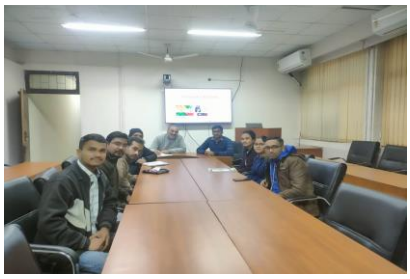
Composite & Smart

Materials and Structures

No. 2, Feb. 2023

Monthly eNEWSLETTER

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



Editorial board

Please share this newsletter to your friends

Editorial Message

It gives me immense pleasure to present the second issue of the newsletter ***Composite and Smart*** *Materials and Structures*, which is being brought jointly by the Indian Institute of Technology Delhi and K. N. Toosi University of Technology, Tehran. On behalf of IIT Delhi, I take this opportunity to thank Prof. S. M. R. Khalili for initiating and shaping this collaborative endeavor to bring to the knowledge of the students and researchers the significant recent developments in this field. The increasing demand for lightweight, high-performance structures across micro to large devices, products and systems is fast replacing traditional metals with composite materials. They possess several favorable attributes, such as high specific strength, stiffness, and corrosion resistance, but are also characterized by a high degree of anisotropy and inhomogeneity and complex failure modes, which bring challenges to their analysis and design. For achieving high-performance objectives such as active control of unwanted vibrations, noise and shape, health monitoring, and energy harvesting, these structures are often equipped with smart materials to act as sensors and actuators for adaptive capabilities. The advent of 3D printing has made a paradigm shift in the tailoring possibilities of such materials and structures. The newsletter on this topic is, therefore, a timely step that I am sure will take research in this area in both institutes to newer heights. I urge all researchers and scholars to contribute to the newsletter to make it a grand success and also benefit from it.

Professor S. Kapuria
AMD
IITD

Contents

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In case of any suggestions and comments, please Email to:

smrkhalili2022@gmail.co

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Ph.D. thesis

Analysis of Polymeric Polycentric Prosthetic Knee Joint

Mr. Ranjeet Kumar (PhD 2019)
Department of Applied Mechanics
Supervisors: Prof. Puneet Mahajan
Prof. Naresh Bhatnagar (Mechanical Engineering Department)

Transformation amputation or loss of major lower limb joints such as knee and ankle results in functional loss and psychological depression due to reduced mobility and high energy expenditure during walking. More than four lakh transfemoral amputees has been estimated in India, which accounts for 8% of total physical disability. The present study aims to design a low cost, reliable and functional polycentric prosthetic knee joint for the transfemoral amputees. The design based on geometric data of the available knee joints was analysed using Finite Element method. Based on the findings of the FE analysis, the initial model was modified.

A prototype of the knee joint was manufactured using 3D printing technology, and a single subject human trail was performed using this.

Based on the trial the junction of the pylon adaptor was modified and tested on the human subject. The patient successfully walked with the new design without any failure of the joint. As the 3D printing prototype lacked strength, it was manufactured using the injection molding process.

The mechanical strength of the final product was tested for the compression, flexural, torsion, and fatigue strength.

The clinical trial, including joint analysis of the proposed design, was performed after obtaining due approval from Human Ethics Committee.

The energy expenditure was reduced and overall quality of life was improved using the design as compared to the existing single axis knee joint.

The proposed polymeric polycentric prosthetic knee joint is light weight, reliable and offers a better option to the transfemoral amputees belonging to the low-income strata of the society.

Post-Doctoral Research

Computational Analysis on Repair Process in Composite Materials

Dr. Daniel Paul

Postdoctoral Research Fellow,

Department of Applied Mechanics,

Indian Institute of Technology Delhi,

Currently involved in computational analysis of the repair process in composite structures such as wind turbine blades.

The analysis is performed using analytical and numerical models with the aim of estimating the residual stresses after the repair process. This can be done for different repair parameters to optimize the process and to find the optimal set of parameters to minimize the stresses after repair. Post-repair behaviour of the repaired patches can also be studied using computational means.

Future Materials

Shape shifting car: Instead of steel and aluminium, this visionary model has a body of seamless fabric which change its shape as per requirement.

https://www.dezeen.com/2016/03/07/bmw-vision-next-100-shape-shifting-driverless-artficial-intelligence-car-design/

K. N. Toosi University of Technology

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Research opportunities

1-IIT Bombay-Monash Research Academy

An Indian-Australian research partnership

Research areas – Cutting-edge nanotechnology, high performance polymers, composite materials, nano-bio hybrid materials

Apply on or before 24 Feb 2023

Link - https://iitbmonash.org/smartMaterials

2-Prof. Sushma Santapuri

(Department of Applied Mechanics, IIT DELHI)

The group is actively looking for research fellows who would like to work on mathematical modeling of functional/smart and advanced material.

Please feel free to contact: ssantapuri@am.iitd.ac.in

Link- https://web.iitd.ac.in/~ssantapuri/

Workshop

Workshop on Shape Memory Materials
Dates: 21-22 Feb, 2023
Venue: Aerospace Engg. Auditorium, IISc Bangalore

Department of Aerospace Engineering, IISc organizing a workshop on Shape Memory Materials to be held during 21-22 Feb, 2023 at the Aerospace Engg. Auditorium, IISc Bangalore. This is being organized around the visit of a distinguished colleague Dr. Petr Sittner from the Institute of Physics, Czech Academy of Sciences, due to his long association with NAL.

The following talk also is being organized:

The Karnataka Association for the Advancement of Science (KAAS)
And
Bengaluru City University,Central College Campus
Jointly organize

An invited talk on
Deformation mechanisms in NiTi shape memory alloys
by
Dr.Petr Sittner
Institute of Physics of the Czech Academy of Sciences, Na Slovance 2, 18221 Prague, CR

Gracious presence
Dr K.Siddappa,
President, KAAS

Presided by
Dr. Lingaraj Gandhi
Vice-Chancellor, Bengaluru City University

Date:23.02.2023
Time: 11 am

Venue: Sir CV Raman Lecture Hall
Dept of Physics, BCU

All are welcome

Dr.B.C. Prabhakar
Secretary, KAAS

Dr.Devaraju
Dean, Faculty of Science, BCU

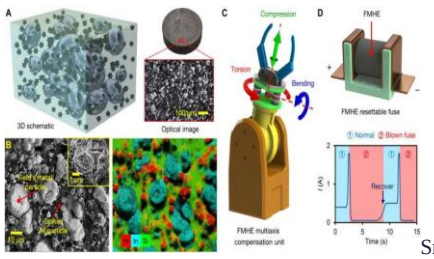
New application of composite Materials

Sumika , Hexagon digitize sustainable compounds, enable 60% carbon reduction for new vehicles

Hexagon's Manufacturing Intelligence division (Cobham, U.K.) and Sumika Polymer Compounds Europe (SPC Europe, Hampshire, U.K.), a manufacturer of thermoplastic compounds, have partnered to digitize the performance of new sustainable automotive-grade recycled short glass fiber-reinforced polypropylene (PP) compounds, enabling engineers to design components that are more recyclable and offer a lower carbon footprint for future vehicles.
Link https://www.compositesworld.com/news/sumika-hexagon-digitize-sustainable-compounds-enable-60-carbon-reduction-for-new-vehicles-

Smart Materials News

A smart elastomer that can self-tune its stiffness and conductivity



Smart materials are materials that have the ability to change their properties in response to specific external stimuli, such as temperature, humidity, light, or applied stress. One of the main advantages of variable stiffness materials is that they can increase the efficiency, safety, and reliability of mechanical systems. For example, variable stiffness materials can be used to create robotic arms and grippers that can adapt to different objects and environments. This allows for the robotic arm or gripper to handle a range of different objects with different shapes, sizes, and weights, which can reduce the complexity and increase the overall efficiency of the robotic system. Link: https://phys.org/news/2023-01-smart-elastomer-self-tune-stiffness.html

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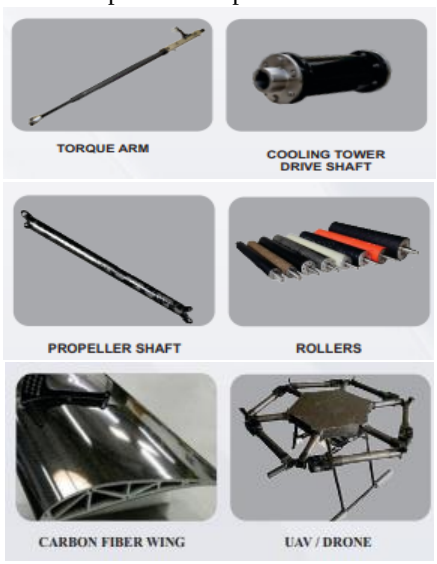
Company

Carbon Light Pvt. Ltd.

Manufacturers of Carbon Fiber Composite Products

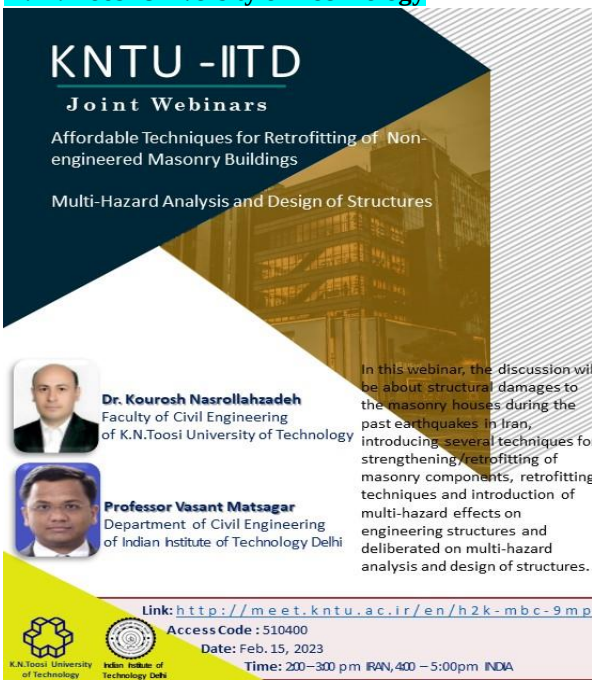
- Carbon Light specialized in designing and manufacturing of carbon fiber composite components for various industrial, Medical, Aerospace and Defence applications.
- Recently they have developed different types of Radiolucent carbon fiber bed which helps a lot in operation theatres



- In India, it was the first company to develop drive shaft for cooling tower application using carbon fiber composite
- Carbon fiber wings, drone parts, customized moulded parts, carbon fiber sheets in different geometry are products developed for aerospace

Registered Office
Carbon Light Pvt Ltd.
A-8/7, Sector-22
Meerut Road Industrial Area
Ghaziabad-201003, U.P, India
www.carbon-light.com

Joint webinar of IIT Delhi and K. N. Toosi University of Technology



Research Laboratory and CoE

Laboratory Name: **Nano and Bio Tribology Lab,**
Department of Mechanical Engineering, IIT Delhi
Faculty in-charge: **Dr. Sujeet K. Sinha**
Facilities/ Equipment Available:

*Pin on Disk Tribometer: This device is designed by IIT Delhi and developed by Invogineering Pvt. Ltd. It can be used of evaluate tribological performance of bulk materials, Coatings and lubricants in dry or lubricated conditions.
*Dip Coater: This device is also designed by IIT Delhi and developed by Invogineering Pvt. Ltd. It can be used to do coating on object of any shape with uniform coating thickness.
*Hot Plate with Magnetic Stirrer: This device is useful in agitating or mixing liquid along with heating. Max. temperature of 500°C can be achieved.
*Hot air oven: It can be used to heat any object of size upto 6 inches to a max. temperature of 450°C
*Scratch Tester: This device can be used to check the durability of the coating. There is an option to adjust the sliding tip angle.
*Air Plasma Cleaner: This is used to ultra clean the surfaces and activating it by removing contaminations.
*Polishing Machine: This setup can be used to polish metallic surface for various applications.
*Spin Coater: It can be used to provide a very thin coating of polymers on flat surfaces.
For more information: https://web.iitd.ac.in/~sks/

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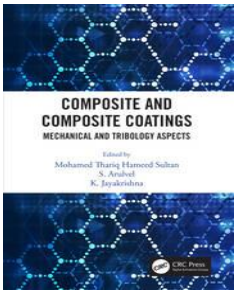
Book



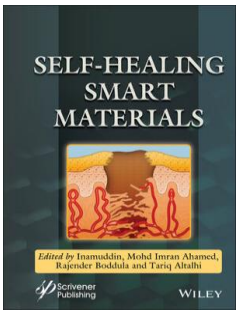
ISBN: 9781000469394, 1000469395
Page count: 264
Published: February 2022
Format: ebook
Publisher: CRC Press
Language: English
Editors: K. Jayakrishna, Mohamed Thariq Hameed Sultan, S. Arulvel

Applications of composite materials and composite coatings have been increasing in the field of automobile and aerospace industries due to the versatility in their properties. Present book comprehensively reviews the composite materials and coatings with a focus on the mechanical and tribology applications. It covers type of fibres (natural and synthetic), reinforcements and their selection, matrix, and technologies used to produce composite materials. Various sections cover basics and associated failures of composites, strengthening mechanisms and background theories, composite manufacturing technologies, mechanical and tribology properties of past and currently used composites.

Contents:

1. Extraction, Treatment and Applications of Bio-fibre Composites.
2. Tribology Properties of Fibre-Reinforced Polymer Composites
3. Tribological Behavior of Fibre-Reinforced Polymer Composites.
4. Effects of Reinforcements on the Tribological Properties of Polymer Composites.
5. Mechanical and Tribological Behaviour of Particulate-Reinforced Metal Matrix Composites.
6. Tribological Properties of Metal Matrix Composites.
7. Achieving Exceptional Mechanical and Tribological Properties of Metal
8. Tribological Properties of Ceramic Reinforced Metal Matrix Composites.
9. Tensile and Wear Behaviour of MMCs Reinforced With Metallic Particles By Solid State Technique.
10. Composites for Corrosive Wear Applications.
11. Composites for High Temperature Wear Applications
12. Influence of Wear Parameters On Friction and Wear Behaviour of Friction Stir Processed AlCaCO3 Surface Composite.
13. Potential Applications of Nano Enhanced Phase Change Material Composites.
14. Bioshells and Calcium Based Composite Coating for Tribology Applications.

Book



ISBN: 978-1-119-71015-8
Page count: 560
Published: June 2021
Publisher: WILEY
Language: English
Editors: Inamuddin Inamuddin, Mohd. Imran Ahamed, Rajender Boddula, Tariq A. Altalhi

This comprehensive book describes the design, synthesis, mechanisms, characterization, fundamental properties, functions and development of self-healing smart materials and their composites with their allied applications. It covers cementitious concrete composites, bleeding composites, elastomers, tires, membranes, and composites in energy storage, coatings, shape-memory, aerospace and robotic applications. The 21 chapters are written by researchers from a variety of disciplines and backgrounds.

Contents:

1. Self-Healing Polymer Coatings
2. Smart Phenolics for Self-Healing and Shape Memory Applications.
3. Self-Healable Elastomers.
4. Self-Healable Tires
5. Self-Healing Bacterial Cementitious Composites.
6. Self-Healable Solar Cells: Recent Insights and Challenges.
7. Self-Healable Core–Shell Nanofibers.
8. Intrinsic Self-Healing Materials.
9. Self-Healable Catalysis
10. Self-Healing Materials in Corrosion Protection.
11. Self-Healable Conductive Materials.
12. Self-Healable Artificial Skin.
13. Self-Healing Smart Composites
14. Stimuli-Responsive Self-Healable Materials.
15. Mechanically-Induced Self-Healable Materials
16. Self-Healing Materials in Robotics
17. Self-Healing Materials in Aerospace Applications
18. Bio-Inspired Self-Healable Materials
19. Self-Healable Batteries
20. Self-Healing in Bleeding Composites
21. Self-Healing Polymers

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Conference

ICSMCS 2024: 18. International Conference on Smart Materials for Civil Structures

November 15-16, 2024 in Jeddah, Saudi Arabia

Important Dates

Abstracts/Full-Text Paper Submission Deadline	July 31, 2023
Notification of Acceptance/Rejection	August 30, 2023
Final Paper (Camera Ready) Submission & Early Bird Registration Deadline	October 15, 2024
Conference Dates	November 15-16, 2024

Theme of Conference

Smart materials
Shape memory alloys and polymers
Electro and magnetorheological materials
Piezoelectric, ferroelectrics, multiferroics, piezomagnetic

Self-healing materials and multifunctional materials

Application of smart materials, structures and related technology
Fundamentals of smart materials
Modeling/formulation and characterization of smart actuators, sensors and smart material systems
Smart material systems that utilize biomimetics and bioinspiration
Smart materials utilized as sensors and actuators with applications at any scale
Smart optical materials for modification in spectral shifts and refractive index shift

Phase boundaries and boundary layers of phase boundaries

For more ionformation: https://waset.org/smart-materials-for-civil-structures-conference-in-november-2024-in-jeddah

Conference

Faculty of Mechanical Engineering
K. N. Toosi University of Technology

The Faculty of Mechanical Engineering was officially established in 1973. It is one of the best-known Institution in the country. In 1980, two main departments namely solid mechanics and fluid and heat engineering was formed. In 1993 production and manufacturing engineering was initiated and in 2001, automotive engineering, materials engineering, energy systems departments have been started. Finally, in 2012 based on multidisciplinary cooperation, mechatronics engineering has been established. K. N. Toosi mechanical engineers do not just response to the society's requirements, they recognize the future needs and innovate for it, and lead to a better destiny. Our programs are to impact the world through a sturdy curriculum, significant research and glorious design experiences. The Faculty is comprised of seven different departments, namely Solid Mechanics, Heat and Fluids, Production and Manufacturing Engineering, Automotive Engineering, Energy Systems, Biomechanics and Mechatronics.
Link: https://en.kntu.ac.ir/faculties/mechanical-engineering/

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Eminent person

Prof. Naresh Bhatnagar, PhD
Email: *nareshb@mech.iitd.ac.in*
Webpage:
http://mech.iitd.ac.in/content/bhatnagar-naresh

Professor Naresh Bhatnagar completed his Ph.D. in 1992 from the Indian Institute of Technology Bombay (IITB), and B.E. in Production, REC Tiruchirappalli, 1984. He joined the Department of Mechanical Engineering at the Indian Institute of Technology Delhi (IITD) in Nov 1998 as an Assistant Professor, after working in the industry for 6 years. He was elevated to Associate Professor and subsequently became a Full Professor in the year 2008.

Prof**. Naresh Bhatnagar** made significant contributions to areas of polymer material processing, biomaterials, biomedical implants, nano-composites, microcellular extrusion, injection molding, manufacturing of bullet and blast-resistant materials, and novel characterization methods for polymeric composites. He has authored over 108 journal papers, and 11 Conference proceedings, and has 10 patents/applications to his credit.

Prof. **Naresh Bhatnagar** has also supervised 25 doctoral theses and 75 master's dissertations in various areas related to materials, manufacturing, and product realization. He has over 5992 citations and has an H-index of 40, as per Google scholar. His research interests include Biomedical Implants, Biomaterials Processing, Polymeric Composites and Nano-composites, Micro and Nano Cellular Thermoplastic Composites, Machining of Composites, Tissue Engineering- Scaffolds, Injection Molding and Mold Design, High Impact Composites-Ballistics, Bullet-proof material development.

His Manufacturing and Machining Awards include the 7th National Award, GOI, Polymers in Public Health, Min of Chem & Fertilizers. He is the coordinator for the Mechanical Fabrication Facility (MFF) located in the Industrial Design Development Center (IDDC) and the faculty in charge of the Production Engineering laboratory (WS105).

List of 10 important journals in composites and smart materials

1. Smart Materials and Structures - Impact Factor: 3.585 (as per the Journal Citation Reports (JCR) - Clarivate Analytics, 2023), Q1

2. Journal of Intelligent Material Systems and Structures - Impact Factor: 2.97 (as per the JCR, 2021), Q2

3. Smart Structures and Systems, Impact Factor: 3.342 (as per the JCR, 2022), Q2

4. Composites Science and Technology - Impact Factor: 9.879 (as per the JCR, 2022), Q1

5. Journal of Composite Materials - Impact Factor: 3.19 (as per the JCR, 2022), Q2

6. Journal of the Mechanics and Physics of Solids - Impact Factor: 5.582 (as per the JCR, 2021), Q1

7. Mechanics of Materials - Impact Factor: 3.266 (as per the JCR, 2023), Q1

8. Advanced Materials - Impact Factor: 32.093 (as per the JCR, 2021), Q1

9. Acta Materialia - Impact Factor: 9.209 (as per the JCR, 2021), Q1

10. Materials Science and Engineering A - Impact Factor: 6.004 (as per the JCR, 2021), Q1

News on smart composites

Using heat and magnetic fields, team remotely manipulates composite material with high level of control

The composite, which is classified as programmable matter, can be remotely manipulated in air, water or inside biological tissue, thus opening up possibilities for the development of biomedical devices, tactile displays and object manipulators.

"It can change its shape, stiffness or other physical properties in a controlled way,"

Block of material turned into a tree

Link:
https://phys.org/visualstories/2022-12-magnetic-fields-team-remotely-composite.amp

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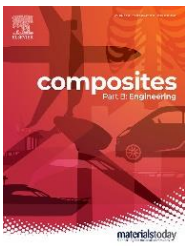
Journal

Composite Part B: Engineering



Composite Part B: Engineering, publishes impactful research of high quality on composite materials, supported by fundamental mechanics and materials science and engineering approaches.. The journal aims to provide a forum for the prompt publication of original and high-quality research, with emphasis on design, development, modelling, validation and manufacturing of engineering details and concepts. Authors are encouraged to address challenges across the application areas, such as (but not limited to) aerospace, automotive, and other surface transportation, energy (renewable application encouraged), and infrastructure. Current topics of key interest to the readers of the Journal includes all the aspects related to manufacturing, design, validation, charecterisation/testing, performance, application and sustainability of composite materials, and including functional and smart composite materials, novel composite material concepts and biomimetics and bio-based composites.

Cite score: 18.6, **Impact factor:** 11.322
Review time: 3 weeks
Publication time: 0.8 weeks
Acceptance rate: 10%
For more information:
https://www.sciencedirect.com/journal/composites-part-b-engineering

Journal

Smart Materials and Structures

Smart Materials and Structures, is a multi-disciplinary engineering journal that explores the creation and utilization of novel forms of transduction. It is a leading journal in the area of smart materials and structures. The theoretical predictions are usually accompanied with experimental verification, characterizing the performance of new structures and devices. SMS has a Board of Associate Editors who are specialists in a multitude of areas, ensuring that reviews are fast, fair and performed by experts in all sub-disciplines of smart materials, systems and structures. the journal will consider articles in the following areas. like Smart materials development and application, Smart materials utilized as sensors and actuators , Adaptive structural systems, Sensor and sensor networks for smart materials, Smart optical materials for modification in spectral shifts, Structural health monitoring, Intelligent systems, integrated with sensors, Energy harvesting systems including modelling, Smart material systems that utilize biomimetics, 3D-printed smart materials , Smart textiles and wearable technology

Cite score: 6.6, **Impact factor:** 4.253(Five year)
Submission to first decision before peer review: 5 days
Submission to first decision after peer review: 37days
Submission to first decision overall: 13days
Submission to final acceptance after peer review:93 days
Acceptance rate: 25%
For more information:
https://iopscience.iop.org/journal/0964-1726