermore, uniaxial tensile and compressive tests indicate an increase in tensile fracture strain, compressive yield, and ultimate stresses.

Keywords: Shot-peening; Surface modification; Magnesium composite; Hydroxyapatite

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Wear Behavior and Microstructure Characteristics of A356/ZrO_2+Al_2O_3 Hybrid Composite

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Abstract

Improving wear resistance is the most crucial property expected from metal matrix composites (MMCs). In this study, wear parameters, i.e., weight loss, wear rate, and friction coefficient of A356/ZrO2+Al2O3 with and without bismuth were evaluated using a pin-on-disc test. Hybrid composites were manufactured using the vortex technique in which reinforcement particles were added in the semi-solid state at 605±5 oC. Results show that ZrO2 and Al2O3 reinforcements were successfully embedded in the A356 matrix. The distribution of particles was more uniform in the Bi-containing composite. Bismuth addition improves wear characteristics in which weight loss, wear rate, and friction coefficient were measured at 0.0014 g, 0. 19 mm3/m, and 0.28, respectively. This can be related to the intrinsic role of bismuth lubrication and reducing the melt's surface tension. Abrasive and adhesive wear mechanisms were observed on the worn surfaces of fabricated composites.

Keywords: Hybrid composite, Wear, ZrO2, Al2O3

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Effect of interlayer dry area extent and interlaminar delamination on the tensile strength of composite plates manufactured by vacuum infusion process

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Abstract

If the infusion strategy in Vacuum infusion process (VIP) is not followed according to the recommended procedures, the resin might not be able to reach some fibers of the composite plate leading to development of patches of dry regions in the composite plate. In this research, six types of 4-ply glass/epoxy composite plates were manufactured. In the first type, no dry region was created in the whole composite plate. In the second type, parts of the first ply, in the third type, parts of the first and second plies, in the fourth type, parts of the first, second, and third plies, and in the fifth type, parts of all the plies were kept dry. In the sixth type of composite plate, a delamination between the second and first layers was induced. The results showed that the presence of dry areas decreases the tensile strength for 12-34%, while the induced delamination decreases the tensile strength for 13%.

Keywords: Vacuum infusion process; Dry fibers; Composite; Tensile test

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The effect of the presence of bubbles inside resin on the tensile strength of composites manufactured by vacuum infusion process

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Abstract

The presence of voids in the structure of composites is one of the important manufacturing defects which has an undesirable effect on the quality of the composite parts. One of reasons the voids appear in a composite plate is the presence of bubbles in the resin before it is infused. In this research, the effect of bubbles in the resin and degassing before the infusion process on the strength of the glass fiber composites is investigated. Four samples infused by a resin with bubble to resin ratios of 2%, 3%, 4% and 5%, and two samples manufactured with degassed and non-degassed resin. The composites were cut and tested according to the ASTM D3039. The results showed that non-degassing and the presence of bubbles decreases the strength of samples from 4 to 21.7%. More specifically, each 1% increase in the volume of bubbles decreases the final strength of the composite obtained from the tensile test by 4.1% in average.

Keywords: Bubbles; Vacuum infusion process; Void defect; Tensile strength.

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Magnetic gelatin-chitosan hydrogel incorporated with graphene oxide as an effective nanocomposite for methylene blue adsorption

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Abstract

Due to recent environmental issues related to water contamination with different types of pollutants such as pigments, developing new and green catalysts for water treatment is an important research subject. In this study, a novel magnetic nanocomposite based on chitosan and gelatin natural polymers combined with graphene oxide (CS-Ge hydrogel/GO/Fe_3O_4) was designed and its ability for methylene blue adsorption was investigated. This composite was characterized using FE-SEM, VSM, TGA and FT-IR and the results indicated that this nanocomposite adsorbed 98.6% of methylene blue, and it can be a potential candidate for water purification applications.

Keywords: Graphene oxide, Gelatin-Chitosan Hydrogel, Magnetic nanocomposite, Water treatment

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Mechanical response of honeycomb and chiral meta-structures under axial compression loading

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Abstract

Improving material's impact resistance while keeping them lightweight is a significant challenge in science and engineering. Meta-structures can provide a strong solution to this problem. The properties of these materials can be tailored and optimized to fit a purpose by changing their internal structure. Meta-structures are structures with usual materials but unusual and useful properties resulted from their internal structures rather than their chemical composition. Meta-structures are commonly known as structures with negative Poisson's ratio (NPR) or auxetic performance. Auxetic structures have high transverse shear modulus and enhanced impact energy absorption performance. In this study, four different lattice structures, i.e., conventional honeycomb, re-entrant honeycomb, tetra chiral, and anti-tetra chiral structures with the same surface density were designed and fabricated through fused deposition modeling (FDM) 3D printing. The structures are tested under compressive axial loading to investigate energy absorption. The Poisson's ratio of the structures is obtained using Digital Image Correlation (DIC).

Keywords: Meta-structures, re-entrant honeycomb, Chiral, 3D printing, Negative Poisson's ratio

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Piezoelectric Effects of Bone Scaffolds of Poly (L-lactic Acid) and Gelatin with Carbon Nanotubes

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Abstract

The piezoelectric effect of scaffold is crucial to restoring the natural environment of bone tissue. This study used poly(L-lactic) acid, gelatin and carbon nanotubes(CNT) to prepare the electrospun scaffold. The output voltage of the scaffold was increased by %60 and scaffolds showed a high percentage of cell viability in the cytotoxicity test.

Keywords: Bone Scaffold, piezoelectric, Poly (L-lactic) Acid, Carbon Nanotubes

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Numerical permeability measurements of a woven fabric preform for different clear-fluid and porous medium interface conditions

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Abstract

Numerical simulations are widely accepted for permeability measurements of fabric preforms used in liquid composite molding (LCM). The lack of research about interface conditions raises the question of the applicability and reliability of these conditions in the simulations of fluid flow through a porous medium. It is obvious that the well-known Navier-Stokes equation can safely be applied to the clear-fluid region though, for the porous region it is not yet well-established, what interface conditions can best accompany the Darcy and/or Brinkman governing equations. Hence, in this paper, these governing equations are employed, with some of the appropriate interface conditions to signify the variations of permeability results due to different mathematical parameters in a validated numerical model. Commercial software COMSOL is used for our simulations, and permeability measurement results for different interface conditions are presented and discussed. The numerical and experimental results are also compared for a woven fabric preform.

Keywords: Composite manufacturing process, Interface conditions, LCM, Permeability measurement

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Improvement of the electrochemical behavior of polymer electrolyte using covalent organic frameworks nanofiller

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Abstract

Researchers seek to improve the mechanical and electrochemical properties of flexible batteries, supercapacitors, etc. In the field of flexible batteries, they are looking to replace liquid electrolytes with solid polymer electrolytes (SPE) to increase the safety of batteries. Due to the wide range of studies, poly(vinylidene fluoride-co-hexafluoropropylene) PVDF-HFP is considered to be an acceptable polymer matrix in terms of electrochemical stability and excellent flexibility. In the present study, the electrochemical behavior of the SPE has been investigated for 45 days. By adding covalent organic framework (COF) nanofillers into the SPE, the electrochemical behavior of SPE has been considered. Adding different percentages of COFs into the SPE shows a shorter duration of stabilization of the polymer matrix compared to the initial state (rejuvenating). Moreover, the results show an improvement of the ion conductivity (around 2.21e-4 S/cm) and enhancing the electrochemical performance of the SPE inside a flexible battery.

Keywords: Rejuvenating, Anti-aging, Polymer electrolyte, Nanofillers, Covalent organic frameworks.

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Evaluating the effect of standing waves on morphological properties of spinodal topologies

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Abstract. During the spinodal decomposition process, a solid solution will be decomposed to its' constituent phases due to thermodynamical instability. It has been shown that the phase-field in this chemical process can be described by a superposition of some standing waves with fixed wave numbers but uniformly distributed waves' directions on the surface of the unique sphere and waves' phases uniformly distributed between 0 and 2π. It has been shown that if the number of the standing waves is large enough, the phase-field will tend to be a Gaussian Random Field (GRF) with specific morphological properties. However, the relationships between the number of standing waves and morphological properties have not been investigated yet. In this work, we shall examine this issue. In the first stage, by superposing various numbers of standing waves, the phase-field in a specific two-dimensional Representative Volume Element (RVE) is computed. In the next step, the level set method has been applied to construct spinodal topologies. For each topology, morphological properties like Betti numbers and relative density are computed, and the relationships between the number of standing waves and morphological properties are investigated. In order to consider the randomness of structures, the computations have been repeated fifteen times, and the mean value and variance of the morphological properties for a fixed level set threshold have been computed.

Keywords: Betti numbers; relative density; standing waves; Gaussian Random Field; morphological properties; spinodal

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Investigation of thermal behavior of epoxy coatings containing surface-modified hollow glass microspheres

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Abstract

In this study, a coating based on epoxy resin containing surface-modified hollow glass microspheres (HGM) (5, 7, and 10% w/w) has been used as a thermal insulation composite. The surface of the hollow glass microspheres is modified with an appropriate amount of silane coupling agent (Amino propyl tri ethoxy silane). The thermal conductivity of the coatings was measured with a temperature-modulated scanning differential calorimeter (TMDSC). The effects of HGMs concentration and surface modification on the thermal and mechanical properties of coatings have been investigated. It was found that the coating containing 5% by weight of modified HGMs has optimal properties compared to other coatings. The coefficient of thermal conductivity in the optimal value has decreased to 26% compared to blank epoxy and has reached 0.16 w/m.k.

Keywords: Hollow glass microspheres, Thermal insulation coatings, Thermal conductivity coefficient, TMDSC.

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Toughened Biodegradable PLA: Comparison Between the Mechanical Performance of EPDM and PBR

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Abstract

As a promising approach to toughen biodegradable poly(lactic) acid (PLA) with elastomeric materials, the mechanical performance of ethylene propylene diene monomer (EPDM) and polybutadiene rubber (PBR) integrated with PLA was separately studied through the melt mixing method. PLA/PBR blended with a composition of 90/10 showed excellent toughness around 106% in elongation at break, which is 45 times superior to virgin PLA. This value was acquired by nearly 22% at the same weight ratio for PLA/EPDM compound. Meanwhile, obtained results from the notched Izod impact test indicated higher improvement in 90/10 blend of PLA/EPDM with 5.34 J/m, whereas the performed Izod impact on the PLA/PBR reached 2.11 J/m in alike formulation, evaluated 2.5 times lower. All demonstrated tensile examinations showed that PBR could prominently enhance the ductility of inherently brittle PLA which lies in higher resiliency of PBR than EPDM, however, EPDM reinforced greatly the impact resistance of PLA.

Keywords: polylactic acid, elastomeric materials, mechanical properties, biodegradable thermoplastic

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Simulation of mixed-mode I/II delamination growth in laminated composites considering fracture process zone

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Abstract

In this paper, the multi-linear cohesive zone model has been extended to simulate the delamination growth in laminated composites under mixed-mode I/II loading. In order to take into account the effects of the fracture process zone and the residual strength of the damaged material in this zone, spring elements have been used whose stiffness characteristics change gradually according to the traction-separation curve with any arbitrary shape of softening behavior (in general case of n-linear breaks). In the extended model, to apply mode II loading in addition to mode I, the angle of spring elements in each mixed mode ratio has been calculated using analytical equations and applied in the finite element model. Finally, to validate the presented model, the load-displacement curves extracted from simulation are compared with the available experimental results.

Keywords: Delamination; Laminated composite; Multi-linear cohesive zone model; Fracture process zone; Mixed-mode I/II loading.

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Numerical analysis of the face material effect on the bending behavior of honeycomb sandwich structure

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Abstract

The use of new composite materials and structures with optimal mechanical properties along with low weight is one of the issues raised in the industries. In this study, the bending behavior of sandwich structures with aluminum honeycomb core and three different materials for the face, carbon-epoxy, glass-epoxy, and aluminum have been analyzed. To analyze the bending behavior, the finite element method has been done by Abaqus software. Samples were subjected to three-point bending test based on the ASTM C393-00 standard and force-displacement diagrams were extracted. Also, the maximum-bending force, modulus, and strength were obtained. maximum-force relative to weight for aluminum, carbon-epoxy, and glass-epoxy obtained 27.3, 24.9, and 21.1 respectively. Finally, the numerical method in this study was validated. With this finite element method, the results of other research are verified that these results had a good agreement. So, the presented model for these sandwich structures can be used and improved.

Keywords: Numerical analysis, Flexural behavior, Honeycomb sandwich structure, Three point bending

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A-10-1811-1

Re-use of thermoplastic polymeric composites reinforced with glass fibers as fillers in the manufacture of epoxy flooring

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Abstract

Due to the wide range of fiber-reinforced composites, the popularity of recycling them has increased. The aim of this study was to re-use waste polymer composites reinforced with glass fibers for use as fillers in the production of epoxy flooring. By using mechanical crushing particles of these composites according to the size and percentage of a certain volume, they were constructed with flooring materials of samples containing the recovered particles so that with 3 particles with 20% and 40% combined percentage of epoxy resin, 6 samples were obtained. By examining the mechanical properties obtained from different tests and analyzing the samples, it was observed that mechanical properties such as tensile strength (between 40% and 163%) and hardness of the final sample increased and with the particle microleakage these properties increased, so the application of these particles can be an efficient method for waste management and production of new waste efficient composites.

Keywords: Fiber reinforced polymer composite, Fiber reinforced polymer material recycling, Waste management.

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The effect of water absorption on the shear properties of glass-Epoxy laminates include woven fabric with different areal density

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Abstract

In this article, the effect of water absorption on the shear properties of glass-Epoxy laminates including woven fabrics with different areal density investigated experimentally. Laminates are constructed by the vacuum injection process. The total Areal density of laminates is equal but laminates are different in the number of layers and layers' areal density. Shear modulus and strength of laminates compared before and after water absorption. Also, the toughness of the laminates has been compared using the Area below the shear stress-shear strain diagram. Laminates are made of fabrics with an areal density of 200, 400, and 600 grams per square meter. The results show in dry samples, with the increase of the areal density, first the shear properties and the absorbed energy increased and then decreased. Also, Humidity has generally reduced all the parameters, and it has reduced the shear modulus, shear strength, ultimate stress, rupture strain, and absorbed energy for some samples by 30, 35, 53, 32, and 60%, respectively have given.

Keywords: water absorption, shear properties, woven fabric, areal density

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Comparison of first-order and higher-order basic theories in calculating critical buckling load of marine sandwich panels

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Abstract

This paper focuses on some of the most widely used theories for global buckling of sandwich panels, (a) Allen's thick face version formula (first-order), (b) High-Order Sandwich Panel Theory (HSAPT) and (c) Extended High-Order Sandwich Panel Theory (EHSAPT). These three theories provide the most accurate and well-known buckling analysis methods for sandwich panels. In order to evaluate the accuracy and correctness of these theories, the buckling behavior of some carbon/epoxy PVC core composite sandwich panels are experimentally studied in this work.

Keywords: Carbon/epoxy PVC core sandwich, Buckling test, Higher-order theory.

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Numerical analysis of vibration behavior of sandwich composite structure with three different types of core

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Abstract

In recent years, due to properties such as high specific strength, low weight, and resistance to damage propagation, sandwich composite panels have been widely used in various industries such as marine, automotive, nuclear, pressure vessels, and aerospace. In this research, three sandwich composite structures with honeycomb, hexagonal and square cores were modeled and analyzed numerically in order to determine the vibrational behavior of the structure. In the numerical method, first, the geometric model and the finite element of the desired structure were created using Abaqus software, and subsequently, analyses of free vibration behavior, extraction of natural frequencies and mode shapes were performed. The results of the natural frequency revealed that the structure with the honeycomb core has higher stiffness than that of other structures. The structure with the honeycomb core had 2.5% and 31.2% higher first frequency than those with hexagonal and square core, respectively.

Keywords: Numerical analysis, Natural frequency behavior, Sandwich structure, Honeycomb core, hexagonal and square core.

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Developing an Empirical Model for Predicting Short Fibers Alignment Angle

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Abstract

In this paper, an empirical model is developed to predict short nickel coated carbon fibres alignment inside epoxy resin in the presence of magnetic field. The model, which is an exponential function, is fitted to experimental data under different conditions including three alignment parameters, field strength, fibre length and fibre weight fraction. The model outputs a parameter α for different conditions which is used in combination with theoretical models, results in the average angle of fibre. The model shows a very good compatibility with experimental results especially in low concentrations of fibres and also overcomes the two significant limitations of current light transfer method, including sample thickness and resin transparency limitations.

Keywords: empirical model, epoxy composites, fibre alignment, short fibres

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Fabrication of metal matrix composite on A516 steel and investigation the effect of powder composition on microhardness

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Abstract

In this research, the effect of adding carbide powder particles (TiC-NbC) and the formation of metal matrix composite welding zone (MMC) was done by TIG welding process and the effect of different weight percentages of these particles on microhardness was studied. For this purpose, welding operation was performed with a current intensity of 120 amps and a speed of 1.36 mm/s on A-516 steel with a thickness of 10 mm and an outer diameter of 24 inches, and different weight ratios of TiC/NbC particles were placed in the welding area. The filler metal used in this study was ER70S-2. In order to check the hardness profile in the cross section of the welded samples, microhardness test was used. The highest hardness was obtained in the TN100 composite weld sample (composite weld containing 100% TiC carbide microparticles).

Keywords: Welding, microhardness, metal matrix composite, A516 steel.

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Effect of Friction stir process (FSP) and surface compositing on tribological properties of pure copper

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Abstract

In this research, effect of Friction stir process (FSP) and making Cu/WC-Co surface composite on the wear behavior of pure copper was investigated. In order to examine microstructure of samples, an optical microscope was used. As a result of both methods of FSP and surface compositing, a fine grained and homogeneous microstructure was observed in the stir zone. Microhardness changes were measured using a Vickers microhardness machine. Based on results of this test, surface composites resulted in an increase in microhardness. The wear properties were evaluated by reciprocating wear test. The results showed that performing FSP on pure copper and making surface composite improve the wear resistance of copper by 69 and 86%, respectively. Examination of wear surfaces and particles by scanning electron microscope (SEM) showed that the main wear mechanism was delamination wear.

Keywords: Copper, FSP, surface composite, wear, microhardness

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The 8th International Conference on Composites: Characterization, Fabrication and Application (CCFA-8) is aimed to bring together both engineers and researchers of the field to review and discuss the recent practical and theoretical methods/ approaches to address composite characteristics and manufacturing processes. The conference topics are:

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