Composite & Smart

Materials and Structures

No. 3, Mar. 2023

Monthly eNEWSLETTER

MoU signed between IIT Delhi, India and K. N. Toosi University of Technology, Tehran, Iran

Editorial board

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Editorial Message

Smart/multifunctional materials and structures are widely used in medical, automotive, energy and aerospace technologies for applications such as force sensing, actuation, energy harvesting and structural health monitoring. While a large number of smart materials exhibiting interesting multiphysics phenomena have emerged in the past few decades, only a minuscule fraction of these have been successfully translated to engineering applications. Most engineering applications, for instance, utilize piezoelectric materials and shape memory alloys (SMAs) due to their robust response, repeatability and wide availability. With the recent scientific advancements in fields such as artificial intelligence, biomimetics, nanotechnology, there is a growing need for smart/responsive materials that can enable miniaturization, improve data storage and energy efficiency. To address these larger problems and to better utilize the existing smart materials, it is important that research advancements across various scientific and engineering communities come together.

To this end, we hope that this newsletter will provide a channel for researchers at IIT Delhi and K.N. Toosi University of Technology to showcase their work and learn more about ongoing work in this field. This in turn can improve collaboration wherein researchers with complimentary expertise can come together to address those larger problems. In closing, I would like to thank Prof. S.M.R Khalili for his efforts in bringing out this newsletter and starting the smart materials forum. These efforts will surely benefit the growing smart materials community across the two partner institutions.

Dr. Sushma Santapuri

Department of Applied Mechanics, IIT Delhi

Contents

You will read in this issue:

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enews.compsmart@gmail.com

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Composite & Smart
Materials and Structures
No. 3, Mar. 2023
Monthly eNEWSLETTER

Recent Publication of Faculties and Students

A generalized model for one dimensional impact response of a heterogeneous layered medium
Authors: Satyendra Pratap Singh, Harpreet Singh, Puneet Mahajan
Publication date: 1/3/2023
Journal: International Journal of Impact Engineering
Volume: 173, Pages:104433, Publisher: Pergamon

Asymmetric Vibrations of Functionally Graded Annular Nanoplates under Thermal Environment Using Nonlocal Elasticity Theory with Modified Nonlocal Boundary Conditions
Authors: Rahul Saini, S Pradyumna
Publication date: 1/5/2023
Journal: Journal of Engineering Mechanics
Volume: 149, Issue: 5, Pages: 04023022,
Publisher: American Society of Civil Engineers

Structural instabilities in soft electro-magneto-elastic cylindrical membranes
Authors: Awantika Mishra, Yadwinder Singh Joshan, Sajan Kumar Wahi, Sushma Santapuri
Publication date: 1/5/2023
Journal: International Journal of Non-Linear Mechanics
Volume: 151, Pages: 104368, Publisher: Pergamon

Efficient time-domain spectral element with zigzag kinematics for multilayered strips
Authors: Mayank Jain, Santosh Kapuria, S Pradyumna
Publication date: 15/10/2022
Journal: International Journal of Mechanical Sciences
Volume: 232, Pages: 107603, Publisher: Pergamon

Dynamic modeling of pneumatic braided muscle actuator based on Hill muscle model
Authors: Saswath Ghosh, Abhishek Kumar Srivastava, Sitikantha Roy
Publication date: 1/4/2023
Journal: International Journal of Non-Linear Mechanics
Volume: 150, Pages: 104340, Publisher: Pergamon

A multi-scale aqueous dispersion coating technique for manufacturing carbon fiber reinforced PEEK composite
Authors: V Balakumaran, Ramasamy Alagirusamy, Dinesh Kalyanasundaram
Publication date: 1/2/2023
Journal: Composites Part A: Applied Science and Manufacturing
Volume: 165, Pages: 107314, Publisher: Elsevier

Recent Publication of Faculties and Students

Investigating the impact of different machinability processes and fibre architecture on the bearing performance of pin-loaded textile structural composites for automotive …
Authors: Sandeep Olhan, Sameer Kumar Behera, Vikas Khatkar, BK Behera
Publication date: 27/1/2023
Journal: Journal of Manufacturing Processes
Volume: 86, Pages: 30-55, Publisher: Elsevier

Comparative analysis of aluminium core honeycomb with 3D woven Kevlar honeycomb composite
Authors: Lekhani Tripathi, Bijoya Kumar Behera
Publication date: 23/2/2023
Journal: Materials Science and Technology
Pages: 1-12
Publisher: Taylor & Francis

Processing and performance evaluation of agro wastes reinforced bio-based epoxy hybrid composites
Authors: Rahul Joshi, Pramendra Kumar Bajpai, Samrat Mukhopadhyay
Publication date: 1/2/2023
Journal: Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications
Volume: 237, Issue: 2, Pages: 482-499, Publisher: SAGE Publications

Creep behaviour of ozone treated jute fabric/epoxy composites
Authors: Debarati Bhattacharyya, Vijay Baheti
Publication date: 17/2/023
Journal: Journal of Composite Materials
Publisher: SAGE Publications

Computation of the homogenized linear elastic response of 2D microcellular re-entrant auxetic honeycombs based on modified strain gradient theory
Authors: S Mohammad Reza Khalili, SM Akhavan Alavi
Publication date: 1/2023
Journal: Journal of the Brazilian Society of Mechanical Sciences and Engineering
Volume: 45, Issue: 1, Pages: 19

Free vibration analysis of rotating functionally graded conical shells reinforced by anisogrid lattice structure
Authors: Seyed Masih Banijamali, Ali Asghar Jafari
Publication date: 3/4/2023
Journal: Mechanics Based Design of Structures and Machines
Volume: 51, Issue: 4, Pages: 1881-1903, Publisher: Taylor & Francis

Composite & Smart
Materials and Structures
No. 3, Mar. 2023
Monthly
eNEWSLETTER

Recent Publication of Faculties and Students

Experimental research on the impact of oxygen control zone thickness on continuous layerless printing of porous polymer parts
Authors: Mohammad Salehi, Siavash Moayedi Manizani, Mohammad Shayesteh, Amir Manzour, Jamal Zamani
Publication date: 10/3/2023
Journal: Modares Mechanical Engineering
Volume: 23, Issue: 3, Pages: 151-159, Publisher: Modares Mechanical Engineering

Rate-dependent electromechanical behavior of anisotropic fiber-reinforced dielectric elastomer based on a nonlinear continuum approach: modeling and implementation
Authors: Marzie Majidi, Masoud Asgari
Publication date: 1/2023
Journal: The European Physical Journal Plus
Volume: 138, Issue: 1, Pages: 1-29
Publisher: Springer Berlin Heidelberg

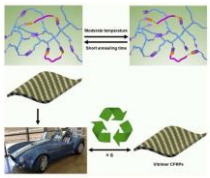
A novel experimental method and computational micromechanical model for in-situ damage detection and prediction of stiffness degradation in cross-ply FML
Authors: Rahmatollah Ghajar, Mehrdad Ghadami
Publication date: 1/2/2023
Journal: Composite Structures
Volume: 305, Pages: 116492, Publisher: Elsevier

A multi-scale aqueous dispersion coating technique for manufacturing carbon fiber reinforced PEEK composite
Authors: V Balakumaran, Ramasamy Alagirusamy, Dinesh Kalyanasundaram
Publication date: 1/2/2023
Journal: Composites Part A: Applied Science and Manufacturing
Volume: 165, Pages: 107314, Publisher: Elsevier

The effect of thermal and cryogenic environments on the impact performance of aluminum-glass fibers/epoxy laminated composites
Authors: Mohammad Askari, Mehrdad Javadi, Reza Eslami-Farsani, Abdolreza Geranmayeh
Publication date: 3/7/2023
Journal: Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science
Pages: 09544062231159485, Publisher: SAGE Publications

Fire Resistance Evaluation of Concrete Beams and Slabs Incorporating Natural Fiber-Reinforced Polymers
Authors: Venkatesh Kodur Svetha Venkatachari Pratik Bhatt Vasant A. Matsagar, Shamsher Bahadur Singh
Publication date: 2/2/2023
Journal: Polymers
Vol: 15, Issue: 3, Pages: 755, Publisher: MDPI

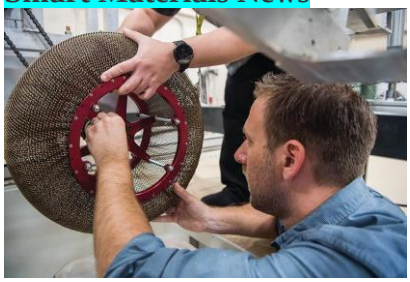
New application of composite Materials



Oak Ridge National Laboratory scientists designed a recyclable polymer for carbon-fiber composites to enable circular manufacturing of parts that boost energy efficiency in automotive, wind power and aerospace applications.
Carbon-fiber composites, or fiber-reinforced polymers, are strong, lightweight materials that can help lower fuel consumption and reduce emissions in critical areas such as transportation. However, unlike metal competitors, carbon-fiber composites are not typically recyclable, meaning wider adoption could present waste challenges.
"Our goal is to extend the lifecycle of these materials by making reuse possible without sacrificing performance," said ORNL's Md Anisur Rahman.
The team's approach incorporates dynamic covalent bonds that are reversible, enabling both carbon fiber and polymer recycling. The new polymer maintained mechanical strength in six reprocessing cycles, a sharp contrast to previously reported polymers.
"ORNL's carbon-fiber composites enable fast processing and can be repaired or reprocessed multiple times, opening pathways to circular, low-carbon manufacturing," said ORNL's Tomonori Saito.

The research was published in Cell Reports Physical Science.

Smart Materials News



CLEVELAND—While NASA's newest tire is the result of years of research and development, it was a chance meeting between old colleagues that moved it from a unique R&D project to a key piece of an upcoming mission to Mars.
The team at NASA Glenn Research Center in Cleveland engineered a tire—the Shape Memory Alloy (SMA) Spring Tire—that can handle the heavy load of a lunar rover while traversing rough, rocky Martian terrain and enduring extreme temperatures.
And while the launch date is years away, the practical uses of the technology already have emerged on the consumer market.

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K. N. Toosi University of Technology

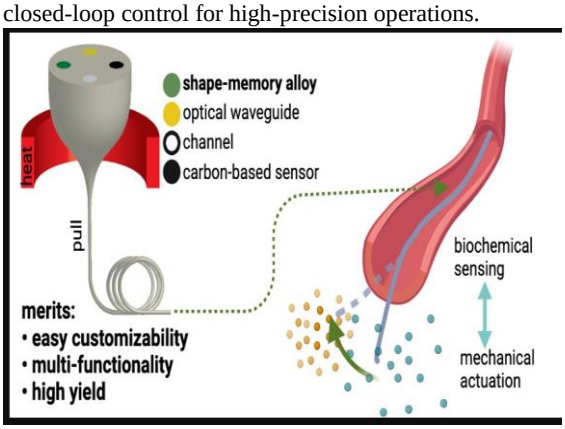
Monthly eNEWSLETTER

News on smart materials

Navigating complex biological systems with smart fibers

Integrative actuators and sensors within a single active device offer compelling capabilities in developing robotics, prosthetic limbs, and minimally invasive surgical tools. However, instrumenting smart and active devices with miniaturized sizes for easy customizability and high yield is largely restricted by the current manufacturing technologies.

Now, a team of researchers has developed a flexible polymer-based actuatable fiber that is capable of being integrated with smart materials and biosensing composite materials. The technology may lead to technological advancements in soft and flexible robotic fields, which could open possibilities for achieving closed-loop control for high-precision operations. It has both mechanical actuation realized by the incorporated shape-memory alloy (SMA) wires and biochemical sensing provided by carbon-based composite materials. The tip of such a fiber could be actuated with a high spatiotemporal resolution by the shape-memory effect. And, its integrated carbon composite exhibits intrinsically high sensitivity toward electroactive molecules. The actuatable fiber sensor technologies developed here can greatly push the technological advancement in the soft and flexible robotic fields to include additional functions on top of their pure mechanical behaviors and open possibilities for achieving closed-loop control for high-precision operations.



An active fiber fabricated by the thermal drawing
To Know more click on link provided- *Yuichi Sato et al, Shape-Memory-Alloys Enabled Actuatable Fiber Sensors via the Preform-to-Fiber Fabrication, ACS Applied Engineering Materials* (2023).
https://pubs.acs.org/doi/10.1021/acsaenm.2c00226

Laboratory and CoE

Rapid Prototyping Lab (Block-III 152)
Faculty in charge: **Prof. PM Pandey**

Rapid Prototyping is an institute central facility created in year 2004. The facility is extensively used by students and faculty across the entire institute apart from many individuals and industries out side IIT Delhi. The term rapid prototyping (RP) refers to a class of technologies that can automatically construct physical models from Computer-Aided Design (CAD) data. These "three dimensional printers" allow designers to quickly create tangible physical prototypes of their designs, rather than just two dimensional pictures. Rapid prototyping machine installed at IIT Delhi is based on Selective Laser Sintering (SLS) technology. The process uses polymer powder (polyamide) as a raw material to build artifacts irrespective of their complexity. The prototypes can be made in five different materials namely polyamide, glass-filled polyamide, Alumide (Aluminium mixed polyamide), primecast (wax type of material) and Somos (rubber-like material).

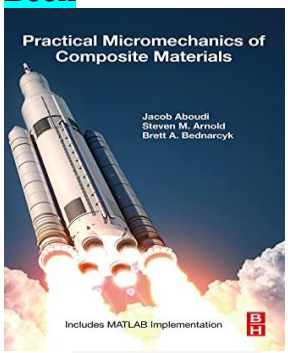
Facilities

EOS P360 Rapid Prototyping Machine from EOS GmbH, Germany, Powder mixer, Powder sieving machine
Shot blasting machine, Magics & Mimics Software

Research Laboratory and CoE

Research Lab: **Mechanics of Advanced Materials** (Block IV) Coordinator: **Dr. Sushma Santapuri;** lab works on analysis of smart/active materials and their applications to sensors and actuator device design, soft robotics. They work on coupled nonlinear theory development, computational analysis and design. Currently they are working on magnetorheological elastomers, magnetostrictive materials, dielectric elastomers, flexoelectric materials. Focus areas: Continuum mechanics; magnetoelasticity; magnetostriction; electroelasticity; asymptotic theories (beam, plate, membrane, rod etc.); energy harvesting; force sensors; actuators.

Book



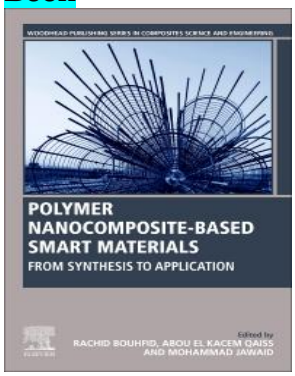
ISBN: 978-0-12-820637-9
Page count: 400
Published: 2021
Publisher: Butterworth-Heinemann
Language: English
Authors: Jacob Aboudi, Steven Arnold and Brett Bednarcyk

Practical Micromechanics of Composite Materials provides an accessible treatment of micromechanical theories for the analysis and design of multi-phased composites. Written with both students and practitioners in mind and coupled with a fully functional MATLAB code to enable the solution of technologically relevant micromechanics problems, the book features an array of illustrative example problems and exercises highlighting key concepts and integrating the MATLAB code. The MATLAB scripts and functions empower readers to enhance and create new functionality tailored to their needs, and the book and code highly complement one another. The book presents classical lamination theory and then proceeds to describe how to obtain effective anisotropic properties of a unidirectional composite (ply) via micromechanics and multiscale analysis. Calculation of local fields via mechanical and thermal strain concentration tensors is presented in a unified way across several micromechanics theories. The importance of these local fields is demonstrated through the determination of consistent Margins of Safety (MoS) and failure envelopes for thermal and mechanical loading. Finally, micromechanics-based multiscale progressive damage is discussed and implemented in the accompanying MATLAB code.

Contents:

1. Introduction.
2. Lamination theory using macromechanics
3. Closed form micromechanics
4. Failure criteria and margins of safety.
5. The generalized method of cell (GMC) micromechanics.
6. The high-fidelity generalized method of cells (HFGMC) micromechanics theory.
7. Progressive damage and failure

Book



ISBN: 978-0-08-103013-4
Page count: 241
Published: 2020
Publisher: Woodhead Publishing
Language: English
Edited by: Rachid Bouhfid, Abou el Kacem Qaiss and Mohammad Jawaid

Polymer Nanocomposite-Based Smart Materials*: From Synthesis to Application* provides a broad, comprehensive review on all major categories of smart materials and their preparation routes. The main application fields and properties for these diverse types of smart polymer-based composite and nanocomposite materials are also discussed. Chapters on modeling methods and simulation look at the physical or chemical change response that is introduced by the effect of changing environmental conditions such as pH, temperature, mechanical force and light. Written by scholars and experts from around the globe, the book covers key aspects, such as synthesis, processing and applications of polymer and nanocomposite-based smart materials.

Contents:

1. Introduction: different types of smart material and their practical applications, 2. Role of characterization techniques in evaluating the material properties of nanoparticle-based polymer materials, 3. Self-healing based on composites and nanocomposites materials: from synthesis to application and modelling, 4. Thermochromic composite materials: synthesis, properties and applications, 5. Piezoelectric polymer films: synthesis, applications, and modelling, 6. Shape memory based on composites and nanocomposites materials: from synthesis to application, 7. Self-assembling smart materials for biomaterials applications, 8. Electroactive polymer composites and applications, 9. Polymer nanocomposites smart materials for energy applications, 10. Smart materials for medical applications, 11. Smart composite materials for civil engineering applications, 12. Molecularly imprinted polymer for water contaminants.

Composite & Smart

Materials and Structures

No. 3, Mar. 2023

K. N. Toosi University of Technology

Monthly eNEWSLETTER

Conference

Celebrating Professor J.N. Reddy receiving the ASME *S. P. Timoshenko Medal* and the *IACM Congress (Gauss-Newton) Medal*

Texas A&M Hotel and Conference Center,
Texas A&M University, College Station, Texas

Organized by

TEES | Center of Innovation in Mechanics for Design and Manufacturing
TEXAS A&M ENGINEERING EXPERIMENT STATION

&

J. Mike Walker '66 Department of Mechanical Engineering
Texas A&M University, College Station

Conference

Research opportunities

1) ASSISTANT PROFESSOR SHIB SHANKAR BANERJEE
MATERIAL SCIENCE AND ENGINEERING
IIT DELHI

The group is actively looking for highly motivated Ph.D students and research fellows who would like to work in the research areas highlighted in the webpage. The group is also looking for Postdoc Fellows with fellowship from independent sources like National Postdoctoral fellowship (N-PDF), CSIR, DST, etc.

Please feel free to contact Dr. Banerjee (ssbanerjee@mse.iitd.ac.in) to discuss research interests and potential projects.

https://sites.google.com/view/shib-shankar/openings

2) PROFESSOR B K BEHERA
DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING
IIT DELHI

We are looking for Faculty candidates in leading areas are encouraged to apply through the online portal https://ecampus.iitd.ac.in/IITDFR-0/login for appointment. The website also contains useful information on various aspects of working and living at IIT Delhi and in the recruitment process.

https://textile.iitd.ac.in/faculty-profile/3

Composite & Smart
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K. N. Toosi University of Technology
Monthly eNEWSLETTER

Eminent person

Prof. Puneet Mahajan
(Dept. of Applied Mechanics, IITD)

Email: mahajan@am.iitd.ac.in

Webpage: https://web.iitd.ac.in/~mahajan/

Professor Puneet Mahajan completed his Ph.D. in 1990 from Montana State University, Bozeman, Montana, and his M.E. in Mechanical Engineering, from Delhi University, in 1985. His B.Sc. in Mechanical Engineering was obtained from Delhi University in 1982. He joined IITD in 1992 and then as an Assistant Professor in 1993 in the Department of Applied Mechanics at the Indian Institute of Technology Delhi (IITD). He was elevated to Associate Professor in 1998 and subsequently became Professor in the year 2005.

Prof. Puneet Mahajan made significant contributions to areas of Finite element methods, Composites and low-velocity impact behavior, snow mechanics, Low and High-velocity impact; Precision glass molding, and Finite Element applications. He has authored over 81 reviewed journal papers, and more than 40 conference proceedings, and has a patent for an Automatic strap mechanism for a motorcycle helmet to his credit. He contributed as PI and consultant to many sponsored projects. **Prof. Puneet Mahajan** has over 3108 citations and has an H-index of 29, as per Google Scholar. His research interests include Composites- Homogenization and mechanical behavior, machining, low and high-velocity impact, Snow Mechanics, Helmet impact and heat transfer, Precision glass moulding, and Applications of Finite Elements.

Ph.D. thesis

Creep behaviour of ozone treated jute fabric/epoxy composites

Ms. Debarati Bhattacharyya
(Department of Textile and Fiber Engineering, IITD) 2020
Supervisors: Prof. Vijay Baheti

Recently, the bio-based textile structural composites gained significant importance in load bearing applications due to rise in environmental concerns and sustainability. The plant fibres have become more popular as reinforcements in composite manufacturing because of their biodegradability, low density, and cheaper cost. Creep is time based progressive deformation under constant applied load. It is undesired phenomena in composites as it leads to instability in loaded structures. The creep behaviour is complex and dependent on the material as well as the environment parameters. The number of chemical treatments (i.e., alkali, acid, bleach, etc.) have been used to improve the plant fibre/matrix interface.

The surface of jute fabrics was modified by ozone gas treatment to remove the non-cellulosic materials and thereby improve their adhesion with epoxy matrix. Further, the performance of ozone surface treatment was compared with traditional alkali treatment based on surface morphology, mechanical properties, hydrophilicity, etc.

The ozone surface treatment was found to remove lignin and increase hydrophilicity of jute fibres to greater extent as compared to alkali treatment, however with higher tendency of defibrillation and fibre rupture. Later, the creep resistance of alkali treated jute fabric/epoxy composites was found superior to the ozone treated jute fabric/epoxy composites at lower temperature of 40°C and 70°C. However, the ozone treated jute fabric/epoxy composites showed higher instantaneous elastic deformation and lower viscous deformation at elevated temperatures of 70°C and 100°C.

The ozone treated jute fabric/epoxy composites showed extended temperature range of 100°C–120°C to restrict segmental mobility of epoxy matrix and depicted higher interfacial shear strength properties from the microbead pull out test.

Journal

Journal of Intelligent Material Systems and Structures

Editorial Board:
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Editor:
N.M.Wereley
University of Maryland, USA

The *Journal of Intelligent Materials Systems and Structures* is an international peer-reviewed journal that publishes the highest quality original research reporting the results of experimental or theoretical work on any aspect of intelligent materials systems and/or structures research also called smart structure, smart materials, active materials, adaptive structures and adaptive materials. Each submitted article is assigned to an associate editor chosen according to the submitted paper's topic. The associate editor then sends the manuscript to 3 researchers who have expertise in the technical topic of the manuscript. These reviewers' names are not known to the author according to the single blind system. We encourage our reviewers to respond within 6 weeks of submission. This journal is a member of the Committee on Publication Ethics (COPE).

Cite score: 5.5 (Scopus), **Impact factor:** 2.774(2 years)/2.734(3 years),
Immediacy index: 0.387,
h5 index: 35(Google Scholar)

Google's h5-index is calculated by finding the h-index for articles in a publication over the last five complete calendar years.

Review time: 6 weeks (approximate)
Total citations: 8879 in the JCR year
SCImago Journal Rank (SJR): 0.620

The **SJR** weighs incoming citations according to the prestige of the publications they come from. Total, weighted citations made in the **SCImago year** to content published in a journal in the prior three years are divided by the total number of items published by the journal in the prior three years.

Immediacy index is the total citations made in the JCR year to content published in a journal in the same year are divided by the number of articles and reviews published in the JCR year.

JCR year is the calender year from January to December.

For more information: https://journals.sagepub.com/home/JIM

Journal

Journal of Mechanics

Editorial Board:
Editor-in-chief
K. N. Chiang:
Department of Power Mechanical Engineering, National Tsing Hua University, Taiwan
Executive Editor:
H.Y. Tsai, *Dept. of Power Mechanical Engineering, National Tsing Hua University, Taiwan*

The *Journal of Mechanics* publishes original research in all fields of theoretical and applied solid/ fluid mechanics. The Journal aims to serve as an international forum for the exchange of ideas among mechanics communities around the world. The *Journal of Mechanics* especially welcomes papers that are related to recent technological advances, such as micro/nanomechanics, multi-scale computational methods, and design on simulation technology. The contributions, which may be analytical, numerical or semi-empirical, should be of significance to the progress of mechanics. Papers which are primarily illustrations of established principles and procedures will generally not be accepted. Reports that are of technical interest are published as Short articles, and Review articles are published only by invitation. This journal encourages the work related to Mechanical engineering from engineering field, Applied Mathematics from Mathematics and Condensed matter physics from Physics and Astronomy field

Impact factor: 1.455 (as per JCR 2021)
H-Index: 24
Publisher: Cambridge University Press
Country origin: United Kingdom

Cite score, Processing time, Acceptance rate etc. are not available

For more information: https://academic.oup.com/jom

Composite & Smart
Materials and Structures
No. 3, Mar. 2023
Monthly
eNEWSLETTER

Promotions and Awards

Prof. Santosh Kapuria, Dept. of Applied Mechanics

has been selected for Prof. P C P Bhat Research Award for Faculty (Basic Research Award)

Prof. Ajeet Kumar, Dept. of Applied Mechanics

Promoted to Full Professor

Prof. Sitikantha Roy, Dept. of Applied Mechanics

Promoted to Full Professor

Conference

An invitation to all speakers, delegates, industrialists, students, and young researchers to attend the "8th International Conference on Smart Materials and Materials Science", which will be held on Aug 10-12, 2023 |Vienna, Austria with the theme "Recent Advancements in Materials Science" covering a broad range of topics to allow the speakers to showcase their highly insightful scientific work and knowledge from the fields of Materials Science & Engineering, Nanomaterials and Nanotechnology, Material Sciences, and Polymers to the audience and attendees.

Smart materials 2023 conferences provide a platform for researchers, engineers, and scientists to share their latest research and findings, as well as network with other experts in the field. They committed to providing international scientific digital conventions that include theoretical and practical information, as well as electronic exhibitions of current trending items in the marketplaces from the top industries in the Nanotechnology and material science arena. You may learn from the convenience of your own home.

https://www.longdom.com/smart-materials

Honoring the Memory

Prof. Y. Nath, Dept. of Applied Mechanics, IITD

Prof. R.K. Mittal, Dept. of Applied Mechanics, IITD

Prof. A. Shokuhfar, Dept. of Materials Sc. and Eng., KNTU

Composite & Smart
Materials and Structures
No. 3, Mar. 2023
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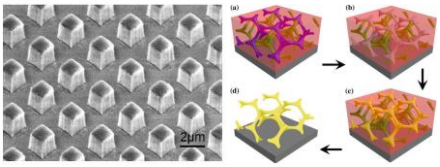
eNEWSLETTER

New Branch in Smart and advanced Materials in KNTU

Materionics



According to the public relations report of KN Toosi University of Technology (KNTU), for the first time in the world, a new field called "Materionics Engineering" will be launched at the master's level with the approval of the Ministry of Science, Research and Technology at KNTU. The engineering name "Materionics" is derived from the combination of the names of materials engineering and electronics engineering. "Materionics" engineering field is designed for students who are interested in studying and benefiting from both fields of engineering. Modeled after other interdisciplinary subjects such as mechatronics (combination of mechanical engineering and electronic engineering), "materionics" is a synthesis of overlapping common goals in the fields of materials engineering and electronics. "Materionics" engineering was formed based on the cooperation between the Faculty of Materials Science and Engineering and the Faculty of Electrical Engineering of KNTU.

According to the contents on the webite of KNTU, the educational and research program of "Materionics" field with scientific and engineering aspects of structure, properties, production, processing and application of advanced materials in electronic engineering and reciprocally with the aspects of manufacturing electronic devices using materials, it is related to different properties and functions. According to the aforementioned report, the goal of this new field is to train expert researchers and engineers in the field of combining materials engineering and electronic engineering, who with sufficient knowledge of the physical, electronic and mechanical properties of materials, they can play a role in the development of electronic materials and equipment, including electrical, optical and magnetic devices, through manipulation and optimization of the manufacturing method, shape, size, structure and composition of materials.

For more information: International Journal of Formal Sciences: Current and Future Research Trends (IJFSCFRT) (2023) Volume 17, No 1, pp 1-11

Eminent person

Prof. Reza Eslami-Farsani
(Faculty of Materials Sc. And Eng., KNTU)

Email: eslami@kntu.ac.ir

Webpage: https://wp.kntu.ac.ir/eslami/

Prof. Reza Eslami Farsani completed his Ph.D. in Mechanical Engineering in 2005 from K. N. Toosi University of Technology, Tehran, and his M.Sc. in Materials Engineering, from the University of Tehran, in 1994. He was also awarded Outstanding graduate of the University of Tehran in the M.Sc. He finished his B.Sc. in Materials Engineering from Tehran University in 1990.

Prof. Reza Eslami Farsani has research experiences by contributing the industrial projects which includes the Fabrication and Study of the Behavior of Self-Healing Composites, Fabrication and Study of the Behavior of Fiber Metal Laminates (FMLs), Fabrication and Study of the Behavior of Grid Composites, Fabrication of Silicon Carbide (Particulates & Whiskers) from Rice Husks and Optimization of Its Production, Fabrication of Metal Matrix Composites Based on SiC Reinforced, Feasibility Study for Producing of Glass Fibers, Feasibility Study for Producing of Magnetic Ceramics (Soft and Hard Ferrite), Feasibility Study for Producing of Anti-Acid Bricks, Feasibility Study for Producing of Servomotor. He has authored over 144 international journal papers, 98 conference proceedings, 3 books, 7 chapters book, and 16 patents. **Prof. Reza Eslami Farsani** has over 3469 citations and has an H-index of 31, as per Google Scholar. His research interests include Advanced Fibers, Composites, Nanotechnology (Nanotube & Nanocomposite), and Advanced and Smart Materials. His Honors and Awards include Distinguish Research of Faculty of Materials Science and Engineering, K. N. Toosi University of Technology, Iran (2019 and 2020), 21st Winner in Invention, Khwarazmi International Award - Iran (2008), Distinguish Research of the Islamic Azad University, Iran (2008)

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Ph.D. thesis

Energy Absorption Analysis of Hybrid Metal-Composite Structure Including Cellular Core Using Micromechanical Model based on Laguerre Method

A. Shiravand (Faculty of Mechanical Engineering-KNTU), 2021

Supervisor: Dr. M. Asghari

In this thesis, the elastic modulus and energy absorption behavior of cellular structures such as aluminum foams have been investigated. The main purpose of this study is to develop microstructure modeling of cellular structures and to study their elastic-plastic behavior through finite element method. In this research, first a unit cell is prepared to reduce numerical calculations, which has the characteristics of the main foam. The behavior of the unit cell under impact is then simulated and analyzed by the finite element method. Using simulated experiments, a model using the response surface method to obtain the densification strain, elastic modulus, mean plastic stress, yield stress as well as foam compaction behavior will be presented. Finally, the results of FEM and RSM for cellular structures with experimental results is evaluated. The results of this study showed that the possibility of modeling and analysis of energy absorption (impact) of foams is possible using the RSM model presented in this study and finally a suitable structural equation can be achieved to analyze the microstructure of different foams. Also, In this paper, the crushing behavior of hybrid metal-composite conical tube under dynamic loading is studied. An efficient analytical solution for FML conical tubes consist of any number of metal and laminated composite layers is developed. In the analytical analysis, the mean collapse load of structures subjected to axial loading was predicted while its accuracy is validated via experimental tests and numerical simulation. Numerical simulation of the structure is also done using explicit dynamic finite element software in order to investigate the effects of different parameters on crushing characteristics of various structures. On the other hand, new values for failure energies of fiber reinforced composites are proposed in the failure evolution criteria in the finite element model. It leads to good agreement between FE simulations and experimental test other. Moreover, a comprehensive parametric study has been done in order to investigate the effect of various parameters including semi-apical angle, ply pattern of laminated composite, diameter of tube, wall thickness and material properties of tubes on energy absorption capacity and crashworthiness characteristics of various considered specimens. Based on the obtained results the optimized structure is determined.

Ph.D. thesis

Studies on design and development of light weight composites for ballistic protection

Anil Yadav (Department of Mechanical Engineering-IITD) 2020

Supervisor: Prof. Naresh Bhatnagar

The use of lightweight protection system by security forces against ballistic threats is one of the important research areas in defence applications. It is very important to provide appropriate protection level with desired mobility for military applications. The high weight drawback of metal based armours directed researchers to explore different types of materials and materials combinations to get lighter armour materials fulfilling similar or better level of protection in armour systems but at lower weight.

In this research work different possibilities of using novel high performance materials were investigated as stand alone body armour for higher protection levels, while also investigating suitable configurations of composites laminates to enhance ballistic strength and reduce back face signature. It was clearly established that a composite light armour consisting of advanced materials with both the high strength/stiffness and high ductility /toughness, if properly configured, can have superior ballistic performance. In order to optimize the processing conditions so as to achieve optimal high strain rate properties, the effect of compression pressure and temperature on high strain rate behavior of composite is also established and the resultant ballistic strength is estimated by using high strain rate behavior using a split Hopkinson Pressure Bar (SHPB) set up. Ballistic test standards, specifications and protocols are largely dependent on the geography since the threat perception, weapons and ammunitions used by the adversaries, environmental conditions and physiology and anatomy of the wearer are different for the different situation, geographies and people. In this research India specific test standards and protocols are proposed with specific focus on permissible back face signature.

This research leads to the development of India standards of body armour and also to novel design of body armour including newer materials and methods under optimized processing conditions.

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