Joint Event

International Conference on

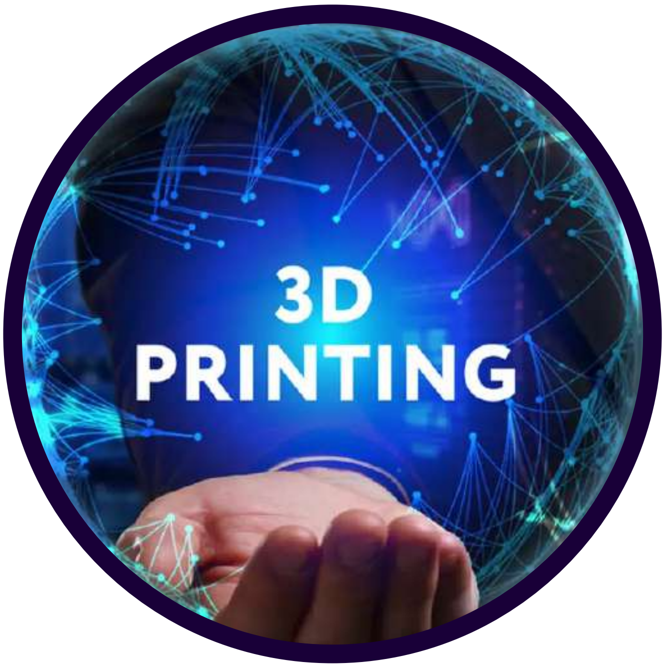
3D Printing & Additive Manufacturing

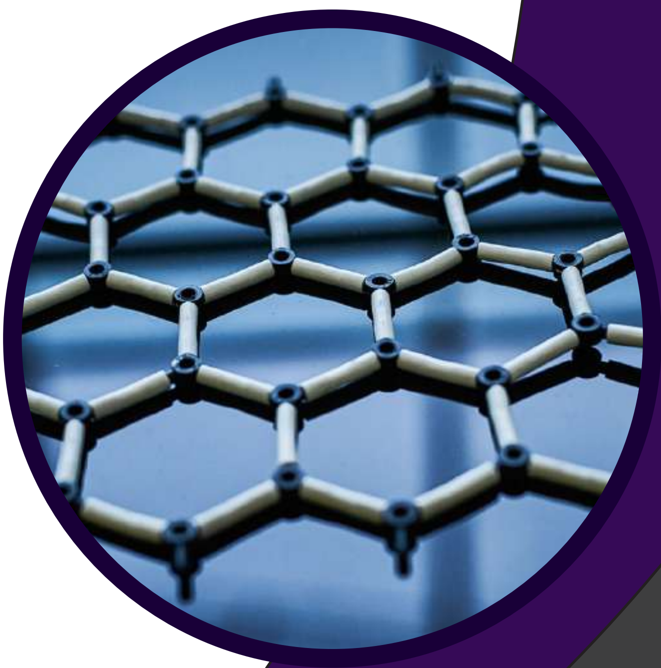
&

International Conference on

Graphene, Semiconductors & 2D Materials

March 20-21, 2023
City Seasons Suites,
Dubai, UAE





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Exhibitor

BCL BUSINESS COMMUNICATIONS LLC

Conference Programme

Conference Programme

March 20-21, 2023, City Seasons Suites, Dubai, UAE

Day 1 March 20, 2023

Meeting Hall: EL DHIYAFA 2

9.30 - 9.45	**Registrations**
9.45 - 10.00	**Introduction**

Keynote Presentations

10.00 - 10.45 **Andreas Heinrich,** Aalen University, Germany

Title: Additive Manufacturing of Optics

10.45 - 11.30 **William O'Neill,** University of Cambridge, United Kingdom

Title: High Throughput Laser Array Based Additive Manufacturing of Metals

Oral Presentations

Session Chair: **William O'Neill,** University of Cambridge, United Kingdom

Session Chair: **Norbert Hampp,** University of Marburg, Germany

Sessions: Additive Manufacturing | Lasers in 3D Printing | Graphene | Semi Conductors | 2D Materials | Semiconductor Materials and Nanostructures | Synthesis of Graphene | 3D Image Processing and Visualization | 3D printing in Digital Light Processing (DLP) | Advances in Graphene | Growth and Synthesis of Graphene and 2D Materials | Physics of Graphene | Applications of Graphene in Biomedical | Perovskites

Group Photo: 11.30 - 11.45

Networking and Refreshments @ Banquet Pre Function Area: 11.45 - 12.15

12.15 - 12.40 **Zhiyong Cai,** Forest Products Laboratory USDA, USA

Title: Synthesizing Multi-Layer Nano-Shell Structure-based Graphene Material from Lignin and Its Potential Applications

12.40 - 13.05 **Julian Polte,** IWF TU Berlin and Fraunhofer IPK, Germany

Title: Opportunities and Advances in Precision Additive Manufacturing

13.05 - 13.30 | **Antonios Dimopoulos,** Brunel University London, United Kingdom

Title: Multi-Response Optimization of Ti_6Al_4V Support Structures for Laser Powder Bed Fusion Systems

Lunch @ El DHIYAFA 1: 13.30 - 14.30

14.30 - 14.55 | **Ana Pilipović,** University of Zagreb, Croatia

Title: Influence of FDM Processing Parameters and Snack Dimension on Food Printability

14.55 - 15.20 | **Terence Xiaoteng Liu,** University of Northumbria, United Kingdom

Title: Graphene Aerogel Electrode for Advanced Electrochemical Devices

15.20 - 15.45 | **Zeina Al-Nabulsi,** Warwick University, DYSE, United Kingdom

Title: WAAM Ultimate Steel and Structural Applications

15.45 - 16.10 | **Sudhir Sharma,** New York University Abu Dhabi, UAE

Title: Synthesis of Calcium Carbonate Molecular Sheets *via* Chemical Route

Networking and Refreshments @ Banquet Pre Function Area: 16.10 - 16.30

16.30 - 16.55 | **Vyas Mani Sharma,** Tel Aviv University, Israel

Title: Additive Manufacturing of QT17-4+ PH Steel Using DED

16.55 - 17.20 | **Daniel Q Tan,** Guangdong Technion – Israel Institute of Technology, China

Title: Fabrication of Large Interlayer Spacing 2D $Mo_2Ti_2C_3$ MXene Suitable for High-performance Supercapacitors

17.20 - 17.45 | **Ivan Stich,** Slovak Academy of Sciences, Slovakia Republic

Title: Colossal Band Gap Response of Single-layer Phosphorene to Strain Predicted by Quantum Monte Carlo

17.45 - 18.10 | **Giada Gasparini,** DICAM – University of Bologna, Italy

Title: Calibration of Structural Design Values for Wire-and-Arc Additively Manufactured Stainless Steel Bars

18.10 - 18.35 | **Shueiwan H. Juang,** National Taiwan Ocean University, Taiwan

Title: Application of Metal 3D Printing to Make Conformal Cooling Lines of Die-Casting Molds

18.35 - 19.00 | **Martin Nozar,** University of West Bohemia, Czech Republic

Title: Simple and Advanced Technologies to Improve The Properties of Metal Additive Manufacturing Products

Day 1 Concludes

Day 2 March 21, 2023

Meeting Hall: EL DHIYAFA 2

Keynote Presentation

10.00 - 10.45 | **Norbert Hampp,** University of Marburg, Germany

Title: Laser-controlled Design of Carbon Nanotube Architectures

Oral Presentations

Session Chair: **Andreas Heinrich,** Aalen University, Germany

Session Chair: **Zhiyong Cai,** Forest Products Laboratory USDA, USA

Sessions: 3D Printing | Nano 3D printing | 3D bio printing | Polymers in 3D printing | Metal 3D Printing | 3D Printing Future Technology | 3D Printing in Tissue Engineering & Organ Printing | | 3D Printing in Medicare, Healthcare and Life sciences | 3D printing in Orthopedics and Traumatology | Organ Printing | 4D Printing | | Organic/Inorganic Hybrid Semiconductors | Synthetic Graphite and Natural Graphite | Carbon Nanotubes | Fullerenes | Novel Hybrid Carbon Materials | Large Scale Graphene Production and Characterization | Graphene-based Nanocomposites | Electrochemistry of Diamond and Nano Carbon Materials | Graphene Modification and Functionalization | Graphene Chemistry | Graphene Applications | Carbon Nano Chips and Nanostructures | Graphene 3D Printing

10.45 - 11.10 | **Aleksey Adamtsevich,** Moscow State University of Civil Engineering, Russia

Title: Salient Features of Structures Made by 3DCP

Networking and Refreshments @ Banquet Pre Function Area: 11.10 - 11.30

11.30 - 11.55 | **Muhammad Zafar Iqbal,** United Arab Emirates University, UAE

Title: Graphene/Polyolefin Nanocomposites

11.55 - 12.20 | **Nikita Ryskin,** Saratov State University, Russia

Title: Facile and Cost-Effective Fabrication of Components for Sub-THz Vacuum-Tube Electron Devices by LCD 3D Printing and Magnetron Sputtering

12.20 - 12.45 | **Poonam Kumari,** IIT Guwahati, India

Title: Development of Flexible PVDF-Graphene Piezoelectric Nanocomposites for Smart Sensing Applications

12.45 - 13.10 | **Vladimir Popov,** Tel Aviv University, Israel

Title: New Alloys and Materials Design *via* Additive Manufacturing

Lunch @ El DHIYAFA 1: 13.10 - 14.15

14.15 - 14.40 | **Prahaladh Srikanth,** SA 3D Solutions, India

Title: A Study on Aero Testing with Reference to F1-75

14.40 - 15.05 | **Rahim Mutlu,** University of Wollongong in Dubai, UAE

Title: 3D Printing in Wearable Robotics: from Prosthetics to Haptics

15.05 - 15.30 | **Umar Asghar,** University of Wollongong in Dubai, UAE

Title: 3D Printed Soft Sensors

15.30 - 15.55 | **Atanu Kumar Metya,** (IIT) Patna, India

Title: Structure and Dynamics behavior of Binary Mixture and Electrolyte Solution in Nanochannel by 2D Materials

15.55 - 16.20 | **Rouslan Svintsitski,** 3DCeram Sinto SAS, France

Title: Multi-material 3DPrinting, Several Technologies in One for New Ceramic Printer

Networking and Refreshments @ Banquet Pre Function Area: 16.20 - 16.50

16.50 - 17.15 | **Igor V. Reshetov,** Sechenov University, Russia

Title: Development and Testing of Individual Titanium Implants with Bioactive Coatings Obtained by SLM for Use in Maxillofacial Surgery

17.15 - 17.40 | **Sudhir Sharma,** New York University Abu Dhabi, UAE

Title: Synthesis of One Atom Thick-2D Gold Nanostructures- Goldene

Keynote Presentation

17.15 - 17.40 **Haider Butt,** Khalifa Uniersity, Abu Dhabi, UAE

Title: 3D Printed Nanocomposite Contact Lenses for Ocular Health Management

Poster Presentations

17.40 - 18.00 **Markéta Havrdová,** Palacký University, Czech Republic

Title: Graphene Dots with Single Atoms as A Tool for Killing Cancer Cells

18.00 - 18.20 **Roberto Marsili,** University of Perugia, Italy

Title: Investigating Additive Manufactured Structures by Thermoelastic Stress Analysis and Dynamic Mechanical Analysis

Video Presentations (18.20 - 19.00)

VP001 **Boris Ezdin,** Novosibirsk State University, Russia

Title: Research on the Nucleation of Carbon Nanoparticles

VP002 **Tatjana Dostalova,** Charles University, Czech Republic

Title: Intraoral 3D Scanner and 3D Stereolithography Print (SLA) in Orthodontic and Dentistry in Long-term Clinical Applications

VP003 **Jolanta Janutėnienė,** Klaipeda University, Lithuania

Title: Investigation of Recycled Polymers for 3D Printing

Day 2 Concludes followed by Panel Discussion - Awards & Closing Ceremony

Virtual Programme

Virtual Programme

March 20-21, 2023, Virtual Program

Day 1 March 20, 2023 GMT (London Time: 09.00 - 15.25)

Oral Presentations

09.00 - 09.25 — **Alexander Emmanuel Tohidi, UNSW, Australia**

Title: Designing for Extreme Heat, Strategies Towards 3D Printing of Earth Structures

09.25 - 09.50 — **Dingwen Nic Bao,** School of Architecture and Urban Design, Australia

Title: Structural Performance-Driven Generative Design and Large-Scale Robotic 3D Printing Fabrication

09.50 - 10.15 — **Xin Ren,** Nanjing Tech University, China

Title: Auxetic Metamaterials and their Applications

Keynote Presentation

10.15 - 10.45 — **Kalaichelvan,** Anna University, India

Title: Review on Ceramic Additive Manufacturing and it's Applications

Oral Presentations

10.45 - 11.10 — **Darío González Fernández,** INDAERO GRUPO EMERGY, Spain

Title: Challenges in the Aerospace Application of Additive Manufacturing

11.10 - 11.35 — **M. A. Fazal,** University of Jeddah, Saudi Arabia

Title: Characterization of Al_2O_3, TiO_2, Hybrid Al_2O_3-TiO_2 and Graphene Oxide Nanofluids and Their Performance Evaluations in Photovoltaic Thermal System

11.35 - 12.00 — **Abhay Meena,** Lok Nayak hospital, India

Title: Evaluation of contour of Acetabular Columns and Their Comparison with Anatomical Acetabular Plates for Fracture Fixation Using 3D Printing

12.00 - 12.25 — **Ibrahim Maouhoubi,** Sidi Mohamed Ben Abdellah University, Morocco

Title: Effects of Applied External Field and The Contribution of The Hydrostatic Pressure on The Electronic Properties of Donor Impurity in A Circular Quantum Disk Made out of GaAs

12.25 - 12.50	**Vijeth H,** Nagaland Central University, India

Title: Polypyrrole Nanotubes Decorated With NiO for All-solid-state Symmetric Supercapacitor Application

12.50 - 13.15	**Ajeet Kumar,** Indian Institute of Technology (IIT) Guwahati, India

Title: Design of Support-less Lattice Structure for Advanced Product

Lunch (13.15 - 13.45)

13.45 - 14.10	**Srin K. S,** Indian Institute of Technology, Kanpur, India

Title : Graphene's Future Lies in LASER-Induced Layers

14.10 - 14.35	**Seongwoo Woo,** Ethiopian Technical University, Ethiopia

Title: Improving The Reliability Design of Mechanical Systems Such As Refrigerator

14.35 - 15.00	**Amna Mazen,** University of Detroit Mercy, USA

Title: Factors Affecting Ultimate Tensile Strength and Impact Toughness of 3D Printed Parts Using Fractional Factorial Design

15.00 - 15.25	**Abdul Salam Sarkar,** Stevens Institute of Technology, USA

Title : Emerging Anisotropic 2D Tin (II) Sulfide Monolayer and Optoelectronic Applications

Day 1 Concludes

Day 2 March 21, 2023 GMT (London Time: 09.00 - 13.10)

Oral Presentation

09.00 - 09.25	**K. Saravanan,** SRM Institute of Science and Technology, India

Title: Synthesis of CuO and ZnO Nanoparticles Using Borassus Flabellifer L. stem (Plant Extract) and Evaluation of Nanomedicine Applications

09.25 - 09.50	**M. Irfan Hussain,** University Of Science And Technology Beijing, China

Title: Research on DLP-Stereolithography 3D Printing, Microstructure and Mechanical Properties of Alumina Reinforced Zirconia (ARZ) Components

Poster Presentation

09.50 - 10.05

Mohammad Tanvir Ahmed, Jashore University of Science and Technology, Bangladesh

Title : Semiconductor to Insulator Transition of Twisted Graphene Nanoribbon *via* Boron and Nitrogen Incorporation

Oral Presentation

10.05 - 10.30

Massah Tagueu Raïssa, University of Dschang, Cameroon

Title: Aminated Metal-organic Framework MIL-101(Cr) for Electrochemical Detection of Tartrazine in Soft Drink

10.30 - 10.55

Shahzad Ashraf, NFC Institute of Engineering and Technology, Pakistan

Title : Broaching Uncouth Water Level Snag in Underground Agriculture Field Through Wireless Sensors

10.55 - 11.20

Farah Marsusia, Amirkabir University of Technology, Iran

Title: Fluorinated Graphene: Electronic and Magnetic Properties

11.20 - 11.45

B. Renganathan, Saveetha Institute of Medical and Technical Sciences, India

Title : Graphene Oxide Coating Fiber Optics Chloroform Gas Sensing Applications

11.45 - 12.10

Tunji John Erinle, Federal Polytechnic, Ekiti State, Nigeria

Title: Fused Deposition Modelling (FDM) and Selective Laser Sintering (SLS) as Indisputable Machines in Additive Manufacturing: A Review

12.10 - 12.35

Robin Singla, Thapar Institute of Engineering and Technology, India

Title : Modified Graphene The True Wonder Material

12.35 - 13.00

Sangeeta Tiwari, Amity University, India

Title : Application of 2D Polymeric Nanofibrous Membranes for Effective Removal of Arsenic From Water

13.00 - 13.25 **Abhay Meena,** Lok Nayak hospital, India

Title: Virtual Planning and 3D Printing Solving Problems in Giant Bone Tumors

13.25 - 13.50 **R. Thiruchelvi,** Vels Institute of Science, Technology and Advanced Studies (VISTAS), India

Title: Algal Polysaccharides for 3D Printing : A Review

Day 2 Concludes Followed by Vote of Thanks

Exhibitor

BCL was formed in 1976 as a joint venture with Dubai Transport Co. LLC. and Cable & Wireless Ltd., U.K., initially to provide engineering support to Etisalat, the UAE telecommunication company.
BCL has since become a major force in the U.A.E and surrounding Gulf States and has developed an excellent reputation for it's technical abilities, quality of service and committed professionalism to its varied clientele.

Industries which we deal

- Academic & Research institutions
- Government & Private Testing Laboratories
- Pharmaceutical Industries
- Oil & Gas, Petrochemicals and polymers
- Food Industry
- Forensic & Criminal investigation Laboratory

3D Printing & Graphene 2023

Day 1

Keynote Presentations

ADDITIVE MANUFACTURING OF OPTICS

Andreas Heinrich
Aalen University, Germany

Abstract:

Here the potential of 3D-printed optics based on conventional printers should be presented. The materials used in the Additive manufacturing of plastic. Optics are first presented using the example of photopolymerization. The characterization of additively manufactured optical components is then discussed. For samples, "post-processing" proves necessary, especially with regard to their surface structure. Another aspect is the resulting inhomogeneity in the refractive index, which is presented in detail. The key focus will be the discussion of completely different examples of additively manufactured optics to illustrate the potential and limitations of additive manufacturing in this area. Starting with light-guiding elements, the advantages and disadvantages of a range of 3D-printed imaging systems are presented and discussed. The potential of 3D-printed liquid lenses, freeform lenses and mirror elements is also described. This discussion is followed by a presentation of the 3D printing of microlenses. Both spherical and aspherical microlenses can be realized additively. The question of how this might allow a greater functionalization of additively manufactured optics is explored by discussing the printing of OLEDs, as well as the additive manufacturing of random lasers and of photoluminescent optics.

The final focus of this presentation is the additive manufacturing technology itself. 3D printing specifically optimized for optics production is discussed. Two different concepts are presented: A robot-based additive manufacturing platform that achieves resolutions in the subpixel range and an additive manufacturing method for microlenses combined with electric fields.

Biography

Andreas Heinrich is a full professor for optical technologies at Aalen University, Germany and head of the Center for Optical Technologies. Since 2013 he and his group focus not only on the development of new concepts for complex optical components, but also on the development of new additive manufacturing methods especially for the manufacturing of optical components. Dr. Andreas Heinrich got his Diploma in Physics at the Technical University of Munich, Germany in 1999 and in 2001 his PhD in the field of solid state physics from the Technical University of Munich, as well. From 2001 until 2006 he did his habilitation at the University of Augsburg, Germany and at the Florida State University, USA. From 2007 – 2013 he headed a research group in the field of applied optics at Carl Zeiss, Germany.

HIGH THROUGHPUT LASER ARRAY BASED ADDITIVE MANUFACTURING OF METALS

William O'Neill
University of Cambridge, United Kingdom

Abstract:

Metal based laser powder bed fusion (LPBF) Additive Manufacturing systems have developed steadily over the past 20 years and now represent a multibillion-pound global market in machines, materials, and software. They find niche low volume applications in many industrial sectors and somewhat wider applications in aerospace and biomedical sectors. Despite the clear attractiveness of this production route, there remain several challenges in terms of build rates, process stability, part accuracy, repeatability, and part cost. The interest in LPBF from all industrial sectors is clear and present, although the aforementioned challenges must be met to deliver a step change in capabilities and enable LPBF AM systems to gather widespread acceptance as a standard industrial manufacturing process. The work presented here showcases the potential of laser array based melting strategies to dramatically improve the quality and throughput of LPBF AM systems.

Biography

William O'Neill is widely acknowledged as a leading expert in the field of high-power lasers and their use in materials processing, his innovations have led to successful industrial applications in: metal based additive manufacturing; bio-medical engineering; advanced coatings; carbon nanotubes; ultra-fast holographic imaging; high strength super magnets; in-process diagnostics; and ultraprecision engineering. Inspired by the rapid development of lasers in the 1960s and 70s, he established a distinguished research career which led to a series of roles as engineer, educator, and entrepreneur. He is a Fellow of the Institute of Physics, a Fellow of the Laser Institute of America and co-founder of two Cambridge Spinouts.

Day 1

3D Printing & Graphene 2023

Oral Presentations

SYNTHESIZING MULTI-LAYER NANO-SHELL STRUCTURE-BASED GRAPHENE MATERIAL FROM LIGNIN AND ITS POTENTIAL APPLICATIONS

Zhiyong Cai, Qiangu Yan and Jilei Zhang
Forest Products Laboratory, USDA, USA

Abstract:

Lignin is one of the most abundant biopolymer on earth; it composes 30% of renewable carbon resources. There is an estimated over 70 million tons of bio-waste lignin available alone from paper/pulping processes worldwide. Over 90% of produced kraft lignin were burnt onsite to generate heat and energy, which also cause CO_2 and other greenhouse gas. An innovative process has been developed to use lignin as a carbon source to synthesize carbon-based nanomaterials like graphene, encapsulated metal nanoparticles, and nano transitional metal carbides. Lignin was mixed with Fe nanoparticles (FeNPs) as a catalyst and thermally treated at 1000°C for 1 hour. The Raman spectrum and X-ray diffraction pattern suggested that graphene sheets were formed. Scanning electron microscopy image showed clusters of thin graphene sheets appearing in the form of nano-flowers. High-resolution transmission electron microscopy and electron reflection images provided further evidence of the formation of graphene. Potential applications in reinforcing concrete and other composites have been explored.

Biography

Zhiyong Cai received his PhD degree from Purdue University. He is Project Leader of Engineered Composites Science, Forest Products Laboratory, USDA Forest Service. Currently, he is leading a group of research scientists developing bio-based composites from nano-cellulose, lignin, wood and other non-wood fiber sources using thermoset, thermoplastic, inorganic, and other naturally-derived binders. He has over 200 publications and 100 presentations related to the bio-based material research. He is the fellow of International Academy of Wood Science and has co-chaired two international conferences.

OPPORTUNITIES AND ADVANCES IN PRECISION ADDITIVE MANUFACTURING

Julian Polte
IWF TU Berlin and Fraunhofer IPK, Germany

Abstract:

A paradigm shift from mechanical to non-mechanical thinking and a redefinition of production technology is essential to unleash Additive Manufacturing's capabilities and bridge the gap to future needs. Additive Manufacturing processes enable lightweight designs of highly complex metallic workpieces and ensure an increasingly important saving of resources and energies. Nevertheless, Additive Manufacturing processes are limited regarding the achievable surface roughness values 5 µm ≤ Ra ≤ 15 µm, the geometrical accuracies and the occurring residual stresses. Due to increasing demands on the properties of additively manufactured workpieces, the development of innovative technologies and process chains is essential for a broad industrial application. Recent advances in process development allow for drastically improvements of surface roughness values and geometrical accuracies in a single digit micrometer range.

Biography

Julian Polte is Professor for precision Additive Manufacturing at the TU Berlin and got a Doctor degree of Engineering -Dr.-Ing.- from the Technische Universität Berlin and spent more than 10 years scientific, industrial and educational challenges in Precision Engineering, Advanced Manufacturing Technologies, Additive Manufacturing, Industry 4.0 and the optimization of the related value chains and dedicates his scientific career, applied research, industrialization programs and high quality education. Julian Polte was a Research Affiliate at the renowned and worldwide leading International Academy for Production Technology CIRP. At the Fraunhofer Institute IPK Julian Polte leads different departments with great impact into industry. He successfully published more than 100 articles and contributions in magazines, journals and on conferences.

MULTI-RESPONSE OPTIMIZATION OF Ti_6Al_4V SUPPORT STRUCTURES FOR LASER POWDER BED FUSION SYSTEMS

Antonios Dimopoulos, Ilias Zournatzis, Tat-Hean Gan and Panagiotis Chatzakos
Brunel University London, TWI Ltd (NSIRC), United Kingdom

Abstract:

Laser Powder Bed Fusion (LPBF) is one of the most commonly used and rapidly developing metal Additive Manufacturing (AM) technologies for producing optimized geometries, complex features, and lightweight components, in contrast to traditional manufacturing, which limits those characteristics. However, this technology faces difficulties with regard to the construction of overhang structures and warping deformation caused by thermal stresses. Producing overhangs without support structures results in collapsed parts, while adding unnecessary supports increases the material required and post-processing. The purpose of this study was to evaluate the various support and process parameters for metal LPBF, and propose optimized support structures to minimize Support Volume, Support Removal Effort, and Warping Deformation. The optimization approach was based on the Design of Experiments (DOE) methodology and multi-response optimization, by 3D printing and studying overhang geometries from 0° to 45°. For this purpose, EOS Titanium Ti_{64} Grade 5 powder was used, a Ti_6Al_4V alloy commonly employed in LPBF. For 0° overhangs, the optimum solution was characterized by an average Tooth Height, large Tooth Top Length, low X, Y Hatching, and high Laser Speed, while for 22.5° and 45° overhangs, it was characterized by large Tooth Height, low Tooth Top Length, high X, Y Hatching, and high Laser Speed.

Biography

Antonis received his BSc in October 2016 in Product and System Design Engineering from the University of the Aegean, and his MSc in April 2021 in Design & Engineering from Politecnico di Milano honoured with a 2-year merit-based scholarship. He started his career as an industrial design engineer in September 2015 when joined Innora/IKH, a company based in Greece, specialising in robotics and control systems. One year before his MSc graduation he joined TWI Hellas where he participated in more than 4 European projects, delivering solutions on Additive Manufacturing modelling and process optimisation. Continue working at TWI Hellas, in October 2021 Antonis started his PhD studies at Brunel University London and NSIRC under the guidance and supervision of Prof. Tat Hean Gan the Director of Brunel Innovation Centre, and Dr. Panagiotis Chatzakos the Managing Director of TWI Hellas. His research focuses on the development of an innovative platform for metal AM able to propose optimized support structures according to the geometric features of a given artefact.

INFLUENCE OF FDM PROCESSING PARAMETERS AND SNACK DIMENSION ON FOOD PRINTABILITY

Ana Pilipović, Mislav Tujmer and Lovro Travaš
University of Zagreb, Croatia

Abstract:

Additive manufacturing is successfully applicable in the food industry. Although various methods are used, the most common process is fused deposition modeling, i.e. extruding paste, gel, snacks, dough, chocolate, etc. through various nozzle diameters. In this paper, attention is paid to the individual printing parameters and shape of snack; printing speed, infill density, wall width and height of snacks and how they affects the printability of the product and its mass. The snack was prepared with wheat bran, oat flour, barley flour and pea proteins. Sunflower oil, salt, baking soda and citric acid were added to the mixture. According to AACC method 10–50.05 (2000), the snack was mixed in three stages with slight modifications. First, pea proteins (5 g), salt (0.10 g) and sunflower oil (3 g) were mixed with a hand mixer for 3 min at low speed, then 21 mL of distilled water was added, and mixing continued for 1 min at low speed and 1 min at medium speed, and finally, oat or barley flour (15 g) and wheat bran (3 g) were added and mixed for another 2 min at low speed. The snack is made by fused deposition modeling process on Foodbot D2 Multi Ingredient Dual Head Food 3D Printer. Printing was done at 60˚C cylinder temperature, first layer and other layers were printed at 1 mm height, no skirt, brim or raft layers were used. Nozzle diameter was 1 mm and fill pattern were rectilinear printed with 45˚ angle. Successful printing was achieved with 23 mm filament diameter which was the measured diameter of the cylinder. The Design Expert software was used for the statistical analysis and from the analysis it can be concluded that the mass is affected by all input parameters, while the printability is only affected by the infill density.

Acknowledgements: The work was created as part of the project Development of New Generation of Snack Food for Consumers with Specific Dietary Needs using 3D Printing Technologies - 3DSnack4Health (Project code: IP-2020-02-3829) financed from the Croatian Science Foundation. The authors would like to thank the Croatian Science Foundation for funding this project.

Biography

Ana Pilipović start to work at the University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture in the Chair of Polymer Processing, Department of Technology in 2008. and done her doctoral thesis on October 2012., with the topic: Influence of processing parameters on the properties of polymer prototype. From 2008 she is participated in several science international and domestic project like FP7, H2020, IPA, IRI, IRI2, Eco-Innovation, Croatian science foundation and project from Croatian Ministry of Science and Education. Her special interest lies in additive manufacturing, polymer processing, composite processing, recycling of polymers, mechanical testing of polymers, biopolymers, etc. Up to now she has published as author and co-author 215 scientific and professional papers in journals and conference proceedings in Croatia and abroad. She was a visiting professor at Tecnologico de Monterrey Santiago de Queretaro, Mexico, Çukurova University Adana, Turkey, Faculty of Mechanical Engineering in Maribor, Slovenia and Sarajevo, Bosnia and Herzegovina. She won the award "Vera Johanides" for young scientists in 2014 in the field of additive manufacturing awarded by the Croatian Academy of Engineering (HATZ). She is now associate professor and head of Chair of Polymer Processing.

GRAPHENE AEROGEL ELECTRODE FOR ADVANCED ELECTROCHEMICAL DEVICES

Terence X. Liu, Yucheng Wang and Hanhui Lei
Northumbria University, United Kingdom

Abstract:

Super lightweight, multifunctional graphene aerogel (GA) monolith has been prepared as electrode material for electrochemical energy and environmental remedy devices. In this presentation, we will discuss its application in a direct methanol fuel cell (DMFC), which is demonstrated for the first time. A new GADMFC design is proposed by using GA to replace two main components within the DMFC-the gas-diffusion layer and the flow field plate. The results indicate a 24.95 mW cm^{-2} maximum power density of air polarization is obtained at 25°C. The membrane electrolyte assembly has a 63.8% mass reduction compared to an ordinary one, which induced 3 times higher mass power density. Electrochemical reduction of CO_2 (eCO_2RR) to low carbon organic compounds has been considered as a promising method to mitigate the greenhouse effect and produce useful energy carrying chemicals. However, from the commercialization points of view, numbers of challenges in the eCO_2RR remain to be tackled: 1. Low energy efficiency. e.g., inertness and low solubility of CO_2, low selectivity and activity of catalysts, which requires high energy input with low fuel production. We will also discuss its application in electrochemical CO_2 reduction reaction (eCO_2RR) electrolyser for alternating the structural design of cells led to massively increased mass transfer and overall performance. A hybrid gas diffusion electrode-based reaction cell is demonstrated using highly porous carbon paper (CP) and graphene aerogels (GAs), which is expected to offer directional diffusion of gas molecules onto the catalyst bed, to achieve an increase in the Faraday efficiency (FE) from ≈60% to over 94% toward carbon monoxide (CO) and formate production compared with a CP only cell with Cu_2O as the catalyst. It also suppresses the undesirable side reaction–hydrogen evolution over 65 times than the conventional H-type cells.

Biography

Terence Xiaoteng Liu an Associate Professor in the Faculty of Engineering and Environment in Northumbria University. He has led/participated a number of EPSRC, EU commission and Royal Society funded projects, to develop novel materials, manufacturing technologies, and systems for general environmental remediation, water and air pollution treatment and renewable energy generation technologies. Terence currently serves as the Committee of UK Society of Chemical Industry Energy Group; European office manager and associate editor of Nano Materials Science; Associate editor of Frontiers In Chemical Engineering; Guest editor of Small.

WAAM ULTIMATE STEEL AND STRUCTURAL APPLICATIONS

Zeina Al-Nabulsi
Warwick University, DYSE, United Kingdom

Abstract:

This presentation reports on a structural engineering project to see how AM fabrication can use a high or normal strength steel, in terms of strength, stiffness and ductility against the requirements of the structural Eurocodes. Wire Additive Arc Manufacturing can provide the benefits of aesthetics, less metal mass per component and/or structure and with less material waste, which inherently and positively lowers the amount of energy used and reduces carbon emissions to meet the climate emergency call.

The new test results have the objective to widen the use of printed steel in the construction industry, the benefits could be doubled if the ultimate strength steel is the one that has been used, as it consume similar heat for a component. The investigation of the printed mechanical properties satisfied the ductility limits in Eurocode 3 EN 1993-1-12.

Biography

Zeina AL-Nabulsi is a visiting researcher at University of Warwick and an Engineer at DYSE Structural Engineers. She holds a PhD degree from Warwick University and an MSc in Structural engineering from the University of Manchester. She worked for three years for Dar before she pursued her MSc and PhD studies, where she was involved in international projects in the MENA area. In 2019, she received a Commendation Research Award in the structural engineering Awards, organized by the Midland Counties Regional group, for a research paper 'The Potential for Metal 3-D printing in structural engineering. Currently, she is working for her chartered status with the institution of structural engineering.

SYNTHESIS OF CALCIUM CARBONATE MOLECULAR SHEETS via CHEMICAL ROUTE

Sudhir Sharma and Ramesh Jagannathan
New York University Abu Dhabi, UAE

Abstract:

The discovery of 2D materials and their unique properties have inspired the researchers to develop a scheme to create 2D sheets of nacre like lamellar structures. In the present manuscript, we report a chemical process to synthesize molecular sheets of $CaCO_3$ interleaved with an organic material, namely, carbon. We developed a facile and scalable chemical process using poly(acrylic) acid (PAA) formulation and calcium acetate to create lamellar stacks of single crystal sheets of $CaCO_3$. The thickness of calcium carbonate molecular sheets is found to 17 Å. The measured thickness of molecular sheets are in agreement with a unit-cell dimension for calcite (c–axis = 17.062 Å). These molecular sheets are interleaved with amorphous carbon with a thickness of around 8 Å. The strong binding affinity between carboxylate anions and calcium cations in the formulation is used as a molecular template to guide $CaCO_3$ crystallization. Computational modeling performed on the FTIR spectra showed good agreement with experimental observations. These studies also confirmed that calcium ions are bridged between polymer chains, resulting in a net-like polymer structure. This chemical process could be extended to explore the feasibility to created 2D molecular sheets of other important inorganic materials. These molecular sheets of $CaCO_3$ potentially find applications in many fields such as super capacitors and "low k di-electric" systems.

Biography

Sudhir Kumar Sharma obtained masters (M.Sc. Physics and M.Tech. Materials) from Department of Physics, Barkatullah University (formerly Bhopal University) Bhopal, India. In 2007, he received his PhD from the Indian Institute of Science Bangalore, India in 2012. As post doc fellow, he joined at Centre for Nano Science and Engineering (CeNSE), IISc. Bangalore, India as. Afterword's Dr. Sharma moved to New York University Abu Dhabi UAE (NYU Abu Dhabi) as a research associate in Nov. 2103. Currently, he is working as a Research Scientist at NYU Abu Dhabi. His publication record includes about 50 publications in international peer-reviewed reputed journals and more than 75 presentations in conferences. His research interest includes implementation of supercritical technologies for nanoparticle synthesis, Smart materials for micro-sensors and actuators, MEMS/NEMS and micro/nano-fabrications, vacuum science, and thin film technology.

ADDITIVE MANUFACTURING OF QT17-4+ STEEL USING DED

Vyas Mani Sharma[1], Vladimir Popov[1], Amir R. Farkoosh[2], Dieter Isheim[2], David N Seidman[2] and Noam Eliaz[1]

[1]*Tel Aviv University, Israel*
[2]*Northwestern University, USA*

Abstract:

In this study, QT 17-4+ stainless steel powder was used for additive manufacturing (AM) by the direct energy deposition (DED) process, for the first time. QT 17-4+ powder has a chemical composition different from the standard 17-4 PH steel powder it was derived from. Process parameters required for the DED of QT 17-4+ are not available in the literature. Therefore, we employed a design of experiments (DOE) approach to optimize the process parameters (laser power, travel speed, powder feed rate, and hatch spacing). For optimization, mass density was used as the response. The mass density of each sample was measured using Archimedes principle. The results demonstrate that the laser power and mass flow rate only weakly influence the mass density. Yet, the interaction of scan speed and hatch overlap has a significant influence on the mass density. DED samples have microhardness values comparable to the H900 thermally treated wrought 17-4 stainless steel. The change in chemical composition of the QT 17-4+ steel compared to the wrought steel results in enhanced mechanical properties. DED printed samples do not require a heat treatment to improve their mechanical properties. Mechanical and microstructural characterization are presented for the optimized process parameters.

Acknowledgment: This work was financially supported by the NSF-BSF (Grant no. 0605814672).

Biography

Vyas Mani Sharma has expertise in additive manufacturing, design of experiment, hydrogen embrittlement, powder metallurgy, metal foam, and friction stir welding/processing. Currently, I am working on the AM of QT17-4+ PH steel. This steel has a chemical composition different from the conventional 17-4PH steel. This opens a vast opportunity for research in this field.

FABRICATION OF LARGE INTERLAYER SPACING 2D $Mo_2Ti_2C_3$ MXENE SUITABLE FOR HIGH-PERFORMANCE SUPERCAPACITORS

Daniel Q Tan, Dayakar Gandla and Fuming Zhang
Guangdong Technion – Israel Institute of Technology, China

Abstract:

MXenes, a new and exciting class of 2D planar structures with over 70 different compositions predicted theoretically and over 30 different compositions experimentally synthesized thus far. These transition metal carbides and/or nitrides, despite in the early stages of application for energy storage, have been proven to be promising electrode materials for supercapacitors due to their excellent electrical conductivity, hydrophilic behavior, unique layered structure, mechanical strength, and ability to host cations of different sizes. 2D MXenes show outstanding specific capacitance in aqueous electrolytes but are limited to delaminated sheets, interlayer spacing, and narrow potential window. For instance, Ti_3C_2 has an interlayer spacing of ~0.2 nm, a lattice constant of 0.3104 nm, and a monolayer thickness of 0.4639 nm. It is desirable to explore larger interlayer-spaced 2D MXenes that can facilitate the large ion intercalation-deintercalation process. This work reports the first-ever supercapacitor application of the $Mo_2Ti_2C_3$ MXene electrode that is made compatible with ionic liquid in acetonitrile electrolyte. Without any pre-intercalating agents, the authors achieved an interlayer spacing of ~2.4 nm in the f-$Mo_2Ti_2C_3$ material through etching, followed by a vacuum-assisted filtration technique. The electrochemical properties and charge storage kinetics of the f-$Mo_2Ti_2C_3$ outperform the common f-Ti_3C_2Tx, exhibiting remarkable specific energy and specific power of 188 Wh kg^{-1} and 22 kW kg^{-1}, respectively. Engineering the interlayer spacing in MXene materials to match the large ions of the ionic liquid opens a new avenue towards the design of next-generation high-performance MXene supercapacitors.

Biography

Daniel Q. Tan is the Deputy Head of the Department of Materials Science and Engineering, Guangdong Technion-Israel Institute of Technology, and the Director of the Guangdong Provincial Key Laboratory of Materials and Technologies for Energy Conversion, China. In 1989, he obtained a PhD in Physics from Chinese Academy of Sciences. He then taught at the University of Science and Technology of China. From 1994 to 2018, Dr. Tan visited the University of Illinois at Urbana-Champaign and received his Ph.D. in Ceramic Engineering. Then, he entered the industry to investigate dielectric ceramics and polymers, energy storage technologies, and filtration membrane technology for 20 years.

COLOSSAL BAND GAP RESPONSE OF SINGLE-LAYER PHOSPHORENE TO STRAIN PREDICTED BY QUANTUM MONTE CARLO

Ivan Stich, Yongda Huang, Jan Brndiar, Lubos Mitas and Jaroslav Fabian
Slovak Academy of Sciences, Slovakia Republic

Abstract:

Quantum Monte Carlo (QMC) methods are applied to study tuning of the quasiparticle electronic band gap of free-standing single-layer phosphorene by applied strain. The band gap is determined for any uniaxial (armchair and zigzag) and biaxial strain with both internal coordinates relaxed at the QMC level using a 4-dimensional paraboloid approximation. As a by-product, the QMC-optimized equilibrium structure is also obtained, which is, unlike in 3D crystals, not experimentally known and strictly required for determining the true applied strain. Using fixed-node QMC methods we have also determined two boundaries: 1) the boundary between the direct ($\Gamma \rightarrow \Gamma$) band gap and direct band gap at Γ but with the LUMO and LUMO+1 states interchanged ($\Gamma \rightarrow \Gamma'$) and with transport properties in conductance band hugely altered, and 2) the boundary between the $\Gamma \rightarrow \Gamma$ and indirect $\Gamma \rightarrow X$ band gap. These authoritative ultra-accurate calculations strongly suggest that the band gap tuning rate is in excess of that in MoS_2, ≈ 0.1eV/% but, at variance with MoS_2, with hugely enlarged region of strain tuning where the band gap remains direct at Γ. The two factors combined lead to prediction of a colossal band gap tuning window, larger by an order of magnitude, in comparison to MoS_2. For this strain range benchmark-quality quasiparticle band gaps are calculated in all three strain regions ($\Gamma \rightarrow \Gamma$, $\Gamma \rightarrow \Gamma'$, $\Gamma \rightarrow X$) and fitted with analytical formulas. The QMC results are compared with a range of DFT models in various common approximations and their biases and failures revealed.

Biography

Ivan Štich got his PhD. in condensed matter physics in Trieste, Italy, in 1989. He worked at Cavendish Laboratory, U.K., where in 1991 he ported, for the first time, plane-wave psedopotential calculations on parallel computers. In 1994 he joined the Joint Research Center for Atom Technology in Tsukuba, Japan. He got his full professorship in solid state physics at the Slovak Technical University in 2003. 2007-2011 he served as director of the Institute of Physics, Slovak Academy of Sciences and 2011-2022 he was head of the Center for Computational Materials Science. In 2022 he joined Institute of Informatics of the Slovak Academy of sciences as head of the Dept. of High-Performance and Quantum Computing. In addition to density functional techniques, he also works in many-body electronic structure, such as Quantum Monte Carlo. His current interests are in surface probe techniques (AFM, STM) and 2D systems.

CALIBRATION OF STRUCTURAL DESIGN VALUES FOR WIRE-AND-ARC ADDITIVELY MANUFACTURED STAINLESS STEEL BARS

Giada Gasparini, Vittoria Laghi, Michele Palermo and Tomaso Trombetti
DICAM – University of Bologna, Italy

Abstract:

Current strategies for the realization of automated steel constructions see the application of metal Additive Manufacturing (AM) processes and in particular Wire-and-Arc Additive Manufacturing, (WAAM) as an opportunity to build a new generation of efficient and reliable steel structures with reduced material use. This goal, though, does require reliable design procedures for the full exploitation of such new technologies. In particular, a novel printing strategies consisting in the deposition of successive metal droplets, known as dot-by-dot technique, enable to manufacturing of complex lattice structures, such as diagrid elements and free-form rebars for Reinforced Concrete (RC) elements. However, their proper design requires an accurate evaluation of the mechanical response of the straight bars, representing the unitary elements composing the lattice structure. The present study focuses on the calibration of design strength parameters of WAAM-produced 308LSi stainless steel straight bars. The results are grouped into three batches of bars, each for a different build angle (i.e. 0°, 10° and 45°) to assess the influence of the printing inclination on the mechanical response. The calibrated values of design strength (both at yielding and ultimate conditions) and corresponding partial safety factors are evaluated according to the best fit statistical distributions derived from experimental test results and Eurocode 0 "design assisted by testing" procedure.

Biography

Giada Gasparini is an Associate Professor in Construction Design since in the Department DICAM, Faculty of Engineering of the University of Bologna. She holds the chairs of "Construction Techniques (module 2)" at the Single cycle degree program in Architecture and Building Engineering, "Laboratory of Construction in Architecture IIA" and "Construction Design" at the Faculty of Architecture of the University of Bologna. In July 2001 she graduated with distinction in Civil Engineering at University of Bologna. In 2005 she became PhD Doctor in "Structural Mechanics" with a dissertation thesis titled "The ALPHA Method, a simplified method for the analysis of torsional problems in eccentric systems subjected to seismic input: theory and application." In 2005 she was the recipient of a Research Assign at the University of Bologna, with a research project titled "Analysis of torsional effects on eccentric structures under seismic excitation", supervised by Prof. Claudio Ceccoli. She published more than 130 scientific papers, some of them on the most relevant international journals. Prof. Gasparini is member of the Emilia-Romagna region technical committee for the economic losses refunds within post Emilia earthquake 2012 reconstruction plan activities. She is also Participating Member of ASTM International (#2265227) within the F42 committee.

APPLICATION OF METAL 3D PRINTING TO MAKE CONFORMAL COOLING LINES OF DIE-CASTING MOLDS

Shueiwan H. Juang and Yeou-Li Chu

National Taiwan Ocean University, LK Advanced Machinery, USA

Abstract:

In recent years, additive manufacturing has become more popular for making molds with 3D conformal cooling lines. In die casting processes, using 3D printed inserts with conformal cooling lines can reduce die casting cycle time, improve the mechanical properties of parts, reduce porosity, and reduce die soldering. As a relatively new process, 3D printing of mold inserts still presents some unknowns. According to experience, 3D printed conformal cooling inserts are at least 2-3 times more expensive than traditional mold inserts. As the manufacturing cost increases die casting companies to expect 3D molded inserts to last longer. Dies casters may be discouraged from adopting this new process if the service life of the 3D inserts cannot match the production cost.

To overcome unknown problems, a systematic study has been conducted on the application of 3D printing inserts in casting. This includes examining the properties of 3D printing powder, comparing the mechanical properties of different printing materials, and evaluating their response to water corrosion. This article outlines general guidelines for insert printing material selection, and insert heat treatment processes for industrial applications. The presentation covered real-world failure cases and guidelines for 3D printing in die casting processes.

Biography

Shueiwan H. Juang has been engaged in die casting research and teaching for over 30 years. He graduated from The Ohio State University in 1991 with a Ph.D. in Mechanical Engineering. To date, he has authored 2 professional books on die casting and forging processes, transferred 15 technologies to local manufacturers, obtained 5 patents in Taiwan, and published more than 20 journal papers and more than 110 conference papers. He was the Dean of the College of Engineering, National Taiwan Ocean University (2018-11-16 to 2021-11-15), and the Chairman of the Taiwan Foundry Society (2015-12-02 to 2018-12-01). He has won 5 times (2005, 2007, 2012, 2016, 2021) of "Industry-University-Research Achievement Award" from the Taiwan Ocean University and "Foundry Engineering Award" (2021) from Taiwan Foundry Society, in recognition of his remarkable achievements in academic cooperation and outstanding technical contributions to the foundry industry. Currently, Prof. Juang serves as the director of the Advanced Manufacturing Engineering R&D Center of National Taiwan Ocean University and assists the Taiwan government in planning the establishment of the "Taiwan Die Casting Mold Center", engaged in technical guidance and talent training for Taiwan's die-casting mold-related industries.

SIMPLE AND ADVANCED TECHNOLOGIES TO IMPROVE THE PROPERTIES OF METAL ADDITIVE MANUFACTURING PRODUCTS

Martin Nozar
University of West Bohemia, Czech Republic

Abstract:

One of the most challenging aspects of modern metal additive manufacturing is to set the appropriate and effective process parameters to ensure flawless and repeatable manufacturing of metal parts with the required properties, quality, and geometrical accuracy. This contribution focuses on the available technologies and sophisticated approaches applicable mainly in metal additive manufacturing based on the Laser Powder Bed Fusion method, such as SLM or DMLS. These make possible manufacturing of parts with extraordinarily complex internal and external structures or parts where additive manufacturing with standard setup often falters. The reason may be that the melting process usually uses default processing parameters that are universal for a wide range of structures – from tiny pieces with thin walls to large and bulky parts. However, in some singular situations or in the case of some unique shapes or structures, modified parameters are more appropriate or even necessary.

This contribution describes the experience with metal additive manufacturing of difficult-to-manufacture industrial components, prototypes, and topologically optimized cutting tools manufactured using the EOS M290 machine. In addition to this, there are several experiments presented here that have been conducted to investigate the effectiveness of methods like time and energy input homogenization and possibilities of process parameters optimization. These, on the one hand, could prevent printed parts from warping, overheating, non-uniform shrinking, and excessive residual stress, and on the other hand, could ensure better surface quality even for down-faced surfaces inclined at relatively small angles printed without support structures.

Finally, there is described the utilization of software simulation and an advanced in-situ process monitoring system to examine the effectiveness of the modified process parameters, observe their effect in real-time and enable early detection and correction of any process faults and defects.

Biography

Martin Nozar, Ph.D. works as a researcher in the Metal additive manufacturing laboratory equipped with EOS M290 machines complemented by an advanced monitoring system and other necessary equipment to research the entire additive manufacturing process from print model and data preparation, through the actual manufacturing to post-processing and heat treatment. This equipment and rich experience in additive manufacturing also enable the laboratory to manufacture components with complex geometries or complicated internal and external structures, unique prototype parts, or cutting tools with optimized design.

Within this laboratory, Martin Nozar specializes in research and preparation of suitable process parameters for usual and unusual printing jobs, utilization of computer simulation of the printing process, economic aspects, and potential health hazards of additive manufacturing and its impact on the environment. He is also involved in the design and coordination of experiments and some research projects, is the author of several scientific publications and lectures, and beta-tester of printing models preparation software.

Day 2

3D Printing & Graphene 2023

Keynote Presentations

LASER-CONTROLLED DESIGN OF CARBON NANOTUBE ARCHITECTURES

Norbert Hampp
University of Marburg, Germany

Abstract:

Laser-controlled stainless steel surface modification is a powerful tool to obtain functional surfaces in a maskless process, allowing coloration of metal surfaces, formation of diffractive gratings, and friction reduction in bearings. The formation of catalytic iron oxide nanoparticle arrays for the controlled growth of carbon nanotubes (CNTs) of various morphologies is one of the recent developments. The laser-driven self-organization process on stainless steel causes a reorganization of the surface composition ending up in spatially selective controlled areas of iron oxide nanoparticle arrays showing a defined density. In a subsequent plasma vapor deposition step the desired architecture is grown. Most interesting are bundles of vertically aligned CNTs up to centimeters in length.

Biography

Norbert Hampp complete his first Ph.D. in pharmacy in 1986 and completed his second Ph.D. in Physical Chemistry in 1992. He spent his post-doc time at the Institute of Semiconductor Technology of the FhG. In 1994 he accepted a position at the central research organization of Wacker-Chemicals dedicated to the acquisition of research and technology. Since 1995 he holds a chair as a full professor of physical chemistry at the University of Marburg. He authored more than 250 research papers and 19 patent families. His research is in the biopolymer field as well as laser-nanostructured surfaces.

3D PRINTED NANOCOMPOSITE CONTACT LENSES FOR OCULAR HEALTH MANAGEMENT

Haider Butt
Khalifa Uniersity, Abu Dhabi, UAE

Abstract:

In this study we presented the fabrication of tinted contact lenses for color blindness, and several issues related to their mechanical properties and toxicity were reported. Gold nanoparticles were integrated into the soft hydrogel material based contact lenses, thus forming nanocomposite contact lenses targeted for red-green CVD application. The integration of nanomaterials into hydrogels is a prominent research challenge for a myriad of healthcare applications, such as bio-sensing, cancer therapy, and bone tissue engineering. In particular practical contact lenses, functionalized with metallic nanoparticles are of interest for therapeutics and targeted therapy. Several types of nanoparticles were synthesized, characterized and incorporated within the pHEMA hydrogel material. The materials were utilized along with Vat Photopolymerization based 3D printer for printing soft contact lenses, and their resulting optical, mechanical, hydration and material properties were assessed. The optical transmission properties of the 3D printed nanocomposite lenses were found to be analogous to those of the commercial CVD glasses, and their water content and wettability properties were better in comparison to some of the commercially available contact lenses used for cosmetic/vision correction purposes. Hence, this work demonstrates the potential of 3D printing multi-functional and nanocomposite contact lenses for ocular health management and, more generally, color filtering applications.

Biography

Haider Butt did his M. Phil. in Electrical Engineering from University of Cambridge (UK) in 2008, followed by a PhD in 2012. He was selected as the Henslow Research Fellow by the Cambridge Philosophical Society, University of Cambridge is October 2012. In 2013, he was appointed as a Lecturer of Nanotechnology at the School of Engineering, University of Birmingham (UK) and was promoted to Senior Lecturer in 2016. He joined Khalifa University as an Associate Professor in Mechanical Engineering in 2019, where he presently leads a Nanophotonic Laboratory. His group's research focusses on additive manufacturing of nanophotonic devices, particularly smart contact lenses for sensing and color blindness related applications.

Day 2

3D Printing & Graphene 2023

Oral Presentations

SALIENT FEATURES OF STRUCTURES MADE BY 3DCP

Aleksey Adamtsevich and Andrey Pustovgar
Moscow State University of Civil Engineering, Russia

Abstract:

Additive manufacturing construction is the development of existing concrete placing technologies used in traditional monolithic construction, but at the same time it is a new approach that can significantly reduce the share of manual labor in construction, increase the speed of construction work, reduce material consumption, and improve architectural appearance of buildings and structures under construction. However more stringent requirements are imposed on the material for 3D concrete printing (3DCP) in terms of controlling rheological characteristics, curing kinetics, interlayer adhesion and other parameters than for ordinary ready-mixed concrete, which makes it difficult to ensure the stability of the mechanical properties of the hardened material in the mass of the printed structure and does not allows to perform a reliable calculation of the structure in the design of buildings and structures.

The results of the authors' experimental study of the 3DCP mode influence on the change in the physical and mechanical properties of concrete and the nature of the samples destruction, according to the load application vector in additive manufacturing construction are presented in the article.

The presentation describes the characteristic features of concrete products made using additive manufacturing construction technology, compared with traditional monolithic products, which should be taken into account when using additive manufacturing construction technology in practice. The main features of products and structures manufactured using the additive manufacturing construction technology are considered, such as: insufficient compaction of the concrete mixture during extrusion; anisotropy of the strength properties of concrete in different directions relative to the print vector; the possibility of defects formation in the form of voids in the interlayer space when printing multilayer products and structures; change in strength characteristics due to the peculiarities of fiber orientation during extrusion when using dispersion-reinforced materials for additive manufacturing construction

Biography

Aleksey Adamtsevich - Senior Researcher of the Research Institute of Construction Materials and Technologies in Moscow State University of Civil Engineering. Areas of professional competence: 3DCP, digital technologies, robotics and machine learning in Civil Engineering

GRAPHENE/POLYOLEFIN NANOCOMPOSITES

Muhammad Z. Iqbal
United Arab Emirates University, United Arab Emirates

Abstract:

Atomically thin graphene sheets are expected to significantly alter the functional properties of polymers. However, the property enhancement is a function of degree of graphene exfoliation and dispersion, and its compatibility with the base polymer. The main issues arise from mixing graphene in non-polar matrices such as polyolefins.

Polyolefins constitute a major market share in today's materials and therefore, the composites of polyolefins can provide a road towards cost-effective functional materials. In this presentation, we will present our research on polyolefins (PE and PP) and their graphene-based nanocomposites. For example, a new compatibilizer (Poly(ethylene-co-butyl acrylate) (EBA) is compared with the conventional compatibilizer (maleic anhydride-grafted-polypropylene) (MA-PP) to produce improved polypropylene/graphene (PP/G) nanocomposites. The EBA-compatibilized PP/G nanocomposites exhibit improved thermal and mechanical properties compared to MA-PP-compatibilized PP/G nanocomposites. The inherently increased crystallinity leading to brittleness in MA-PP compatibilized PP/G nanocomposites also decreased using EBA as compatibilizer which evidently affected the mechanical properties.

Furthermore, a series of experiments elucidating the dispersion efficacy of graphene in PP are evaluated to compare the solution and melt blending techniques for manufacturing nanocomposites. Various structural analysis techniques reveal that solution blending is not an appropriate method for mixing graphene in non-polar polymers, espacially in PP. Owing to the strong van der Waals forces leading to re-stackability, the graphene nanosheets make a surface film rather than enforcing PP itself in solution blending whereas majority of graphene is embedded inside the matrix when mixed via melt blending method. The current results present

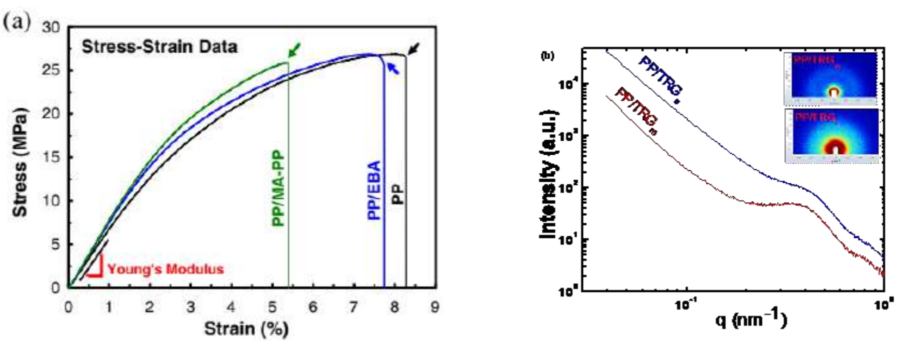

Figure 1: Figure illustrating the fundamental difference in mechanical properties of compatibilized PP (a), and high scattering of x-rays in solution processed PP/graphene nanocomposites compared to melt processed nanocomposites (b).

fundamental aspects of PP/G nanocomposites which can be extended to various other graphene/non-polar matrix composites for property enhancement and applications.

Conclusion: In order to produce uniformally dispersed graphene/polyolefin nanocomposites, two-step extrusion proves to be better than single-step extrusion or solution blending (espacially in case of polypropylene). Certain structural features appear in melt-processed polyolefins which are different than in the solution-processed materials and should be considered while manufacturing nanocomposites. Additional investigation will reveal more control over the structure during processing, leading to smart functional materials.

Biography

M. Zafar Iqbal is an Assistant Professor of Chemical Engineering at UAE University. Prior to joining UAE University, Dr. Iqbal has worked as a lecturer at University of Engineering and Technology (UET) Lahore, Pakistan for about three years and later, as a research and teaching assistant at Petroleum Institute, Abu Dhabi for about three more years. Dr. Iqbal's teaching interests are in the areas of flow of non-Newtonian Fluids (Polymers), Transport Phenomena, and Polymer Science and Engineering.Dr. Iqbal's research interests include 2D materials, polymers, and wastewater treatment. The main focus of his research is to understand structure-property-processing relationships in filled polymers.

FACILE AND COST-EFFECTIVE FABRICATION OF COMPONENTS FOR SUB-THz VACUUM-TUBE ELECTRON DEVICES BY LCD 3D PRINTING AND MAGNETRON SPUTTERING

Nikita Ryskin, Andrey Starodubov, Timur Amanov, Ilya Kozhevnikov, Alexey Serdobintsev, Sergey German, Viktor Galushka, Sergey Molchanov and Igor Bahteev

Saratov State University, Russia

Abstract:

Fabrication of components for miniaturized vacuum electron devices (VED) operating at sub-THz (0.1-0.3 THz) band and above is still a challenging task. During the recent years, significant advancements have been made in the use of additive manufacturing methods. Resin 3D printing, also known as vat polymerization, comes in three main types: conventional stereolithography (SLA), 3D printing based on the using digital light processing (DLP), and 3D printing based on the using liquid crystal display (LCD). The 3D printing additive manufacturing techniques allow for rapid design and easy fabrication of complex-shape 3D objects, requiring minimal material consumption. Combination of the plastic 3D printing and metallization is a promising way for fabrication of various VED components, such as slow-wave structures, vacuum windows, waveguide couplers, etc. In this work we propose and verify an approach for rapid prototyping of mm-band components by using the LCD 3D printing and magnetron sputtering. The LCD 3D printing is the most cost-effective now due to the low-cost equipment in comparison with convenient SLA or DLP technologies. To verify the proposed approach, the waveguide couplers for operation in D-band (110-170 GHz) and H-band (170-260 GHz) were fabricated. Magnetron sputtering is used to deposit thin copper films onto the inner surface of the fabricated structures. The morphology and profilometry studies show that surface roughness after metallization is less than 500 nm. Measured reflection loss is no worse than 10 dB, while the transmission loss is less than 2 dB/cm. Several ways to decrease the surface roughness in order to decrease the transmission loss, such as prior chemical polishing of the inner surface of the 3D-printed parts before metallization and increasing the metallic layer thickness are considered.

Biography

Nikita M. Ryskin received the Diploma, Ph.D., and D.Sc. degrees from Saratov State University, Saratov, Russia, in 1991, 1996, and 2005, respectively. Since 1991, he has been with Saratov State University, where he is currently a Professor and Chair of the Department of Dynamical Systems. In 2013, he also joined Saratov Branch of Kotelnikov Institute of Radio Engineering and Electronics RAS, where he is currently a Head of the Vacuum Micro- and Nanoelectronics Laboratory. In 2016 and 2019, he served as a Visiting Professor at Fukui University, Japan.Prof. Ryskin has conducted research on time-domain simulation of nonlinear and chaotic phenomena in various vacuum microwave electron devices. His research team is mostly focused on developing miniaturized millimeter and sub-THz band vacuum-tube amplifiers and oscillators. His other research interest is in theoretical study of nonlinear phenomena in gyrotron and other microwave oscillators. He has co-authored more than 250 journal articles and conference papers, as well as three books. Prof. Ryskin is Senior Member of IEEE. He served as a member of the IEEE EDS Vacuum Electronics Technical Committee in 2015-2018. He also has served as a member of Technical Program Committee for several prominent international conferences. Since 2020, he has been an Editor of IEEE Electron Device Letters.

DEVELOPMENT OF FLEXIBLE PVDF-GRAPHENE PIEZOELECTRIC NANOCOMPOSITES FOR SMART SENSING APPLICATIONS

Poonam Kumari, Nikhil Dilip Kulkarni and Mukesh Kumar
IIT Guwahati, India

Abstract:

Graphene-based nanomaterials have gained much attention recently due to their excellent mechanical, electrical, and thermal properties. The numerous applications of polymer-based nanocomposites have made them a dominant force in today's global market. This research work investigated the role of Reduced Graphene oxide (rGO) nanosheets on the dielectric and piezoelectric properties of Polyvinylidene difluoride (PVDF). Different quantities of rGO sheets were loaded in a PVDF matrix using DMF solvent to fabricate nanocomposite films using solvent casting process. The piezoelectric response of nanocomposites was enhanced using thermal poling process. The morphology and structure of nanocomposite films were studied using field emission scanning electron microscopy (FESEM) and X-ray diffraction (XRD). Increasing rGO content increased the film's dielectric constant, confirming its enhanced piezoelectricity. Each nanocomposite sample was converted into a piezoelectric nanogenerator (PENG) device and piezoelectric output voltage was recorded with a digital storage oscilloscope (DSO) using continuous finger tapping operation. Increment in output voltage was observed upon rGO addition. These flexible composites have potential role in sensor and actuator applications.

Biography

Poonam Kumari is currently an Associate Professor in the Department of Mechanical Engineering of the Indian Institute of Technology Guwahati. She received her Ph.D. degree from Indian Institute of Technology Delhi in 2012.She did her Post-Doctoral Fellowship at Simon Fraser University. She works in the area of Continuum Mechanics and Smart Material and structures. She has developed three-dimensional as well as two-dimensional solution for composite and piezolaminated plates. She has 29 International Journal publications and 29 International Conference publications. She is teaching course of Theory of plates and Shells since 2014 at IIT Guwahati. She has also conducted an online course on theory of rectangular plate under MOOCs. Her course was selected for faculty development programme course by AICTE. She received Young Engineer Award in 2017 from Indian National Academy of Engineers very recently, she also received approval for SERB women excellence award,2019.

NEW ALLOYS AND MATERIALS DESIGN *via* ADDITIVE MANUFACTURING

Vladimir Popov, Vyas Mani Sharma, Shir Batat and Noam Eliaz
Tel Aviv University, Israel

Abstract:

Material Design *via* Additive Manufacturing (MaDe-*via*-AM) is a relatively novel methodology that utilizes the unique advantages of AM for new alloys and new materials fabrication and development.

We will illustrate how MaDe-*via*-AM methodology can be successfully applied for High Entropy Alloys (HEAs) design, functionally graded materials (FGMs) *in situ* alloying, and even ceramic and composite materials manufacturing. Such approach requires comprehensive understanding of process parameters optimization, material characterization and proper microstructural analysis.

TAU Additive Manufacturing Center (AMC) works on the development and characterization of new and existing metals and alloys, and more complicated materials like CMCs and MMCs. The center is based around an Optomec Lens 3D Hybrid machine, which allows printing whole parts from scratch, repair, and cladding. The printer enables 3D printing of metals, ceramic materials, composite materials, and functionally graded materials using Directed Energy Deposition (DED) technology.

Biography

Vladimir V. Popov holds a PhD in Metallurgy (Ural Federal University, Russia) and is managing director of Additive Manufacturing R&D Center at Tel Aviv University, Israel. He is a lecturer of academic courses focused on technological, materials, and application aspects of additive manufacturing and 3D printing. Dr. Popov is one of the pioneers in the additive manufacturing of permanent magnets, high entropy alloys, and other functional materials.

A STUDY ON AERO TESTING WITH REFERENCE TO F1-75

Prahaladh Srikanth
SA 3D Solutions, India

Abstract:

Aerodynamics is an essential element in automotive design. With an ever-growing interest towards automotive designing, Prahaladh has created a replica wind tunnel to test and evaluate aerodynamics for the automobile models he has been creating. He uses Stereolithographic 3D Printers to being his designs to life and test their aero. With massive interest in F1 and their technological innovation, Prahaladh has been researching on different aerodynamic changes to the F1-75 3D Model he has modelled from the ground up using blueprints and photos from the grands prix he scoured from the internet. To understand about aerodynamics, he has created numerous versions of the F1-75 to understand the changes in the aero as he constantly changes the car's shape to understand the airflow in an F1 car. Many of the observations have been noted but still yet to disclose as the research about the parts which are 3D Printed are yet to be over as there are plenty of technical heads such as the material used, changes in the aero, the airflow, etc. This is done to understand the mechanics of an F1 car by using additive manufacturing. Prahaladh also used the MJP Printer – 3D Systems' Projet 660 Pro to some of his iterations of the F1 Car. But to maximize precision and durability, the stereolithographic 3D Printer – Phrozen Sonic Mini 8K was majorly used to print out parts. As 3D Printing is widely used in the field of F1 and its innovations, Prahaladh is endeavoring to understand about the innovations 3D Printing can bring to every field.

Biography

Prahaladh Srikanth is a student who is passionate towards the field of 3D Design and 3D Printing and with an ever-growing knowledge about the latest 3D Design softwares and techniques in the field of 3D Design and 3D Printing. With his ever-growing interest in the field of CG (Computer Graphics) and 3D Printing, Prahaladh pursues a graduation course in finance

3D PRINTING IN WEARABLE ROBOTICS: FROM PROSTHETICS TO HAPTICS

Rahim Mutlu
University of Wollongong in Dubai, UAE

Abstract:

Additive manufacturing, (AM) has found greater momentum than ever with recent technological developments in not only manufacturing but also in amalgamation of Engineering and Materials Science. Wearable technologies such as prosthetics, exoskeletons and haptic devices may results highly sophisticated and multi-material fabrication requirements which can be challenged by employing AM methods to simplify fabrication process while also contributing to consolidation of design parts and component leading ease of manufacturing. Developing a robotic hand prosthesis mimicking a human hand in terms of appearance, functionality, as much as dexterity has always been a fascinating topic in robotics research. Challenges associated with current robotic prosthetic hands in the market including cost, weight, operating noise, mechanical compliance, aesthetics and sensory feedback, we have developed a soft robotic prosthetic with principles aforementioned to realize a robotic hand monolithically. A fully compliant design enriched with flexural hinges is created with the incorporation of palmar closures to eliminate complicated assembly and, more importantly, lower the overall weight of the hand dramatically to 159.10g. The grasping and gripping performance of the soft prosthetic hand is reported with various objects that have different shapes, sizes, textures, weights, and stiffnesses. In addition, a soft haptic device work has been conducted developing a multi-material haptic device for better human-robot interface in order to deliver biofeedback which plays a significant role in substituting sensory data when sensory functions of an individual are reduced or lost such as amputation, and neurological disorders. The soft haptic device was directly manufactured using a low-cost and open-source fused deposition modeling (FDM) 3D printer by using a soft conductive and nonconductive thermoplastic poly(urethane) (TPU) materials. Upon characterization, both mechanically and electrically to assess its performance, a dynamic model is developed to estimate force output for pressure inputs. The efficacy of the soft haptic device for inducing biofeedback was demonstrated as balance feedback, tactile feedback as gripping force, and proprioceptive feedback as a limb positioning.

Biography

Rahim Mutlu is a passionate researcher for Wearable Robotics to realize them from ideation to functional devices with use of interdisciplinary approach. Mutlu's journey commenced in Mechanical Engineering complemented with a Business Administration, Master's and Ph.D. degrees in Mechatronics. He worked as a postdoctoral research fellow on Soft Robotics in medical applications, developing a soft robotic prosthetic hand, in the ARC Centre of Excellence for Electromaterials Science (ACES) at Intelligent Polymer Research Institute (IPRI). He was a Lecturer - Biomedical Engineering with University of Wollongong, Australia, prior to committing his current leading role as Assistant Professor - Mechatronics with the Faculty of Engineering and Information Sciences at UOWD, Dubai, UAE. He is also founder of the Intelligent Robotics & Autonomous Systems Co (iR@SC), NSW, 2529, Australia.
His research interests include soft robotics, soft haptics, wearable robotics and their use in biomedical applications, assistive and rehabilitation exoskeletons, innovative manufacturing techniques including additive manufacturing (aka 3D printing), and demand driven mechatronics.

3D PRINTED SOFT SENSORS

Umar Asghar, Rahim Mutlu and Ciara O'Driscoll
Univeristy of Wollongong in Dubai, UAE

Abstract:

Robust soft wearable sensors are highly demanded to monitor human activities by measuring biochemistry to bio signals through various means. Flexible structures produced with Additive Manufacturing (AM) methods are promising to address stretchable wearable sensors. Such soft structures can be instrumented to stretchable wearable sensors to measure mechanical input such as force, pressure, displacement, strain into electrical signals creating Human-Computer Interfaces (HCIs). This study designs, fabricates, and characterises such soft sensors using Fused Deposition Modelling (FDM) type AM with a conductive thermoplastic polyurethane material. Experimental results are validated with FEA results. Experimental results demonstrate the efficacy of the such structures to create soft wearable sensors which was also demonstrated with experimentally monitoring various human activities.

Biography

Umar Asghar holds Ph.D. in the Polymer Manufacturing Process from University of Bradford (UK). He has 8 years of experience across the Nuclear and Medical industry undertaking various roles some of which include Design Engineer and Project Management. Dr Umar Asghar is presently working as the Discipline Lead for Mechanical and Civil Engineering degree program at the University of Wollongong in Dubai and is involved research associated with 3D printing. Some of the areas include manufacturing new products and developing 3D printed structures for a wide range of applications. Furthermore, he is member of the Smart and Sustainable Cities Research Group and is continuously working on developing collaborations with industry.

STRUCTURE AND DYNAMICS BEHAVIOR OF BINARY MIXTURE AND ELECTROLYTE SOLUTION IN NANOCHANNEL BY 2D MATERIALS

Atanu Kumar Metya
Institute of Technology (IIT) Patna, India

Abstract:

Two-dimensional (2D) materials such as graphene, graphene oxide, hexagonal boron nitride, honeycomb silicon, and transition metal dichalcogenides including molybdenum disulfide (MoS_2), and tungsten disulfide nanosheets have received considerable attention due to widespread application in electronics, electrochemical catalysts, sensors, transistors, various biological processes, and energy harvesting fields. For example, the phase separation of the ethanol-water binary mixture within the nanopore. Recent studies have suggested that 2D materials such as MoS_2- based membranes could be a potential candidate for separation techniques. Although various studies have reported on the phase separation of a binary mixture in the presence of graphene and desalination applications using MoS_2-based membranes, the molecular level insight into the structure and dynamics of water remains unexplored. For example, how do pore widths, ethanol content, and temperature affect the phase separation of a binary mixture? How does water transport depend on the width of the nanochannel and the nature of the ions? In this seminar, I will present insights into the mechanism of ethanol-water separation confining between model hydrophilic mica and hydrophobic graphene surfaces as a function of ethanol concentrations, nanochannel widths, number of graphene layers, and temperatures. Furthermore, I will present the structure and mobility of electrolyte solutions confined between two single layers of MoS_2 sheets at various salt concentrations, pore sizes, and cations. We find that water molecules are adsorbed at the mica surface, while ethanol molecules prefer to be adsorbed near the graphene surface. We find that distinct layers of ethanol molecules form as the channel width and ethanol content in the mixture are increased. The diffusion of confined ethanol and water molecules depends on the nanopore widths, concentrations, and temperatures. These comprehensive analyses and finding will be of great significance to the broad scientific and engineering communities in interfacial phenomena, biology, and energy systems.

Biography

Atanu Kumar Metya joined the Chemical and Biochemical Engineering department at the Indian Institute of Technology (IIT) Patna in 2020, as an Assistant Professor. Prior to joining at IIT Patna, he was a Postdoctoral Researcher in the Department of Chemistry at the University of Utah (2019- 2020). He received his Ph.D. and M.Tech in Chemical Engineering from the IIT Kanpur, and B.Tech. in Chemical Engineering (2009) and B. Sc. in Chemistry (Hons.) (2006) from the University of Calcutta.

He has a strong research background in computational science and engineering fields and expertise in the area of Thermodynamics and Molecular Modelling. The research experiences lie broadly in interfacial phenomena, nucleation and wetting of pure liquid and solutions. Our research team focuses on understanding the important interfacial phenomena and the development of new materials capable of water and ice-repellent properties and drug discovery. We investigate the microscopic structure, phase transitions, and dynamics of bulk, confined water, and fluid mixtures using a multiscale simulation approach from quantum to coarse-grained simulations. We further focus on machine learning methods for computational drug discovery and ML-based force field development. He has published fourteen peer reviewed articles in various international journals.

MULTI-MATERIAL 3DPRINTING, SEVERAL TECHNOLOGIES IN ONE FOR NEW CERAMIC PRINTER

Rouslan Svintsitski
3D Ceram Sinto SAS, France

Abstract:

Today, there are many ways to shape materials among which additive manufacturing. Until now, the 3D printing has been identified as interesting in the framework of prototyping. On another hand, stereolithography is known as the best technology to get the best quality after sintering.

3DCeram has developed two new printers which will fit the dreaming tools for research centers:

- New hybrid machines which could combine two different 3D technologies, one will be our stereolithography and the second one would be co-developed with the research center. We put our know-how and our machines at the service of research centers to allow them to integrate the technologies that they themselves have developed into our machines. Our goal is to open our machines to become technological hosts.
- A Multi Additive Technologies (M.A.T.) printer which would be able to host several technologies in the same frame to combine complementary skills.

This new way of conceiving the development of 3D machines opens up perspectives that will be revealed as needs arise. With the new M.A.T. machines, we are creating a favorable ground for a multitechnological deployment.

Biography

Rouslan Svintsitski is a 3DCeram Area Sales Manager. He has done MBA and graduated from ISCV of Conservatoire National des Arts et Métiers (France). Has More than 25 years of experience in ceramic process and technologies.

DEVELOPMENT AND TESTING OF INDIVIDUAL TITANIUM IMPLANTS WITH BIOACTIVE COATINGS OBTAINED BY SLM FOR USE IN MAXILLOFACIAL SURGERY

Igor V Reshetov, Pavel A Karalkin, Konstantin G Kudrin, Dmitriy S Svyatoslavov and Alexei V Dub

Sechenov University, Russia

Abstract:

Over the past few decades, numerous studies were carried out to determine the optimal conditions for creating a strong interaction between the bone and metal, including titanium, implants in maxillofacial surgery and oncoorthopedics. In our work, we used the selective laser melting (SLM) method to create a new generation of personalized porous osteoinductive implants with a multimodal pore distribution and bioactive coatings. Additive manufacturing was carried out on the original MeltMaster-250M 3D printer (Rosatom, Russia) using "medical grade" powders of commercially pure titanium and titanium alloy Ti_6Al_4V. At the modeling stage, we performed the topological optimization of the implant in order to reduce the weight of the structure, improve its biomechanics, and increase osteoconductive properties. In addition, a layer of a bioactive coating 1–2 μm thick based on TiCaPCON composition was applied to the finished products by magnetron sputtering followed by silver ions (Ag) implantation to improve bactericidal properties.

Preclinical testing of the obtained samples was carried out using two in vivo models using laboratory rabbits and primates. The tests performed on the lower jaw of rabbits showed pronounced signs of bone tissue regeneration at the border with implants; active processes of endochondral ossification and bone tissue remodeling were noted after 4 month. Also, five primates of the species Papio anubis received implants of the mandibular angle and zygomatic-orbital complex. X-ray images and histological examination obtained 3 months after the operation did not reveal any signs of inflammation, edema, or implant instability. All animals showed smooth edges of the bone defects, without signs of destruction and instability of the implants. Thus, our approach allows to achieve a high intensity of local osteosynthesis and an extended life cycle of SLM titanium implants.

Biography

Igor Reshetov has over 25 years of experience in surgery. Full member of the Russian Academy of Sciences, Head of the Clinical Medicine Section. Director of the Scientific, Clinical and Educational Center for Oncology, Radiotherapy and Reconstructive Surgery of the First Moscow State Medical University (Sechenov University). A world-famous specialist who combines intensive surgical practice with scientific and teaching activities. The creator of the method of bioengineering reconstruction of the larynx and trachea, which has received international recognition. The developer of unique face replantation techniques, the use of laser technologies in modeling reconstructive surgeries on the skull and face. In recent years, Igor Reshetov has been actively implementing additive manufacturing methods in clinical practice.

SYNTHESIS OF ONE ATOM THICK-2D GOLD NANOSTRUCTURES-GOLDENE

Sudhir Sharma and Ramesh Jagannathan
New York University Abu Dhabi, UAE

Abstract:

Two-dimensional (2D) materials demonstrated an immense interest due to their wide range of applications in various disciplines. The unique properties of 2D metal nanostructures have offered a number of emerging applications in photovoltaics, optical sensing, drug delivery and etc. Gold nanostructures have synthesized by various biological, photochemical and wet chemical routes but the synthesis of one-atom thick two-dimensional (2D) gold are not available. We report a technique to synthesize one-atom thin gold crystals (goldene) from thin films of gold after post heat-treatment of 475ºC. Thinfilm of gold with 65 nm thickness were deposited by thermal evaporation process. Freestanding 2D gold crystals were floated with isopropyl alcohol (IPA) from the substrates and transferred to TEM grids for in-depth characterization and analysis. High- resolution Transmission Electron Microscopy (HRTEM) imaging showed herringbone and honeycomb lattices with a lattice spacing of 2.4Å. Selective Area Electron Diffraction (SAED) showed the presence of (111), (200) and (220) planes of fcc gold. Atomic Force Microscopy (AFM) of IPA transferred crystals from silicon to sapphire substrates confirmed that they are 1-2Å in thick and are one-atom thin crystals. Energy Dispersive X-Ray Spectroscopy (EDS) confirmed the 2D crystals/films are gold. Current-Voltage (IV) spectroscopy using conductive AFM (C-AFM) revealed that the 2D gold crystals are essentially insulators and application of a localized e-field using the C-AFM tip, resulted in the alignment of the 2D crystals into stable patterns implying the presence of axial charge polarization.   Goldene exhibited several, intense and well-resolved optical absorption peaks and several finer bands across the UV-vis region with optical band gap of 3.59 eV.

Biography

Sudhir Kumar Sharma obtained masters (M.Sc. Physics and MTech Materials) from Department of Physics, Barkatullah University (formerly Bhopal University) Bhopal, India. In 2007, he received his PhD from the Indian Institute of Science Bangalore, India in 2012. As post doc fellow, he joined at Centre for Nanoscience and Engineering (CeNSE), IISc. Bangalore, India as. Afterword's Dr. Sharma moved to New York University Abu Dhabi UAE (NYU Abu Dhabi) as a research associate in Nov. 2103. Currently, he is working as a Research Scientist at NYU Abu Dhabi. His publication record includes about 50 publications in international peer-reviewed reputed journals and more than 75 presentations in conferences. His research interest includes implementation of supercritical technologies for nanoparticle synthesis, Smart materials for micro-sensors and actuators, MEMS/NEMS and micro/nano-fabrications, vacuum science, and thin film technology.

Day 2

3D Printing & Graphene 2023

Poster Presentations

GRAPHENE DOTS WITH SINGLE ATOMS AS A TOOL FOR KILLING CANCER CELLS

Markéta Havrdová, Banerjee Shashwat, David Panáček, Kateřina Bartoň Tománková, Martin Petr, Zdeněk Badura and Kateřina Poláková

Palacký University, Czech Republic

Abstract:

Single-atom catalysts (SACs) have been receiving increasing attention in nanomedical applications, especially in cancer therapy. They can provides a novel tumor chemotherapy modality by initiating localized catalytic chemical reactions in tumor microenvironment (TME) thereby achieving appealing tumor-therapeutic efficacy. In this work we have shown that the fluorescence nitrogen-doped graphene dot single atom catalysts (NGDs-Fe^{2+}, NGDs-Cu^{2+}) could effectively kill cancer cells. Different viability, cell cycle profile and oxidative stress were investigated in this study. Cell lines were used according to intracellular behavior of nanomaterial and both healthy and cancer cells were investigated. Furthermore, we evaluated photocatalytic properties of NGDs-Fe^{2+}, NGDs-Cu^{2+} in killing the cancer cells. Under irradiation, the efficacy of NGDs-Fe^{2+}, NGDs-Cu^{2+} in killing cancer cells were significantly higher. The successful demonstration of single-atom nanocatalyst in killing cancer cells may provide highly promising protocols in designing of novel nanocatalytic medicine against tumors.

Biography

Marketa Havrdova is a young researcher currently working with Regional Centre of Advanced Technologies and Materials (RCPTM), which is a scientific institute dedicated to chemical and materials research, particularly in nanotechnology and its applications in energy, environmental technologies, catalysis and biomedicine. It is part of the Czech Advanced Technology and Research Institute (CATRIN) of Palacký University Olomouc. Dr. Havrdova obtained her Doctor of Science in the year 2017 (Ph.D. in Physics) from Palacký University. She graduated in the field of Nanotechnology in the year 2012 (Master of Science) and also studied two bachelor's degrees. She worked with electron microscopes during her first study of Bc. degree (in 2010 from Biophysics) and in the field of Optometry during her second Bc. degree in 2014. In RCPTM, Dr. Havrdova is working in the field of novel nanomaterial synthesis and their interaction with both healthy (incl. stem cells) as well as cancer cells. Dr. Havrdova has published many articles in peer reviewed journals. Her works has been cited over 1074 times and her current h-index is 13.

INVESTIGATING ADDITIVE MANUFACTURED STRUCTURES BY THERMOELASTIC STRESS ANALYSIS AND DYNAMIC MECHANICAL ANALYSIS

Roberto Marsili
University of Perugia, Italy

Abstract:

Additive Manufacturing (AM) is gaining relevance for the freedom it gives to designers in experimenting topologically optimized components, especially those having trabecular morphology. Indeed, these are of great interest in various application fields (automotive, biomedical, etc.) because, in addition to a significant mass reduction, trabecular topology (micro-scale) can be tuned to provide the final product (macro-scale) with the specific properties it needs to exhibit. However, additive manufactured trabecular structures are still to be fully investigated, given the mismatch between the designed and the manufactured final product.

This paper presents some preliminary results from a multi-instrument approach to characterize structures in terms of stress-strain distribution and modal behavior based on Thermoelastic stress analysis and dynamic mechanical analysis.

Biography

Roberto Marsili is Associate Professor of Measurement and Testing at Department of Engineering University of Perugia, PhD in Mechanical measurements. The research interests is Testing and Measurement Techniques, the development of new optical (by DIC) and thermographic (by TSA) measurement systems for non contact measurements of stress and strain field, the development and application of new measurement and testing techniques based on dynamic mechanical analysis for complex material characterization.

Day 2

3D Printing & Graphene 2023

Video Presentations

RESEARCH ON THE NUCLEATION OF CARBON NANOPARTICLES

Boris Ezdin, Sergei Vasiljev, Valerii Kalyada, Lyudmila Yanshole, Yuri Pakharukov and Farid Shabiev

Novosibirsk State University, Russia

Abstract:

The growth of carbon nanoparticles at the stage of nucleation was experimentally investigated. The nuclei were synthesized in a chemical compression reactor of the piston-cylinder type. The use of buffer monatomic gases due to the high adiabatic index makes it possible to carry out the pyrolysis of hydrocarbons at relatively low compression ratios and, accordingly, pressures. The atomic weight of buffer gas molecules has a significant effect on pyrolysis under essentially nonstationary and nonequilibrium conditions, which makes it possible to intensify or suppress the process of nanoparticle synthesis. To suppress the synthesis of nanoparticles in order to maximize the yield of nuclei, helium and neon were used as buffer gases. Acetylene was used as a precursor. The resulting product contained mainly carbon nanoparticles with size of 10-100 nm, but a significant part was also nuclei, which could be separated by dissolution in organic solvents. The content of the ethanol-soluble part was about 20%. The soluble part was examined by MALDI TOF MS. The MALDI spectrum showed almost continuous series of peaks spaced 12 m/z away. The mass distribution of nuclei obeys a lognormal distribution, which speaks in favor of the mechanism of their formation mainly by the fusion of nuclei of different sizes. To test the existing hypothesis that fullerenes can be the nuclei of nanoparticles, before conducting the MALDI TOF MS study, a part of the samples dissolved in ethanol were subjected to centrifugation at 14400 g and the part less affected by centrifugal separation was isolated for study. Individual masses had several peaks, indicating different carbon structures corresponding to the same number of carbon atoms. After centrifugation, some of these peaks disappeared, indicating a relatively high density of structures corresponding to them. Low density carbon structures can be hollow structures, in particular fullerenes.

Biography

Boris Ezdin, National State University of the Russian Federation, has developed a chemical compression reactor (CCR) and methods for its use in technology. In the compression reactor, the main friction unit, the “piston-cylinder” pair, operates without oil lubrication, which makes it possible to eliminate the problem of introducing contaminants and additional chemical impurities with lubricants into the reactor volume. The surfaces of the piston and cylinder in the reactor volume are able to withstand the operating temperature in the reaction zone up to 1700 K. The possibility of reforming methane and APG in the CCR have been studied. Promising results have been obtained for the conversion of light hydrocarbons with a high degree of processing of the feedstock. Nanopowders of silicon, silicon carbide, carbon and gaseous hydrogen were experimentally produced by pyrolysis in the CCR. Experimental work has been carried out to study the efficiency of using the obtained nanomaterials in specific technologies: oil production, production of anode materials for lithium-ion batteries. Initial work has been carried out on the use of the obtained nanomaterials in semiconductor devices and the study of their effect on living media - cells. The results are published in international journals.

INTRAORAL 3D SCANNER AND 3D STEREOLITHOGRAPHY PRINT (SLA) IN ORTHODONTIC AND DENTISTRY IN LONG-TERM CLINICAL APPLICATIONS

Tatjana Dostalova[1], Hana Eliasova[1], Petra Hlinakova[1], Petra Urbanova[2], Ales Prochazka[3]

[1]Charles University, Czech Republic
[2]Masaryk University, Czech Republic
[3]University of Chemistry and Technology, Czech Republic

Abstract:

3D and 4D printing are new technologies that enable precise and expedited manufacturing of objects also for orthodontics, dentistry and maxillofacial surgery. 3D print in orthodontics and dentistry is based mainly on intraoral scanners which contain a handheld camera, computer, and software and creation of three-dimensional geometry of the dental arch. For 3D printing, the digital format STL (Standard Tessellation Language) is prepared. 3D printing techniques in dentistry, orthodontics and maxillofacial surgery include: stereolithography, digital light projection, fused deposition modelling, selective laser sintering, photopolymer jetting, and powder binder printer and computer axial lithography. In our contribution, stereolithography, a rapid laser manufacturing method, was used, involving photoinduced polymerization creating layered structures with highly cross-linked polymers. The aim of our study was 3D objectification of stereolithography-prepared printed models. During clinical treatment, patients were scanned by an optical scanner. The scanned data were transferred to the STL files and then stereolithographic models were prepared. Optical triangulation, photogrammetric methods and mathematical model analysis were used for measurements. The surface profile was also evaluated. Three years later, the quality of STL models was smooth and homogeneous, which was directly connected with the type and structure of filaments. The methodology included the use of digital filters and morphological operations for spatial objects analysis, their registration, and evaluation of changes during the treatment of specific disorders. The results included 3D models of selected dental arch objects, enabling comparison of their shape and position during repeated observations. Clinical applications demonstrated also treatment options for patients with nausea, rare diseases, or small space between the upper and lower jaws. The methods proposed presented digital alternatives to the use of plaster casts for semiautomatic evaluation of dental arch measurements. Our contribution evaluates both the advantages and disadvantages of 3D digital technology replacing classical impressions and plaster cast dental models in dentistry and orthodontics.

Biography

Tatjana Dostalova, MD., PhD, DrSc. MBA, Prof Dr med dent., is Head of the Department of Stomatology, 2nd Medical Faculty, Motol University Hospital, Charles University, and Prague, Czech Republic. She received her specialization status in Prosthetic Dentistry in 1992, and since 2010 has also been a Recognized Specialist of the European Prosthodontist Association. She was coordinator of 22 research projects dealing with lasers in dentistry, laser print in dentistry, 3D reconstruction in prosthodontics, and implantology. Professor Dostalova is a member of the Editorial Board and reviewer cooperating with the following journals: Photobiomodulation, Photomedicine, Laser Surgery; Quintessenz Czech Republic, and the Czech Dental Journal. The Web of Science Core Collection lists 147 of her results and over one thousand citations.

INVESTIGATION OF RECYCLED POLYMERS FOR 3D PRINTING

Jolanta Janutėnienė , Klaidas Drevinskas and Artūras Tadžijevas
Klaipeda University, Lithuania

Abstract:

In recent decades, 3D printing technologies using polymer materials have expanded significantly. The most widely used polymer materials are polylactide (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate (PET), etc. At the same time, considerable amounts of waste from these polymer materials are generated. There is still a problem related to the sorting of polymer waste, their separation according to the type of polymer. The principles of circular economy should be applied to 3D printed products. In this work, 3D printed samples from new PLA and ABS materials and recycled ones were made and tested. Samples were tested by static and dynamic tests, mechanical properties such as tensile strength, elongation, impact resistance and other properties were investigated. The research results showed that the properties of recycled polymer materials are deteriorating, especially the plasticity property. Mathematical relationships of degradation of the recycled polymer materials properties were deduced.

Biography

Jolanta Janutėnienė is professor at Klaipeda University, PhD of mathematical sciences. Main research interests include investigation of engineering materials, mathematical modelling of technological systems, statistical analysis of data, composite materials, numerical analysis. She has her expertise related with investigations of the properties of engineering materials and degradation of these properties depending on operating time. In recent years, her research has focused on circular economy problems, secondary use of polymer materials, and research on recycled material properties for 3D printing.

Virtual Presentations

3D Printing & Graphene 2023

Keynote Presentation

REVIEW ON CERAMIC ADDITIVE MANUFACTURING AND IT'S APPLICATIONS

Kalaichelvan K

Anna University, India

Abstract:

Ceramic additive manufacturing process creates a structure by slicing a 3D model and stacking ceramic materials layer by layer without mould. However, many barriers to practical use remain due to process speed, defects and lack of knowledge. It is a key process for producing more complex ceramics by solving the inherent limitations of machinability and formability. According to the supplied state of Additive manufacturing materials, it is majorly classified into three types of Liquid based, solid based and Powder based. The liquid based systems is comprising of Photo Polymerisation and Material jetting, Solid based systems consist of material Extrusion and sheet lamination and powder based systems consists of Binder jetting, Direct energy deposition and Powder bed fusion. This review focuses on process and materials for Ceramic Additive manufacturing. In this process, model or formula based research, high speed sintering research and Technology fusion research have been conducted. These research ideations will help in effectively suppressing micro defects and prevention of failures in advance. These studies have been applied to various fields such as medicines, energy, environment, nuclear and space engineering to move into better materials to meet the requirements.

Biography

Kalaichelvan is working as a Professor in the Department of Ceramic Technology, Anna University. His areas of interests are composites and Ceramic-Metal joining. He is actively participating in development of photosensitive slurry of Alumina and Al-Alumina joining processes. His expertise in evaluation and passion in improving the performance of Ceramic Components.

3D Printing & Graphene 2023

Oral Presentations

DESIGNING FOR EXTREME HEAT, STRATEGIES TOWARDS 3D PRINTING OF EARTH STRUCTURES

Alexander Emmanuel Tohidi
UNSW, Australia

Abstract:

The planet has continued on its warming trend with some urban areas experiencing 50+ degrees Celsius temperature. Such extreme temperatures disrupt the heat regulation mechanisms of a human's body, which can lead to hyperthermia and places stress on the body. This evolving crisis warrants the rethinking of housing solutions that provide adequate and affordable shelter for the inhabitants. Inspired by nature, this paper presents an innovative approach for the design and fabrication of a self-cooling earthen wall segment using 3D printing technologies. The study adopted computational methods for form-finding and toolpath design through design of the self-shading wall segment. The material selected for this study was cob. After printing 1:20 glazed ceramic prototypes, the experiments were conducted in a 3-day workshop setting. The experiments involved sourcing local materials; testing various earth mix recipe; finding an appropriate earth mix recipe for a viscosity that could be 3-D printed; calibrating the 3D printer and pumping equipment; and printing the final 1:1 wall segment. Action Research (AR) methodology framework was applied to deliver outcome and to answer the research question: "How can knowledge of vernacular architecture in arid climates, in combination with biomimicry principles and computational design inform 3D printing processes to design and develop housing in areas with extreme heat due to climate change?".

Biography

Founder of AEC-AT. An architect & computer scientist with extensive experience on challenging architectural and infrastructural projects across Australia. Have worked with number of architectural, engineering & manufacturing firms on the implementation of digital technologies & workflows. An advocate for sustainability, Digital technology & digital fabrication. Providing training for industry and teaching Digital technologies to "architectural, industrial design and engineering students" in the University of Sydney and UNSW. Some of my work been exhibited on multiple galleries, research presented in number of conferences across Australia. Well stablished with-in the industry and having a wide range of connections. Expert in Digital Technology, Systems implementation, Architecture, Software architecture, 3D printing, Robotic, Artificial Intelligence (AI), BIM & Digital fabrication, manufacturing processes with leadership and people skills. The focuses of recent research have been on Robotic & 3D printing, implementing policies & digital systems, workflows to improve the efficiency of the industry. Substantial work on sustainability to be able to achieve Net 0 emission by 2050.

STRUCTURAL PERFORMANCE-DRIVEN GENERATIVE DESIGN AND LARGE-SCALE ROBOTIC 3D PRINTING FABRICATION

Dingwen 'Nic' Bao
School of Architecture and Urban Design, Australia

Abstract:
This research posits an innovative design methodology that establishes a complementary relationship between topological optimization, behavioural generative design algorithms, and robotic fabrication. The research explores and evaluates the application of topology optimization and multi-agent algorithms in a form-finding design process and later, robotic fabrication through a series of prototypes. It demonstrates the process of integrating these two algorithms to establish a real-time structural feedback loop in the process of designing intricate forms. It describes a hybrid of architectural and structural performance behaviours through the integration of multi-agent generative design algorithms and the BESO method. This approach creates a negotiation between concerns of architectural design and structural optimization in a simultaneous generative approach. This is an important shift from the normative sequential workflows that either inform generative approaches with structural analysis or operate sequentially to optimize the complex geometries already created within generative processes structurally. A series of installations have been completed to prototype this approach at a small scale, to understand the implications of long-span large spatial structures. This approach enables the creation of complex, expressive architectural form which is highly efficient in terms of material and structural performance. The complexity and intricacy of the geometry generated through this process are demonstrated to be feasible to build through large-scale additive manufacturing. It is part of the wider agenda, exploring the fabrication of algorithmically generated architectural forms through robotic fabrication techniques involving additive manufacturing. Due to the complex and intricate nature of the forms developed through this approach, we believe that additive manufacturing offers the logical fabrication approach and intend to integrate this with some collaborative 3D printed composite and sacrificial formwork projects. This approach also has the potential to create a closer working collaboration between architect and structural engineer in the early stages of design and to avoid the structural rationalization of unfeasible architectural forms in the AEC industry.

Biography
Ding Wen 'Nic' Bao is a Lecturer (a.k.a., Assistant Professor) at the School of Architecture and Urban Design. His research explores design methodologies for establishing a complementary relationship among architecture, computational design, structural engineering, behavioural algorithms, robotic fabrication, additive manufacturing, and intelligent construction. Nic is a practising architect with ten years of professional experience, he holds Australian Registered Architect (ARBV). US Registered Architect (NCARB) and RIBA Chartered Architect. Currently, Nic is the Director and Founder of BDW Architects and FormX Technology. Nic is also a committee member of the Australian Institution of Architects (AIA) – Education Committee and Design Technology Advisory Group to the National Practice, as well as an officer/committee member and Chair of the award at the Association for Computer-Aided Architectural Design Research in Asia (CAADRIA). He is a core member of the organizing committee of DigitalFUTURES International conferences (2020 - 2022) and the IASS 2023 Annual Symposium. Nic completed his PhD at the School of Engineering and School of Architecture and Urban Design, RMIT University. He holds a Master of Architecture from the University of Melbourne and a Bachelor of Architecture degree from RMIT University. Nic has published over 30 articles including high-impact journal papers,

book chapters and conference papers. Nic's work has been exhibited widely, which is recognised at the national and international levels, including Hong Kong BoDW, Shanghai DigitalFutures Exhibition, Barcelona IASS Expo, Shenzhen Biennale, Melbourne Design Week, Venice Biennale, National Gallery of Victoria and Melbourne Design Fair, etc. Nic also played a role as a scientific reviewer and session chair for the international conference including CAAD Futures, CAADRIA, ASCAAD, eCAADe and DigitalFutures as well as ran 8 workshops at international conferences including DigitalFutures, CAADRIA and SIGraDi. Recently Nic received the 2022 IAI Design Award, 2021 Grand Prix Design Paris Gold Award, 2021 Muse Design Award, 2021 RMIT Prize for Research Impact (Design), 2021 Young CAADRIA Award, 2020 RMIT Engineering Publication & Impact Prize, 2019 CISM Research Excellence Award and two significant first prizes structural optimisation and additive manufacturing competitions nationally and internationally in 2019 & 2020.

AUXETIC METAMATERIALS AND THEIR APPLICATIONS

Xin Ren, Dong Han, Xiang Yu Zhang, Chen Luo, Xue Gang Zhang and Wei Jiang
Nanjing Tech University, China

Abstract:

Metamaterials refer to a new class of materials with extraordinary macroscopic physical properties, which are composed of artificial structural-functional units according to a specific spatial arrangement. It has been listed as one of the ten important scientific advances in the 21st century by the US "Science" magazine, and recently listed by the European Commission as one of the "100 disruptive technological innovations for the future". As one of the most typical mechanical metamaterials, negative Poisson's ratio materials have special mechanical properties and undergo lateral contraction (expansion) under the action of uniaxial pressure (tension). It has more advantages than traditional materials in terms of shear bearing capacity, fracture resistance, energy absorption and indentation resistance, so negative Poisson's ratio materials are used in civil engineering, medical equipment, sensors, protective facilities, aviation, navigation and national defense engineering, etc. The field has broad application prospects. In this presentation, the state-of-the-art progress of auxetic materials will be introduced, including some research outcomes of our group. In addition, several potential applications, challenges and prospects of auxetic metamaterials will be given for inspiring interested researchers.

Biography

Xin Ren is a full Professor in the Centre of Innovative Structures, School of Civil Engineering, Nanjing Tech University. He graduated with a Ph.D. from RMIT University, Australia in 2017. Vebleo Fellow, Winner of Jiangsu Outstanding Youth Fund in China. Member of the International Negative Poisson's Ratio Materials and Structure Academic Committee (the only one in mainland China); Published more than 50 peer-reviewed journal papers, with a total cited number of more than 1,600 times. Acted as guest editor for the following international journals: Engineering Structures (JCR-Q1), Buildings (JCR-Q1) and Applied Sciences (JCR-Q2). Mainly engaged in the research of structural engineering, new materials and new structures, mechanical metamaterials, composite materials, etc.

CHALLENGES IN THE AEROSPACE APPLICATION OF ADDITIVE MANUFACTURING

Darío González Fernández
Indaero Grupo Emergy, Spain

Abstract:

Additive manufacturing has been rapidly introduced in the industrial, dental, medical, and automotive sectors, however, it is more difficult for these technologies to succeed in the aeronautical sectors, since the risk of failure involves human lives. In the case of parts for satellites, although the weight saving that accompanies additive manufacturing is very important, however, these parts cannot be replaced and must ensure their correct operation for years in extreme conditions of temperature and radiation. At Indaero we collaborate with companies in the aerospace sector to apply controls in the verification processes to ensure that they comply with the standards created by important companies such as Boeing and Airbus and to guarantee the service life of the product, which will be subjected to stress, vibrations, high temperature and fire ranges. The enormous number of additive manufacturing technologies, the multitude of materials and manufacturing strategies make additive manufacturing a great unknown for the engineers who must design the equipment and therefore the fear of incorporating this technology is high. At INDAERO GRUPO EMERGY we have successfully manufactured a multitude of 3D printed parts and have met technical challenges such as precision, limited dimensions, design problems, post-processing and qualification.

Biography

Darío González Fernández studied Industrial Technical Engineering at the University of Seville and did business internships in the AIRBUS Tablada Plant Engineering department. In 2004 he was selected for the 50K program of San Telmo Business School and in 2006 he completed the Master of Aeronautical Management at the School of Industrial Organization. In 2002 he cofounded the company INDAERO GRUPO EMERGY dedicated to the manufacture of machined parts and the design of equipment for aircraft. In 2014 he acquired his first additive manufacturing equipment and the company has developed projects with this technology for important companies in the sector such as AIRBUS, ACITURRI, SENER Aerospace, ITP, AERONNOVA. In the space sector, the company delivers more than 800 pieces per year for different satellite constellations and in 2021 the first structure of the NEPTUNE satellite manufactured in ULTEM by 3D printing was launched. INDAERO GRUPO EMERGY has research agreements with different Technological Centers and Universities and carries out Innovation projects related to digital manufacturing and aerospace engineering.

CHARACTERIZATION OF Al_2O_3, TiO_2, HYBRID Al_2O_3-TiO_2 AND GRAPHENE OXIDE NANOFLUIDS AND THEIR PERFORMANCE EVALUATIONS IN PHOTOVOLTAIC THERMAL SYSTEM

MA Fazal, Saeed Rubaiee, Syed Mohd Yahya and Mohd Danish
University of Jeddah, Saudi Arabia

Abstract:

An advanced nanofluid with high stability is required to meet the demands of current industry and solar thermal systems. In industrial application, Graphene Oxide (GO) nanofluid formulated with Ethylene Glycol (EG): water (W) is usually known well for good stability along with high thermal conductivity. In this research, GO nanofluid is characterized for exploring thermal, optical, and suspension stability under certain conditions and then utilized as working fluid in photovoltaic thermal (PV/T) system performance optimization compared to those of water and Al_2O_3, TiO_2, hybrid Al_2O_3-TiO_2 based nanofluids. The thermal conductivity, thermal stability, morphology and optical absorbance are characterized by using thermal analyser, TGA, SEM, and UV-vis analysis respectively. The prime goal of this study was to compare the performance of PV/T for various working fluids. The results revealed that the thermal conductivity of GO/EG:W nanofluid was increased by 9.5% at 40°C compared to water. It also showed good stability with a zeta potential of 30.3 mV. The numerical implantation of GO/EG:W nanofluid performed by COMSOL Multiphysics software presented significant improvement compared to Al_2O_3/EG:W, TiO_2/EG:W, TiO_2-Al_2O_3/EG:W nanofluids with a concentration of 0.01 wt.% to 0.1 wt.%. The measured electrical and thermal efficiencies of the PV/T system were 13.5% and 76% respectively using GO/EG:W with 0.07 kg/s mass flow rate and 0.01% wt. concentration. The stated findings identified GO/EG:W nanofluid as more effective in enhancing PV/T performance than other tested working fluids.

Biography

M. A. Fazal, PhD in Materials Engineering (University of Malaya, 2011) is currently working at the Dept. of Mechanical and Materials Engineering, University of Jeddah (UJ), Saudi Arabia. He was awarded Bright Spark Scholarship (by UM in 2010) and then worked as a lecturer (Jan 2012–Jul 2012) and senior lecturer (Jul 2012-July 2016) at the Dept. of Mechanical Engineering, UM, Malaysia. His current research interest includes advanced materials, energy materials, renewable energy, tribology, corrosion & coating technology. Till date, Dr. Fazal has supervised seven master's theses and two PhD theses. Being a Project Leader, Dr. Fazal secured and successfully completed a good number of research grants. He has published more than 55 ISI-indexed scientific papers and 25 international conference papers. The citation database of Google Scholar presents total 4,213 citations along with H-index 33 in Jan 2023. He has potentially contributed for designing course curriculum, organizing a number of seminars, short courses, and conferences. Dr. Fazal is a member of IEB, Dhaka, the Institution of Mechanical Engineers (MIMechE, UK) and a Chartered Engineer (CEng) with the Institution of Engineers (UK). He worked as a guest editor in the journals of Frontiers in Materials (IF:3.985) and Energies (IF: 3.252).

EVALUATION OF CONTOUR OF ACETABULAR COLUMNS AND THEIR COMPARISON WITH ANATOMICAL ACETABULAR PLATES FOR FRACTURE FIXATION USING 3D PRINTING

Abhay Meena and Lalit Maini
Lok Nayak Hospital, India

Abstract:

Background: Surgical treatment of acetabular fractures requires complete exposure, anatomical reduction and fixation using recon plates bent intra-operatively or to match the acetabular contour. We intended to evaluate the acetabular contour of dry bones and acetabular fracture patients and compare the accuracy of available anatomical plates in market with the same using 3D printing.

Methodology: There was two group dry bone group and acetabular fracture group. We evaluate of fit of 5 different anatomical acetabular plates on dry pelvic bones, developed a patient specific plate template using 3D printing pre-operatively by virtual planning for acetabular fracture patients and also made an Intraoperative contoured template over reduced fracture and post-operative evaluation for validations of result. Finally, we defined the plate design for acetabular fracture fixation.

Conclusion: pre-operative planning is very crucial step and use of pre-bent plates help in improving the surgical outcome of acetabular fractures by decreasing surgical invasiveness and increasing the accuracy of reduction. Plates made by using 3D software's were found to match the surface of reduced bone precisely. Anterior and posterior column plate design defined in our study for acetabular fracture fixation. It reduces surgical time and intraoperative blood loss. It helps to achieve the near anatomical reduction. These plates also gave surgeons a sense of preparedness.

Biography

Abhay Meena has expertise in orthopaedic trauma and bone tumors. He has years of experience in research, evaluation, teaching and clinical application of 3D printing in orthopaedic surgeries. He has also presented many scientific papers and won many prestigious awards at various levels. He has been a faculty in many 3D printing workshops at national level. He has passion in improving the health and wellbeing by collaborating newer technologies with medical science.

EFFECTS OF APPLIED EXTERNAL FIELD AND THE CONTRIBUTION OF THE HYDROSTATIC PRESSURE ON THE ELECTRONIC PROPERTIES OF DONOR IMPURITY IN A CIRCULAR QUANTUM DISK MADE OUT OF GaAs

Ibrahim Maouhoubi, Zorkani Izeddine and Soukaina Dardaz
Sidi Mohamed Ben Abdellah University, Morocco

Abstract:

In this work, we investigate the influence of the hydrostatic pressure, magnetic field, and conduction band non-parabolicity on both the diamagnetic susceptibility and the binding energy of shallow donor impurity in a quantum disk made out of GaAs. The Hamiltonian of the investigated problem has been solved within the framework of the effective-mass approximation. The energy minimization has been performed using variational approach. Our results reveal that both the diamagnetic susceptibility and binding energy have been reduced with increasing the disk size. Moreover, the diamagnetic susceptibility increases as the impurity moves from the extremity to the center of the disk. However, both the diamagnetic susceptibility and binding energy have been improved under applied magnetic field, hydrostatic pressure, and by considering the conduction band non-parabolicity model as well. We hope that the reported results will be a modest contribution to further theoretical research in the field of nanostructures.

Biography

Ibrahim Maouhoubi is a Doctor in materials science engineering, Software Engineer · Solar Engineer · Senior Material Handler · Python/Fortran/Mapel Developer

POLYPYRROLE NANOTUBES DECORATED WITH NiO FOR ALL-SOLID-STATE SYMMETRIC SUPERCAPACITOR APPLICATION

Vijeth H, Yashaswini M, and Devendrappa H
Nagaland University (A Central University), India

Abstract:

Nickel oxide (NiO) is a promising electrode material in supercapacitor (SC) applications, but the poor electronic conductivity and weak electrochemical stability of NiO limits the fast charge/discharge rate and long-time reuse. Herein we report a core-shell nanostructure formed by NiO nanoparticles decorated on Polypyrrole nanotube (PNT) through a chitosan (CS) layer (NiO/CS-PNT), as a supercapacitor electrode material. The PNT is synthesized using a self-degradable soft-template approach. The one dimensional (1D) nanotube structure gives increased surface area to Polypyrrole (PPy). The inevitable aggregation of the NiO nanoparticles is reduced by the incorporation of CS, thereby increasing the surface area of the active material and bringing the higher electrochemical performance. NiO/CS-PNT core-shell nanostructure is found to have a large surface area, low charge transfer resistance (Rct) and high specific capacitance (Csp) as compared with that of NiO/PNT and pure PNT. Besides, an all-solid-state symmetric supercapacitor (SSC) was fabricated with NiO/CS-PNT as positive and negative electrode, which shows high power density (PD) of 4045.69 Wkg^{-1} at an energy density (ED) of 27.80 Wh Kg^{-1}. Also, an outstanding cyclic stability was found with capacitance retention of 84.90 % even after 10000 cycles. The results demonstrate that the NiO/CS-PNT core-shell nanostructure is a favorable electrode material for supercapacitors.

Biography

Vijeth H is currently an Assistant Professor in the Department of Physics at Nagaland Central University. He obtained his M.Sc. degree in Physics from the National Institute of Technology, Surathkal, Karnataka in 2015. He received his Ph.D. degree from Mangalore University in 2021. His current research interests focus on the synthesis of two-dimensional nanomaterials, semiconducting nanomaterials, and conducting polymer nanocomposites for flexible supercapacitors and electrochemical sensors. He has published more than 75 research articles in reputed international journals and is a reviewer for various journals published by Elsevier, Springer, Wiley, and RSC Publications. Currently, he is running a DST-SERB Major Research Project in 2023.

DESIGN OF SUPPORT-LESS LATTICE STRUCTURE FOR ADVANCED PRODUCT

Ajeet Kumar, Mayur Prajapati, Jeng Ywan Jeng and Chinmai Bhat
Indian Institute of Technology (IIT) Guwahati, India

Abstract:

Additive Manufacturing (AM) has come a long way, from rapid prototyping to manufacturing functional components for industrial requirements. Design for AM is one of the key ingredients to such progress. Innovative design solutions can significantly improve mechanical properties and reduce manufacturing time and costs. Once such innovative design solution to manufacture industrial components based on the design for AM and post-process is proposed in this study. This design solution consists of a support-free lattice structure design based on sea urchin morphology which can be printed in different orientations without any support requirement using the material extrusion process. The openings of the lattice structure are closed using thin membranes to accommodate a secondary material filled on demand after the printing. This global closed sea urchin lattice structure consists of polyurethane foam in the present study. It is shown that foam-filling improves the lattice structure's energy absorption and crash force efficiency when tested at different strain rates. The importance and application of this lightweight and tough design are then shown using an industrial case study. A consumer-based industrial scenario is chosen wherein format pucks are used to transfer cosmetic bottles on high-speed filling lines. The pucks are prone to a constant collision on the supply line, generating large forces and noise. Support-free global close cell lattice structures filled with PU foam not only improve the stiffness and energy absorption characteristics but also caters to noise reduction, thereby promoting safe working conditions in the industries.

Biography

Ajeet Kumar is passionate about the intersection of additive manufacturing technologies, design and their application to bring sustainable engineering solutions for a better digital world. He is currently Assistant Prof at the Indian Institute of Technology (IIT) Guwahati in the department of design. Here, he does research on high-speed additive manufacturing with technology like page-wide 3D printer, design for additive manufacturing and post-processing, cellular lattice structure, closed-cell lattice structure, advanced product design.

GRAPHENE'S FUTURE LIES IN LASER-INDUCED LAYERS

KS Srin, J. Ramkumar and Ravi Bathe
Indian Institute of Technology, Kanpur, India

Abstract:

One of the most recent forms of graphene, LASER-induced graphene (LIG), is created by exposing materials to short-pulse, longer-pulse, and other laser radiation. The carbon atom is rearranged into graphene or a morphologically modified form of graphene, and here the property progression of LIG is happening. The characteristics of synthesised LIGs are also improved by the doping. Environmental protection, signal detecting, and energy storage are only a few of the main applications of LIG. In lab, we now have sophisticated air filters, water treatment systems, and other environmental protection devices, thanks to LIG's chemistry, porous structure, and increased specific surface area. The physical and chemical characteristics of porous LIG are also extremely useful in the design of sensors and signal receiving and transmission equipment. Supercapacitors may be attractive due to their high electrical conductivity LIG and flexible, user-friendly nature. In light of this, LIG is the focus of contemporary graphene research.

Biography

Research studies with six years' experience on targeted complex projects. Strong technical, analytical and computer literacy earned during from all committed professional career and able to plan and prioritize the work and solve problems using both logic, creative and innovative approaches. Currently working on research project on laser assisted micro and nano machining for surface modification, and PhD student of Material Science Programme, Indian Institute of Technology Kanpur, India. Research fellow of Centre for LASER processing of materials, International Advanced Research Centre for powder metallurgy new materials Hyderabad, India. Postgraduate in mechanical engineering from National Institute of Technology Calicut and Graduate in mechanical engineering from The institution of engineers India and having patents and many more peered journal publications.

IMPROVING THE RELIABILITY DESIGN OF MECHANICAL SYSTEMS SUCH AS REFRIGERATOR

Seongwoo Woo
Ethiopian Technical University, Ethiopia

Abstract:

To enhance the lifetime of mechanical system such as automobile, new reliability methodology-parametric Accelerated Life Testing (ALT) – suggests to produce the reliability quantitative (RQ) specifications-mission cycle-for identifying the design defects and modifying them. It incorporates: (1) a parametric ALT plan formed on system BX lifetime that will be X percent of the cumulated failure, (2) a load examination for ALT, (3) a customized parametric ALTs with the design alternatives, and (4) an assessment if the system design(s) fulfil the objective BX lifetime. So we suggest a BX life concept, life-stress (LS) model with a new effort idea, accelerated factor, and sample size equation. This new parametric ALT should help an engineer to discover the missing design parameters of the mechanical system influencing reliability in the design process. As the improper designs are experimentally identified, the mechanical system can recognize the reliability as computed by the growth in lifetime, LB, and the decrease in failure rate. Consequently, companies can escape recalls due to the product failures from the marketplace. As an experiment instance, two cases were investigated: 1) problematic reciprocating compressors in the French-door refrigerators returned from the marketplace and 2) the redesign of hinge kit system (HKS) in a domestic refrigerator. After a customized parametric ALT, the mechanical systems such as compressor and HKS with design alternatives were anticipated to fulfill the lifetime – B1 life 10 year.

Biography

Seongwoo Woo has a BS and MS in Mechanical Engineering, and he has obtained PhD in Mechanical Engineering from Texas A&M. He majors in energy system such as HVAC and its heat transfer, optimal design and control of refrigerator, reliability design of thermal components, and failure Analysis of thermal components in marketplace using the Non-destructive such as SEM & XRAY. In 1992.03–1997 he worked in Agency for Defense Development, Chinhae, South Korea, where he has researcher in charge of Development of Naval weapon System. He was working as a Senior Reliability Engineer in Refrigerator Division, Digital Appliance, SAMSUNG Electronics. Now he is working as associate professor in mechanical department, Ethiopian Technical University.

FACTORS AFFECTING ULTIMATE TENSILE STRENGTH AND IMPACT TOUGHNESS OF 3D PRINTED PARTS USING FRACTIONAL FACTORIAL DESIGN

Amna Mazen, Brendan McClanahan and Jonathan M Weaver
University of Detroit Mercy, USA

Abstract:

This work aims to investigate the mechanical properties of specimens printed by 3D open-source printers. It discusses the effect of five factors (part orientation, layer height, extrusion width, nozzle diameter, and filament temperature) on the ultimate tensile strength and the impact toughness of the 3D-printed samples. A 2^{5-1} resolution V fractional factorial experiment was run with the 16 samples printed on a Prusa I3 MK3S in PLA. Tensile strength and impact toughness were tested using Instron 3367 and Tinius Olsen 66 testers, respectively. In analyzing the data, a normal probability plot of the effects complimented with ANOVA (Analysis Of Variance) revealed that, for both responses, only part orientation was statistically significant at $p = 0.05$. Regression equations were used to predict the ultimate tensile strength and the impact toughness as a function of the part orientation. Both the toughness response and the tensile strength response are maximized with horizontal part orientation. Verification experiments have been implemented to validate the adopted regression equations' predictions under different circumstances, and the results of those experiments appear to confirm the model.

Biography

Amna Mazen received the B.S. and M.S. degrees in electrical and power engineering from Fayoum University, Fayoum, Egypt, in 2013 and 2018, respectively. She is currently pursuing the Ph.D. degree in electrical and computer engineering with the University of Detroit Mercy, MI, USA. From 2019 to 2021, she was a Research Assistant in electrical and computer engineering with the University of Detroit Mercy. Her research interests include robotics, deep learning, and AI.

EMERGING ANISOTROPIC 2D TIN (II) SULFIDE MONOLAYER AND OPTOELECTRONIC APPLICATIONS

Abdus Salam Sarkar
Stevens Institute of Technology, USA

Abstract:

The family of emerging low-symmetry and structural in-plane anisotropic two-dimensional (2D) materials has been expanding rapidly in recent years for optoelectronic device applications. As an important emerging anisotropic 2D material, the black phosphorene analog group IV_A–VI metal monochalcogenides (MMCs), more specifically, tin (II) sulfide (SnS) have been surged recently due to their distinctive crystalline symmetries, exotic in-plane anisotropic electronic and optical response, earth abundance, and environmentally friendly characteristics. In this talk, I will present the anisotropic 2D tin (II) sulfide (SnS) for photonic and optoelectronic device applications. At first, the isolation of an electronic grade ultrathin and monolayer of SnS (UL/1L- SnS) along with the spectroscopic and microscopic confirmation will be presented. The spectroscopic analysis and electron–phonon interactions of an ultrathin layer SnS will be displayed, which reveals a linear phonon shifts. Furthermore, the polarized second harmonic generation intensity of the isolated crystals, which are associated with the crystallographic anisotropic axes and with the relative strength of the second-order nonlinear susceptibility tensor will be presented. Finally, it will be shown that the exfoliated 1L-SnS crystals exhibit high carrier mobility and deep-UV spectral photodetection, featuring a fast carrier response time of 400 ms. At the same time, monolayer- based SnS transistor devices fabricated from solution present a high on/off ratio, complemented with a responsivity of 6.7×10^{-3} A W^{-1} and remarkable stability upon prolonged operation in ambient conditions.

Biography

Abdus Salam Sarkar is currently a postdoctoral research fellow at Stevens Institute of Technology, USA working in 2D quantum materials based optoelectronics. Past he was working in emerging 2D Materials optoelectronics with Prof. Emmanuel Stratakis at IESL, Foundation for Research and Technology Hellas (FORTH), Greece. He is an associated member of Royal Society of Chemistry (AMRSC), Associated Editor in 'Frontiers in Electronics' and editorial board member of 'American Journal of Physics and Applications'. Dr. Sarkar completed his B.Sc in Physics (H) from University of Calcutta (India) M.Sc. degree in Physics from University of Delhi (India) and his Ph.D. degree in emerging 2D materials & optoelectronics from School of Basic Sciences (Physics), Indian Institute of Technology (IIT) Mandi (India), supervised with Prof. Suman K. Pal. His research interests focused on introducing of novel 2D quantum materials, understanding of 2D quantum science and demonstration in optics, optoelectronics, photonics, energy and biophysical electronic devices.

VIRTUAL PLANNING AND 3D PRINTING SOLVING PROBLEMS IN GIANT BONE TUMORS

Abhay Meena and Lalit Maini
Lok Nayak Hospital, India

Abstract:

Introduction: Giant bone tumors are difficult to operate as they are distorting the normal anatomy of that area, so it is not easy to operate on them. These very very large bone tumors sometimes displace the neurovascular and vitals structures from their normal area which increases the more chances of complications intra-operatively. 3D virtual planning gives us the exact idea about the tumor and its relation with the vital structures, so it'll help in decreasing the complication.

Methods: We have done 40 cases of large bone tumors in which we have used MRI, CT scan and CT angiography fusion technique using Materialise MIMICS and 3-MATIC software and created the exact image of tumor and its relation with vital structures and created 3D printed jig to resect tumor with precise tumor free margin.

Results: Intra-operative and post-operative period was uneventful in all the cases and we have got tumor free margins in all the cases.

Conclusion: Virtual planning and 3D printing creates the exact anatomy of the pathological tumor area which leads to greater understanding and precise excision of the tumor.

Biography

Abhay Meena has expertise in orthopaedic trauma and bone tumors. He has years of experience in research, evaluation, teaching and clinical application of 3D printing in orthopaedic surgeries. He has also presented many scientific papers and won many prestigious awards at various levels. He has been a faculty in many 3D printing workshops at national level. He has passion in improving the health and wellbeing by collaborating newer technologies with medical science.

AMINATED METAL-ORGANIC FRAMEWORK MIL-101(CR) FOR ELECTROCHEMICAL DETECTION OF TARTRAZINE IN SOFT DRINK

Raïssa Tagueu Massah, Sherman Lesly Zambou Jiokeng, Jun Liang, Evangeline Njanja, Tobie J Matemb Ma Ntep, Christoph Janiak and Ignas Kenfack Tonle
University of Dschang, Cameroon

Abstract:

In this work, tartrazine (Tz) contents in some soft drinks were determined using metal-organic framework MIL-101(Cr)-NH_2 as carbon paste electrode (CPE) modifier. The amino material was synthesized and then characterized by electrochemical impedance spectroscopy and the results showed faster electron transfer with lower charge transfer resistance (0.13 kΩ) compared to the electrode modified with the unmodified MIL-101(Cr) material (1.1 kΩ). MIL-101(Cr)-NH_2 modified CPE (MIL-101(Cr)-NH_2-CPE) was then characterized by cyclic voltammetry (CV) using $[Fe(CN)_6]^{3-}$ and $[Ru(NH_3)_6]^{3+}$ ions as the redox probes, showing good accumulation of $[Fe(CN)_6]^{3-}$ ions on the electrode surface. A CV scan of the tartrazine in a Britton Robinson buffer solution showed an irreversible system with an oxidation peak at +0.998 V *vs.* Ag/AgCl/KCl. Using CV and Differential Pulse Voltammetry (DPV), an electrochemical method for quantifying tartrazine in trace amounts in aqueous medium was then developed. Several parameters that affect the accumulation and detection steps were optimized. Optimal detection of tartrazine was achieved in Britton Robinson buffer solution (pH 2), using 2 mg of MIL-101(Cr)-NH_2 material. Under optimal conditions, the sensor had a linear response in the concentration range of 0.004 – 0.1 µM, good detection sensitivity (35.4 µA μM^{-1}) and the detection limit for tartrazine was found to be 1.77 nM (S/N = 3). The sensor was applied in three commercial juices and the results obtained were approximately the same as those given by UV–Vis spectrophotometry.

Biography

Massah Tagueu Raïssa obtained a PhD in inorganic chemistry, in the specialty of materials chemistry and electrochemistry at the department of chemistry of the University of Dschang in Cameroon. She is working there as a part-time lecturer. She is currently doing a postdoctoral fellowship in Burkina Faso, where she is continuing her research on the synthesis of porous materials and their application in the field of electrochemistry. Recently, she has developed some electrochemical sensors based on Metal organic-framework and shown practical applications in the field of food quality control.

ALGAL POLYSACCHARİDES FOR 3D PRINTING: A REVIEW

R. Thiruchelvi
Vels Institute of Science, Technology and Advanced Studies (VISTAS), India

Abstract:

Despite the advancement of 3D printing technologies in recent decades, the materials used in 3D printing are typically metal, ceramic, or petroleum-based plastics. This input restricts the widescale adoption of this technology by some sectors. For example, toxin by-products, as well as the lack of biodegradability or biocompatibility of synthetic materials, restrict the use of 3D printing for biomedical applications. Combining the paradigm of 3D printing with that of bio-based renewable materials (biomaterials) can provide an opportunity to achieve a sustainable and renewable bioeconomy across multiple sectors. Algae hold promise as a potential feedstock for biomaterials, as they are capable of producing a wide variety of polymers having rheological properties suitable for 3D printing.

Algae hold particular promise as a feedstock for biomaterials, as they are capable of producing a wide variety of polymers with the properties required for 3D printing. However, the use of algal polymers has been limited to alginate, agar, carrageenan, and ulvan extracted from seaweeds. Diverse algal taxa beyond seaweeds have yet to be explored. In this comprehensive review, we discuss available algal biomaterials, their properties, and emerging applications in 3D printing techniques. We also identify elite algal strains to be used in 3D printing and comment on both advantages and limitations of algal biomass as a printing material. Global 3D printing market trends and material demands are also critically analyzed. Finally, the future prospects, opportunities, and challenges for using algal polymers in 3D printing market for a sustainable economy are discussed. We hope this review will provide a foundation for exploring the 3D printable biomaterials from algae.

Biography

R. Thiruchelvi, Assistant Professor & Admission Advisor, Department of Bio- Engineering, Vels Institute of Science, Technology and Advanced Studies (VISTAS) Chennai, India. I had 5 years of teaching experience and 4 years of research experience. I have dedicated to academics and research in latest cutting-edge technologies in the field of biotechnology. My research findings illuminate on Environmental Biotechnology, Marine Biology, Cell Culture, Biopolymers, Drug Discovery, Regimen and Development. My passion for research led me as expert in proposal submission, research methodology, problem formulation and publication. I have published more than 30 research and review papers in esteemed peer reviewed Scopus indexed national and international journals, 10 more book chapters & 4 more patents too. Honored for Active contribution to VISTAS as Admission Representation of Biotech Department for the year 2017-2018 & 2018-2019. My interest towards Environment has significantly contributed to the Development of Bio-Nano composite degradable Plastic Patented and published according to IPR. I have completed several projects and have guided more than 35 Engineering undergraduate Projects adding to credit. I had won many awards as “Global Contour Award” “Women’s Achievers Award” TAMILNADU WOMEN ACHIEVERS AWARD 2021, “Most Promising Women Educators in Tamil Nadu” “Exceptional Women of Excellence, “Outstanding Research work in the field of Biotechnology” “Outstanding Faculty Research” “THE REAL SUPER WOMAN” “AIR International Eminent Women Achiever” “Best Young Faculty Award”, “Young Scientist award”, “Educator Excellence Award” ., to name a few.

BROACHING UNCOUTH WATER LEVEL SNAG IN UNDERGROUND AGRICULTURE FIELD THROUGH WIRELESS SENSORS

Shahzad Ashraf
NFC Institute of Engineering and Technology, Pakistan

Abstract:

The major problem faced by the agriculture industry is the growth of seeds at optimal fertility. Such uncouth fertility occurs when either no water reaches under soil seed or some obstacles prevent it. This issue degrades agriculture growth at an aggravation level and consequently barren the land. A wireless sensor-based communication model has been developed to notice the accurate status of the water level reaching seeds of various crops such as wheat, maize, barley, and cotton with soil types Loamy, Silty clay, and Black soil. In the proposed model, "Broadening Uncouth Water Level Snag in Underground Agriculture Field with Wireless Sensors" (BUWLN), the water level would be measured in real time and the data would be transmitted to a base station accordingly. The 8 sensor nodes and a base station would be deployed accompanied by an Arduino package in an area of 90 x 30 square feet to monitor water levels efficiently. The study will keep track of water levels, and the farmer will be informed of the water level so they may manage water resources more effectively. In addition, farmers will also be aware of the field if water is distributed uniformly so that the crops yield increases. The performance of the proposed BUWLN model has been compared with Remote water-level monitoring system (RWMS), Low cost wireless sensor network (LCSN), and Ensemble groundwater level prediction (E-GWLP) by conducting simulation using PROTEUS. result showed that the proposed BUWLN model has enough potential for future growth.

Biography

Shahzad Ashraf received B.E. degree in Computer Systems Engineering, and M.E. in Communication System and Networks from Mehran Engineering & Technology University, Jamshoro Pakistan in 2004, and 2014 respectively. He secured Ph.D degree from Hohai University Changzhou China in 2020. At present, he associates with NFC Institute of Engineering and Technology Multan, Pakistan. His area of interest includes Wireless sensor communication, Underwater routing, Computer graphics and architecture, Computer Networks, Grid and distributed computing and Computer hardware. He is an active reviewer and member of technical committee of more than 70 renowned international journals and conference proceedings including IEEE and ACM. He is associate editor of more than five renowned international journals.

GRAPHENE OXIDE COATING FIBER OPTICS CHLOROFORM GAS SENSING APPLICATIONS

B Renganathan, Subha Krishna Rao, AR Ganesan and A Deepak
Saveetha Institute of Medical and Technical Sciences, India

Abstract:

In this work, a cladding-modified Graphene oxide coating optical fiber-based gas sensor is proposed for detection of toxic gas (chloroform). Graphene oxide is synthesised and coated by dip coating route over the region in which cladding is removed. This synthesised graphene oxide is characterised by x-ray diffraction (XRD), ultra violet-visible absorption spectrum, ultra violet -visible reflectance and transmittance spectrum, scanning electron microscope images (SEM) The response of the sensor is recorded for different concentrations of test gas (chloroform) and the sensor's selectivity is compared and analysed. It is observed that graphene oxide is more sensitive to gas compared to different room temperatures.

FUSED DEPOSITION MODELLING (FDM) AND SELECTIVE LASER SINTERING (SLS) AS INDISPUTABLE MACHINES IN ADDITIVE MANUFACTURING: A REVIEW

Tunji John Erinle, Koleola Ebenezer Ojaomo and Oluwatosin Samuel Adeoye
Federal Polytechnic, Ado- Ekiti, Nigeria

Abstract:

The additive manufacturing process is one of the keys to advanced engineering manufacturing processes in this era of the Fourth Industrial Revolution. Fused deposition modelling (FDM) and selective laser sintering (SLS) are two additive manufacturing (AM) techniques that can be used for rapid prototyping. The importance of fused deposition modelling and selective laser sintering as viable equipment for advanced technology development in the manufacturing of interchangeable parts in automotive and aerospace was demonstrated in this review study. The impact of these two machines on the advancement of manufacturing technology is also discussed in this article. The findings demonstrated the enormous benefits of fused deposition modelling and selective laser sintering in the manufacturing industry for efficient and successful production, as well as the duo's applications. The purpose of this paper is to summarise fused deposition modelling and selective laser sintering as important technological tools for advanced manufacturing technology advancement. Many advantages and applications are highlighted in the study, including durability, ease of use, lower production costs, shorter lead times manufacturing process, ease of dealing with complicated cavities and geometries, several high-performance, lower tooling costs, produce customised products, and bring product to market quickly with low-volume production and bridge manufacturing, flexible concept, engineering models, functional testing, and high-heat applications.

Biography

Tunji John Erinle is currently a Lecturer and Academic Researcher in the Department of Mechanical Engineering at Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria.
He has expertise in Mechanical Engineering. His knowledge of Mechanical Engineering opens the way for him to advance in the field of Mechanical Engineering with Advanced manufacturing. He has built on this field after many years of experience in research, evaluation, teaching, and administration both in research and education institutions.
He is a Research Scholar, Academician, Academic Researcher, Lecturer, Engineer, Innovator, Tutor, Mentor, and Motivator. He is a Reviewer, Editorial Board Member of some reputable International Journals.
He is a member of many professional societies and associations, a Member of the American Society of Mechanical Engineers (ASME), USA, a Member of the Chinese Mechanical Engineering Society (CMES), Beijing, China, a Member of the Canadian Society for Mechanical Engineering (CSME), Ottawa, Ontario, Canada, a Member of the American Academy of Environmental Engineers and Scientists (AAEES), USA, Member of the Chartered Institution of Wastes Management (CIWM), United Kingdom, a Member of the International Association of Innovation Professionals (IAOIP), USA, a Member of the Institution of Engineers Australia (IEAust), Australia, a Member of the National Society of Professional Engineers (NSPE), USA, a Member of the Industrial Engineering and Operation Management Society (IEOM), USA, a Member of the Society for Protective Coatings (SSPC), USA, a Member of the Association for Materials Protection and Performance (AMPP), USA, a Member of the National Association of Corrosion Engineers (NACE), USA, a Member of the American Society of Safety Professionals (ASSP), USA, a Member of the American Institute of Aeronautics and Astronautics, USA, a Member of the American Society for Testing and Materials (ASTM), USA, a Member of the Society of Automotive Engineers (SAE), USA, a Member of the International Association of Engineers (IAENG), Hong Kong, a Member of the Future Additive Manufacturing in Africa (FAMA), Africa.
Engr. Tunji John Erinle was awarded the Student Workshop Participation Award 2020 in the Microscopy Society of Southern Africa (MSSA), Witwatersrand, Johannesburg, South Africa, and a Certificate of Excellence in Reviewing.

MODIFIED GRAPHENE THE TRUE WONDER MATERIAL

Robin Singla
Thapar Institute of Engineering and Technology, India

Abstract:

In the theoretical realm, graphene's extraordinary electrical and mechanical properties have led researchers to declare it a wonder material. Our experience, however, is that it offers no practical value, especially when it comes to semiconductor devices. Despite researchers' predictions of high mobility, it is worthless in semiconductor devices without a bandgap. Graphene in pure crystalline form does not strike me as a true wonder material. Modification of graphene via functionalization, doping, or defects enables its use in several fields, such as semiconductors, spintronic, chemical and gas sensors, and optoelectronics. It is for this reason that graphene oxide has been the subject of many publications related to practical applications. In the same way, CVD graphene as well as exfoliated graphene can be modified to get graphene with new and controlled properties. Modification of graphene can be achieved in several ways. These include treating it with oxidizing or reducing agents, exposing it to plasma, and annealing it at high temperatures. The modification can be confirmed with analytical tools such as Raman spectroscopy, XPS, and AFM.

Biography

Robin Singla has obtained Ph.D. in Electrical Engineering from Indian Institute of Technology Bombay, India and currently working as assistant professor at Thapar Institute of Engineering and Technology at India. He has more than 8 years of experience of research in the field of graphene and other 2-D materials. He has developed several methods for modification of graphene and shows practical applications of modified graphene in the field of semiconductor devices, spintronic devices, and sensing. He is currently working on modified graphene for energy storage applications.

APPLICATION OF 2D POLYMERIC NANOFIBROUS MEMBRANES FOR EFFECTIVE REMOVAL OF ARSENIC FROM WATER

Sangeeta Tiwari and Shubhangi Madan
Amity University, India

Abstract:

Polymeric Nanofibrous membranes, made by electrospinning, are two dimensional (2D) materials, having extraordinary properties like very high specific surface area, highly porous, interconnected pore structure and good mechanical strength. They are easy to produce by electrospinning and can be further modified/ functionalized. These characteristics makes them attractive high efficiency adsorbents for removing toxic metal ions from contaminated water.

The present work describes fabrication and characterization of polymer composite nanofibrous membranes (CNMs) through electrospinning, for application in removal of ultra-low concentrations of a highly lethal metal anion, As (III). In addition, the role of surface functionalization/immobilization of magnetic nanoparticles on the fabricated CNMs, as well as their properties and applications, has been studied.

CNMs were prepared using Poly acrylonitrile (PAN) and titania (TiO_2) and then modified with nano zero valent iron (nZVI) for removal of As (III). The fibers were found to have good strength and water absorption characteristics. It could be observed that the fabricated CNMs (nZVI@PAN/TiO_2) purify water within the permissible limits, prescribed by WHO/EPA from initial concentration (1000 μg/L) of As (III). Furthermore, the composite nanofibers are capable of eliminating As (III) at extremely low concentrations (less than 100 ppb). The maximum adsorption capacity of nZVI@PAN/TiO_2 composite nanofibers with 10 mg/L As (III) solution is 12.18 mg/g. The nanofibrous membranes are potential alternative for waste water treatment.

Biography

Sangeeta Tiwari is Professor in Chemistry at Amity Institute of Applied Sciences, Amity University Noida. She is actively associated in teaching, research and other important developmental activities at Amity University. She did her PhD from CSIR-Advanced Materials Processes and Research Institute (AMPRI), Bhopal, India, in the year 1999. During her early research career, she was awarded M.P. State Young Scientist as well as Indian Science Congress -Young Scientist Award.

After Ph.D., she joined Amity University where she is at present, Professor in Chemistry, and Head (Academic Co-ordination) at Amity Institute of Applied Sciences. She has quite a good number of high impact research publications to her credit, produced PhDs and has number of patents with Amity University. Her current area of research is functional materials for various applications like removal of toxic contaminants from water, carbon dioxide conversion and NIR reflective coatings. She has successfully completed some sponsored National and International research projects and is still doing. She has successfully conducted many International Conferences and has delivered Invited talks.

RESEARCH ON DLP-STEREOLITHOGRAPHY 3D PRINTING, MICRO-STRUCTURE AND MECHANICAL PROPERTIES OF ALUMINA REIN-FORCED ZIRCONIA (ARZ) COMPONENTS

M Irfan Hussain, Min Xia, Xiao Na Ren and Changchun Ge
University of Science and Technology Beijing, China

Abstract:

Progress in additive manufacturing over the past decades represent a new technological paradigm. 3D printing of ceramics shows promising due to its tangible design, custom freedom, and excellence in accuracy of laying printing parts. In recent years, Digital light processing (DLP), as a revolutionary technology, has revitalized interest for future advanced ceramics parts, possesses inherent advantages such as faster printing rate and high resolution. Similar to stereolithography, DLP uses vat-photopolymerization followed by layer-upon-layer curing to create objects. Alumina-reinforced zirconia composite shows considerable promise for application, namely, aerospace, semiconductor, electronics and biomedical parts. Herein, Al2O3 core, ZrO2, Kaolin and Alumina reinforced ceramics with complex shapes were successfully manufactured using DLP 3D processing. XRD, SEM, TG-DSC, and Nanoindentation probe characterization were employed to investigate the green body's phase composition, microstructure, thermal analysis, flexural strength, fracture toughness and modulus properties. The influence of low sintered temperature (1200 °C- 1670 °C) on microstructure and mechanical properties was investigated. The physical properties were investigated, including shrinkage, weight loss, water absorption, porosity, and density. Results revealed density (97.4 %) and flexural strength and shrinkage were drastically exceeded with increased sintering temperature, but porosity and water absorption decreased. We demonstrated the successful fabrication of complex shapes of aerospace parts, as well as green body parts. This work provides access to opportunity for the potential usage of ceramics for industrial applications.

3D Printing & Graphene 2023

Poster Presentations

3D PRINTING AND SCANNING, FREE USE, AND FREE REPAIR: IS THE DESIGNS ACT 2003 (CTH) REPAIR DEFENCE ADEQUATE?

Connor Davidson
Swinburne University of Technology, Australia

Abstract:

3D printing and scanning are two of the most significant developments in manufacturing since the industrial revolution, impacting how we design, manufacture, and share objects. This article considers how these technologies impact the right to repair, and specifically, the 'repair defence' in the Designs Act 2003 (Cth). This review is achieved by analysing the current registered design scheme, its history and the application of the repair defence as demonstrated in GM Global Technology Operations LLC v S.S.S. Auto Parts Pty Ltd (2019) 371 ALR 1. This article then considers whether the repair defence is fit for purpose given the impact that 3D printing, and scanning have had on intellectual property rights holders, consumers, and repairers. It concludes that the repair defence contained in the Designs Act 2003 (Cth) is unfit for purpose considering this emerging and rapidly establishing technology.

Biography

Connor Davidson is a final year LLB student with a passion for intellectual property law and technology. In his paper, 3D Printing and Scanning, Free Use, and Free Repair: Is the Design Act 2003 (Cth) Repair defence adequate, he explores 3D printing and scanning and its impact it may have on Designs Law in Australia.

SEMICONDUCTOR TO INSULATOR TRANSITION OF TWISTED GRAPHENE NANORIBBON via BORON AND NITROGEN INCORPORATION

Mohammad Tanvir Ahmed, Shariful Islam and Farid Ahmed
Jashore University of Science and Technology, Bangladesh

Abstract:

The effects of incorporating boron (B) and nitrogen (N) atoms on twisted (Mobius) graphene (C_{48}) nanoribbon (NR) are studied due to the interesting properties of twisted graphene. We employed the density functional theory calculations in order to obtain the structural and electronic properties of pristine graphene NR and B, N doped graphene NR. All the structures showed a negative formation energy with real vibrational frequency suggesting the natural existence of the structures. A semiconductor-to-insulator transition i.e., an increase in the energy gap is observed due to the increase in BN concentration. High absorption coefficients of 10^4 cm^{-1} order are obtained for every structure. The reactivity decreased whereas the chemical stability increased with the increase of boron and nitrogen content. The electric and optical studies indicate that the structures can be potential research materials in optoelectronics.

Biography

Mohammad Tanvir Ahmed was born in Dhaka district of Bangladesh. He completed his SSC and HSC from Savar Cantonment Public School & College, Savar, Dhaka. He went to Jahangirnagar University earning his Bachelor's and Master's degrees in Physics. He conducted his M.S. Thesis on Perovskite thin film for optoelectronic research. He received the NST fellowship under the Ministry of Science and Technology Bangladesh for his M.S. research. Tanvir joined as a lecturer at Jashore University of Science and Technology on 05 November 2022..

3D Printing & Graphene 2023

Accepted Abstracts

AUTONOMOUS GENERATION OF A TWIN MODEL FOR 3D PRINTED STRUCTURES

Mohammad Harb
American University of Beirut, Lebanon

Abstract:

Today's industrial designers seek to optimize product designs to best meet the requirements of clients and markets. In recent years, requirements and expectations have become increasingly strenuous to fulfill the ever-increasingly demanding economic, environmental, and societal needs. It has thus become important for engineers to design and manufacture high-performance and lightweight products, which has become possible via advanced manufacturing techniques including additive manufacturing (AM). Though AM is ubiquitous, AM structures are currently not sufficiently analyzed for the design of parts. For instance, such progress in manufacturing is yet to be followed by recent innovations in Computer-Aided-Design (CAD) and computational analysis tools. In other words, current design strategies and CAD tools are not yet tailored for AM. This work aims to help engineers to integrate several AM parameters in part designs to form an exact computerized replication of what is to be 3D-printed, which entails improved structural analysis that is instrumental to the production of lightweight high-strength products. That is, the printed filament's diameter, layer thickness, infill density, and the infill patterns of the printed model will be precisely embedded into the reversed CAD model of the part. To do this, it is required to follow the path the printer takes to deposit and form the inner and outer material structure within each layer of the model thickness. Such information is included in the model G-code toolpath. Hence, to understand fully the printed model and its geometrical influences, the G-code printing path must be reversed back into a CAD model. This will accurately represent the inner and outer structure of the printed part with all its printing parameters. The project aims to achieve an efficient and repeatable process that will reverse the G-code toolpath into an accurate 3D CAD model.

Biography

Mohammad Harb, an experienced educator and researcher in design, manufacturing, and sustainable materials is an assistant professor of mechanical engineering at the American University of Beirut. Dr. Harb leads the Smart Structures Research Lab contributing to the advancement of composite and 3D printing materials, structures, and fabrication processes. He is the founding director of the Engineering Learning Lab leading major initiatives on enhancing students' learning experiences, promoting design methodologies in the engineering curriculum, and reimaging teaching and learning spaces. Dr. Harb is also the founder and director of AUB makerspaces where art, technology, learning, research, and collaboration collide through interdisciplinary student-driven projects.

ADDITIVE MANUFACTURING IMPLEMENTATION AND SCALABILITY

Aymen Montasser
Solutions Additive Manufacturing, Germany

Abstract:

3D printing is considered one of the most important technologies of the modern era, which has the power to disrupt conventional industries in the future. Switching from conventional production to 3D Additive Manufacturing has the means to make industries more resilient to crises, supply chains and third party dependencies.

At current status, companies striving for mass production by using additive manufacturing easily encounter barriers of scalability, such as computing complexities, wastage of resources and many more. Aymen Montasser will guide you through the barriers and possible means to unblock those with a close look on the potentials of automating, optimizing and AI supported solutions.

Biography

Aymen Montasser has started his career as architect before becoming an experienced Technician in Additive Manufacturing and Production with a strong focus on optimization of processes in Germany. He has built one of the largest Multi printing 3D printing farms known in EMEA with up to 180 3D FDM printers, successfully leading the production for a German manufacturer in the gaming sector where he discovered the need in the industry of smart solutions to unlock barriers of scalability. Currently, Aymen Montasser develops such a solution as the CEO and Founder of Solutions Additive Manufacturing, located in Berlin, Germany.

EXTRUSION BASED 3D PRINTING OF CELLULOSE-BASED MATERIALS

Maria Oliviero, Livia Cafiero and Andrea Sorrentino
National Research Council, Italy

Abstract:

Nowadays, 3D printing, as any other type of Additive Manufacturing (AM) techniques is widely used with many applications in different industries and research fields. This is due to the numerous benefits of this technology in manufacturing, design, and distribution to customers. Design freedom, flexibility, high customization, and waste minimization are the principle advantages of this technology among many others. Besides, AM is considered as a sustainable production method compared to the conventional processes. In fact, it has many sustainability benefits in production design, quality, and optimization. However, to make AM a totally sustainable process, it is necessary to develop also reproducible and high-performance bio-based materials from renewable resources through sustainable approaches.

In this study, we investigate the printability of a common cellulose-based material (cellulose acetate (CA)). CA is one of the most used and valued cellulose derivative. It is a transparent, glossy, non- flammable and tough polymer with good dimensional stability and high resistance against heat and chemicals. Under appropriate conditions, CA is biodegradable and approved for food or cosmetic use. Up to now, only few research works were dedicated to the application of CA in AM. However, compared to the conventional polymers, CA present some disadvantages both in terms of processing and functional performances. To overcome these restrictions, the inclusion of a suitable plasticizer (such as Triacetin (TA)) offers a suitable and valuable approach. In this study, the effect of TA content on the printability of thermo-plasticized CA is analyzed and correlated to its thermo-rheological behavior. Differential scanning calorimetry, thermo-gravimetric analysis and dynamic mechanical analysis are used to gain a comprehensive understanding of the changes in material composition and material properties during processing. These results are used to optimize the printing conditions and obtain 3D printed objects with various material compositions.

Biography

Maria Oliviero is a Researcher at the Institute for Polymers, Composites and Biomaterials (IPCB) of Italian National Research Council (CNR). Expert in the technologies for the production of films and multi-scale foams. She has wide experience in the thermoplastic processing, characterization and property analysis of natural polymers such as proteins. Her research activities have been mainly focused on: I) Study of the correlations between structure-process-properties of natural polymers including polymeric blends; II) Technological development of novel class of biomaterials based on thermoplastic proteins able to elicit and direct specific cell fate by encoding multiple arrays of biological active moieties; III) Study and modelling of transformation processes of "lightweight" materials (scaffolds) with designed structural and functional properties for tissue engineering applications; IV) Development of hybrids and nanocomposites by using sol-gel approach and preformed nanoparticles in biopolymers, natural rubber and polyurethanes for different application fields such as transport, buildings and electronic; V) Development of multifunctional polymer based materials based on polymers or adducts from natural sources for packaging and sustainable manufacturing.

COMPARISON OF LATTICE STRUCTURES WITHIN A WORKING FLUID CHANNEL FOR INCREASED HEAT TRANSFER USING ADDITIVELY MANUFACTURED CAST IRON

Matthew Drummond, Abdelkrem Eltaggaz, Riya Vasan and Ibrahim Deiab
University of Guelph, Canada

Abstract:

Lattice structures have been integrated into a wide variety of applications due to their light weight and high strength to weight ratio. The addition of lattice structures in a working fluid channel, allows for additional heat transfer between the materials and the working fluid. Binder Jetting additive manufacturing technique can produce complex lattice structures that cannot be created using traditional subtractive manufacturing. This work focuses on the heat transfer capabilities of different lattice structures when a working fluid is passed through. These lattice structure channels can be integrated using additively manufacturing into many cast iron cooling systems such as the cooling system in head of a cast iron diesel engines. Latticed channels assisting the working fluid in a diesel engine head can improve temperature regulation and increase cooling within the engine when experiencing heavy loads. Finite element model was used to simulate cooling efficiency of different lattice structure additively fabricated using cast Iron. Simulated lattices were compared using a 25% volume fraction with a constant temperature applied to one face of the block. A working fluid was run through the system and the average temperature of the opposite face was measured. Results showed that the inclusion of lattice structures increased the cooling potential ≈28-60%. Experimental test blocks are slated to be printed in cast iron using binder jetting technology, which is one of the first experimental usage of additively manufactured cast iron.

Biography

Matthew is working towards his Masters of Applied Science in mechanical engineering at the University of Guelph. His passion towards driving advancements in the manufacturing sector has led him into the additive manufacturing field. His research interests into topology exploration/optimization have combined with the additive manufacturing of metals to create this project. He is currently part of a research team working with an industrial partner exploring the additive manufacturing of cast Iron. His favorite sport is ice hockey and enjoys watching Formula One.

RUBBER & RUBBER LIKE MATERIAL IN 3D PRINTING

François MIGEOT
EPEIRE3D, France

Abstract:

In the last 30 years, additive manufacturing has been bringing a lot of tools and possibilities to the world. Today, we are able to print high end material like PEEK, titanium and zirconia ceramics, as well as commodity material like PLA or ABS. One range of material has been occulted all this time: rubber & rubber-like material. This presentation will demonstrate how EPEIRE3D manages to print this kind of material, not only from a material point of view, but also with a software and machine mechanic too.

Biography

François MIGEOT began his carrier as an element analysis engineer. Nowadays he follows the evolution of additive manufacturing and starts to propose solutions to connect both worlds : use the topologic optimization, deeply coupled with highly specific algorithm. The results bring to high quality parts offering the perfect balance between performance, material and additive machine.

THE DEVELOPMENT OF AN OPEN-SOURCE LOW-COST 3D "MICRO"-BIOPRINTER

Lauren R. Harrison and Joseph Matt Kinsella
McGill University, Canada

Abstract:

The impact of three dimensional (3D) bioprinting within the tissue engineering field has grown significantly in recent decades. 3D bioprinting allows for automated and accurate high- throughput fabrication of functional tissues and organs using a layer-by-layer bottom-up printing approach using bioinks. The expansion of this field can be attributed to the huge advancement of commercial bioprinters, however, the high cost of these printers ($10,000 to $200,000+) make them highly inaccessible. Additionally, the proprietary software of these printers poses significant limitations to innovation within the bioprinting industry. As a result, cost-effective custom-built bioprinters have gained increased attention in the last several years. The objective of this work is to build a novel 'micro'-bioprinter for less than $800 (USD) using an off-the-shelf 3D filament-base printer that is open-source and accessible. We designed this device using a micropipette to hold and print the bioink, reducing sample waste and allowing for working volumes less than 1ml. The bioprinter is also equipment with a bioink heating element and allows for automatic bioink refilling. Using alginate-gelatin hydrogels with and without decellularized extracellular matrix (dECM), the printing accuracy was evaluated and compared to a commercially available bioprinter, GESIM BioScaffolder 3.1. Overall, we demonstrated the feasibility of developing cost-effective bioprinters of equal caliber to commercially available bioprinters. Future work is required to quantify the success of cell-laden bioprinting using our custom-built bioprinter.

Biography

Lauren R. Harrison is a 5th year undergraduate student studying Bioengineering at McGill University, Canada. Lauren has completed several research internships in bioinformatics, developing software for protein modelling and simulation. Outside of academia, Lauren worked at a Robotics start-up company in Montreal, Canada, building painting robots to replicate fine art paintings for 2 years.

STRUCTURE AND PHASE ENGINEERING OF 2D TRANSITION METAL CHALCOGENIDES

Bijun Tang and Zheng Liu
Nanyang Technological University, Singapore

Abstract:

Since the discovery of monolayer graphene in 2004, two-dimensional (2D) materials have attracted considerable attention owing to their potential applications in various fields such as optics, electronics, and catalysis. Numerous 2D materials have been developed in the past decade. Among them, 2D transition metal chalcogenides (TMCs) attract most of the attention, mainly attributed to their large spectrum of fascinating properties along with various crystal structures. In parallel with the discovery of new candidate materials and exploration of their unique characteristics, engineering 2D TMCs into designated structures and phases are also of great importance for meeting the requirement for different applications. In this talk, I will discuss how we use the chemical vapor deposition (CVD) method to engineer the structure and phase of 2D TMCs and as a result, to tune their electronic and magnetic properties. Several strategies will be particularly introduced including construction of heterostructure, alloying, phase-selective growth, and dimension tuning. Additionally, the feasibility and capability of using state-of-the-art machine learning (ML) techniques to guide the synthesis and engineering of 2D TMCs will also be discussed.

Biography

Bijun Tang obtained her bachelor's degree with First Class Honours from the School of Materials Science and Engineering (MSE), Nanyang Technological University (NTU), Singapore in 2017. Upon graduation, she joined Prof. Zheng Liu's research group and obtained her Ph.D. degree in 2021. She is now a Presidential Postdoctoral Fellow at NTU. Her research interests primarily lie in the synthesis and engineering of novel 2D materials as well as materials development with machine learning. Dr. Tang has published 19 peer-reviewed papers in top journals, including Nature, Nat. Mater., Nat. Electron., Nat. Synth., Mater. Today, Adv. Mater., Adv. Funct. Mater., ACS Nano, JACS, etc. She is the awardee of NTU Presidential Postdoctoral Fellowship, Chinese Government Award for Outstanding Self-Finance Students Abroad, NTU Graduate College Interdisciplinary Research Award, as well as Women in Engineering, Science, and Technology (WiEST) Development Grant.

ROADMAP: NUMERICAL-EXPERIMENTAL CHARACTERIZATION TOWARD OPTIMIZING THE 3D-PRINTED PARTS

HamidReza Vanaei, Samir Yahiaoui, Pascal Clain, Sofiane Khelladi and Abbas Tcharkhtchi

ESILV, Léonard de Vinci Pôle Universitaire, France

Abstract:

3D printing is broadly used to generate prototypes for aerospace, medical, and automotive industries. With its fast development, the role of process variables is more prominent, and industries are focusing more on optimizing the process. To acknowledge the bonding of deposited layers, it is crucial to consider the temperature evolution at their interfaces. We aim to present a roadmap through the numerical and experimental characterization toward optimizing the quality of the 3D-printed parts. At the early stage, the role of the most important parameters such as liquefier temperature, platform temperature, and print speed on the mechanical strength and the quality of the final part will be discussed. It is believed that the interaction of parameters plays a crucial role in consideration of mechanical behavior of printed parts. Young's modulus could be an indicator to evaluate the mechanical performance of 3D-printed parts. Then, we will present a numerical approach that is capable of modeling the heat transfer of deposited filaments. The usefulness of this model refers to the fact that it has been validated by a novel experimental approach in which very small K-type thermocouples were employed to perform the *in situ* monitoring of temperature profile at the interface of deposited filaments. Using a numerical approach, the temperature evolution was predicted in good agreement with the recorded experimental results. The consequence of this study is a computer code that considers the obtained results and predictions, potentially letting researchers optimize the process to obtain good final parts. Further studies are in progress to be able to implement rheological characteristics of the materials being printed as well as the obtained results so far. The aim is to perform a platform including all possible phenomena toward the optimization of 3D-printing process.

Biography

HamidReza Vanaei got his MSc and PhD in Mechanics of Materials in Arts et Métiers, Paris-France; and he is now an Associate Professor in ESILV, Léonard de Vinci Pôle Universitaire, Paris-France. He has 6 years of experience in Material Science, Mechanical Engineering, and particularly Additive Manufacturing. He worked as a post-doctoral researcher to apply Artificial Intelligence and Machine Learning toward the optimization of one of the hot topics in Turbomachinery. During his journey as a researcher, he developed an in-situ processing approach for temperature recording which results in publishing several papers with high numbers of citations. He wrote a proposal through the publication of a book related to the field of study, which is accepted and will be published in few months. His focus is now on the optimization of 3D-printing process by implementing AI/ML tools and perform a multi-disciplinary approach.

INDUSTRIALIZATION OF ADDITIVE MANUFACTURING

Ian Gibson
University of Twente, Netherlands

Abstract:

Additive manufacturing (AM) technology has been commercially available for over 30 years with double digit market growth throughout. Initial usage of AM was mainly restricted to prototyping, hence its original name of Rapid Prototyping. The basic principles of AM have changed little since the early techniques were established. However, over this period, regular and mostly gradual improvements have been made to the range of materials, build speed, strength and accuracy of final parts built, overall part dimension, resolution, accuracy, repeatability, etc. Such improvements have extended the range of applications and led to reductions in the costs of both machines and materials. Having said all that, there are still many manufacturing companies who are unsure of how AM can benefit them. This is partly because implementation of AM generally requires companies to rethink their product designs, manufacturing processes and supply chains. This presentation will discuss the maturity level of AM and what still needs to be done to the technology to broaden use throughout manufacturing industry. It will also cover what additional tools are required for industry to successfully implement AM, illustrated by a number of use-cases. The presentation will conclude by covering recent technological developments showing demonstrating that it still has significant growth potential aimed at enhancing productivity.

Biography

Ian Gibson is Professor of Design Engineering and Director of the Fraunhofer Innovation Platform in Advanced Manufacturing; both at the University of Twente, The Netherlands. Originally from Scotland, Ian has worked at top universities in the UK, Hong Kong, Singapore and Australia over the last 30 years before arriving at his current location in The Netherlands in 2018. In 1992, as a young lecturer at Nottingham University, he was introduced to Rapid Prototyping (which is now more commonly known as additive manufacturing or 3D printing) and became part of the first UK research group specialising on this topic. He has followed the development of the technology throughout his career and is a widely-known researcher in numerous related areas as well as the founding editor of the Rapid Prototyping Journal and co-author of the very popular book, Additive Manufacturing Technologies, published by Springer and now in its 3rd edition. As Director of the Fraunhofer Innovation Platform, he is very focused on helping AM transition towards industry as well as looking at next generation AM, particularly on how adaptive control can help ensure quality and reliability of part output.

DESIGN FOR ADDITIVE MANUFACTURING: UNDERSTANDING VALUE

Olaf Diegel

University of Auckland, New Zealand

Abstract:

AM is one of the most expensive manufacturing methods in the known universe. Therefore, for it to be commercially viable for production applications, it must add enough value to overcome those high costs. This talk will focus on the main factors that affect AM cost and how to design around these so that they can, instead, be transformed into value adding features. It will demonstrate how, with good design for AM (DfAM) practices, AM can be transformed from a slow and expensive technology into one that can transform products into success stories. It will present numerous real-world examples of how AM can be used to add significant value to products. This includes products in aeronautical and industrial transport applications, medical applications, heat exchangers, and even artistic applications.

The recent advent of automated design software technologies has also created new opportunities for product design automation. It gives users the ability to almost completely automate the design of complex products that are perfectly suited to the complexity that AM offers. If these software technologies are combined with good design for AM practices, it can become a tremendous catalyst for increased innovation. This talk attempts to impart some practical guidance on how to design parts and use automated design software to gain the maximum benefit from what AM can offer.

Biography

Olaf is an educator and a practitioner of additive manufacturing and product development with an excellent track record of developing innovative solutions to engineering problems. As professor of additive manufacturing, at the University of Auckland, in New Zealand, he is involved in all aspects of AM and is one of the principal authors of the annual Wohlers Report, considered by many to be the definitive publication on AM. In his consulting practice he develops a wide range of products for companies around the world. Over the past three decades he has developed over 100 commercialized new products and, for this work, has received over 50 product development awards.

Over the last 20 years, Olaf has become a passionate follower of 3D printing. He believes it is one of the technologies that has been a real catalyst for innovation as it allows designers and inventors to instantly test out ideas to see if they work. It removes the traditional manufacturing constraints that have become a barrier to creativity. In 2012, Olaf started manufacturing a range of 3D printed guitars that has developed into a successful little side-business.

ANALYZING FUNCTIONING AND QUALITY OF LIFE WITH 3D PRINTED PROSTHETIC HANDS

Regina Rossi and Gregory Chown
Alvernia University, USA

Abstract:

Around the world, there are 40 million people with amputations, and more than 1 million people lose a limb each year. According to the World Health Organization, when individuals are able to obtain prosthetics, they are able to live more productive, healthy, independent, and dignified lives while being able to engage in their social, educational, and work environments. Conversely, when unable to obtain this necessary equipment, they can be isolated, excluded, and trapped in poverty which could cause further disability or disease. Only 5-15% of people are able to acquire these necessary prosthetics and orthotics due to the lack of awareness, trained professionals, availability, policies and financing, as well as the high cost. In developing countries, 95% are unable to receive this essential equipment. Prosthetic hands can cost between several hundred to several thousand US dollars. However, with 3D printing technology, this expense can be significantly reduced which can create a positive impact for those in nations throughout the world. This study focuses on how client's quality of life and ability to function are impacted after receiving a hand prosthetic by surveying participants with the Disability of the Arm, Shoulder, and Hand (DASH) measure to analyze function and the SF-36 measure to examine quality of life before and after receiving a hand prosthesis.

Biography

Regina Rossi is a Senior student at Alvernia University majoring in Occupational Therapy (OT) with a Psychology minor. She is the Senior Scholar and completed the Honors Program researching how OT can help young adults transition out of the foster care system. She has explored Interfaith relations by researching how music is a universal call to holiness. Regina is a Golden Guide Ambassador/tour guide, a Peer Minister, Writing Mentor, maintains a 4.0 GPA, and loves making the world a better place one hand at a time!

Dr. Chown is a tenured associate professor at Alvernia University, a contributing faculty member at University of St. Augustine and an adjunct lecturer at Faculté des Sciences de Réhabilitation de Léogâne in Haiti. As an occupational therapist, he has focused on hand injuries and burns for over 20 years in Canada, Singapore, and the United States. Dr. Chown has presented lectures and research in Singapore, China, Mexico, South Korea, Australia, England, Scotland, Sweden, India and the United States, and has published articles in the Journal of Burns, OT Practice, Open Journal of Occupational Therapy, and Health and Interprofessional Practice.

DESIGN FOR ADDITIVE MANUFACTURING AND ITS IMPLEMENTATION ON A METAL MECHANICAL PART

Richard (Chunhui) Yang
Western Sydney University, Australia

Abstract:

Additive manufacturing (AM) is a category of fabrication techniques and a core technology of Industry 4.0 and Advanced Manufacturing. AM can synthesise products with complex geometric shapes by using Computer Aided Design (CAD) models as three-dimensional blueprints. As a new advanced manufacturing technology, further research is urgently needed to explore the material fabrication and manufacturing process to get expected mechanical properties of additively manufactured materials. Meanwhile, there is an urgent need to explore how to update the design philosophy with new contents and principles of Design for Additive Manufacturing (DfAM). The product design and development process need to be revised to accommodate this new design philosophy.

In this study, the design, fabrication, and characterisation of selective laser melted 17-4PH stainless steel are numerically and experimentally conducted and as a research case study, a typical mechanical component – water spray block from our industrial partner - Colmar Engineering, Australia for high-pressure fluid applications is studied, which was initially designed for traditional manufacturing technologies including casting and CNC machining as traditional subtractive manufacturing technology. The adoption of Additive Manufacturing makes it possible to manufacture such a mechanical part with complex geometrical profile only in one process by using additively manufactured 17-4PH stainless steel. Therefore, this part is firstly redesigned with the implementation of DfAM principles for additive manufacturability. The numerical analyses including both finite element analysis (FEA) and computational fluid dynamics (CFD) are conducted to ensure that the re-designed part with using DfAM can perform within safety limits required for this component under industrial settings. Furthermore, the additive manufacturing process of this part is simulated with calibrations to mitigate potential cracking caused by residual thermal stresses, which are generated during the lay-by-layer thermomechanical additive manufacturing process. As a result, the mechanical part – water spray block is manufactured successfully using Additive Manufacturing Technology.

Biography

Richard (Chunhui) Yang is the Discipline Lead, Mechanical, Mechatronic and Robotic Engineering and Professor, Mechanical Engineering and Smart Structures at the School of Engineering Design and Built environment, Western Sydney University, Australia. His research interests including multi-scale modelling of advanced engineering materials, material properties and mechanical behaviours of advanced engineering materials, structural health monitoring (SHM) and smart structures, metal forming and manufacturing, metal surface treatment, Industry 4.0, Advanced Manufacturing, Additive Manufacturing, etc.

DIRECT GROWTH OF SINGLE METAL ATOM CHAIN

Shasha Guo, Yongmin He and Zheng Liu
Nanyang Technolgical University, Singapore

Abstract:

Single-metal-atom chains (SMACs), as the smallest one-dimensional structure, have intriguing physical and chemical properties. Although several SMACs have been realized so far, their controllable fabrication remains challenging due to the need to arrange single atoms in an atomically precise manner. Here we develop a chemical vapour co-deposition method to construct a wafer-scale network of platinum SMACs in atom-thin films. The obtained atomic chains possess an average length of up to ~17 nm and a high density of over 10 wt%. Interestingly, as a consequence of the electronic delocalization of platinum atoms along the chain, this atomically coherent one-dimensional channel delivers a metallic behaviour, as revealed by electronic measurements, first-principles calculations and complex network modelling. Our strategy is potentially extendable to other transition metals such as cobalt, enriching the toolbox for manufacturing SMACs and paving the way for the fundamental study of one-dimensional systems and the development of devices comprising monoatomic chains.

Biography

Guo Shasha has strong research interest in the growth of single atom doped 2D materials, the interaction between the single metal atom and 2D based materials, and electrochemical properties of 2D materials. Her single-atom-chain work offers a promising route to fabricate air-stable SMACs on a large-scale, and provides one of the smallest one-dimensional platforms for studying Luttinger liquids, the Fermi-liquid microscopic model, and other theoretical one-dimensional models

3D PRINTING OF PHARMACEUTICAL ORAL SOLID DOSAGE FORMS BY A FUSED DEPOSITION METHOD: PRINTING OF NON-PRINTABLE HYPROMELLOSE ACETATE SUCCINATE (HPMC-AS)

Valentyn Mohylyuk

Queen's University Belfast, United Kingdom

Abstract:

3D printing (3DP) by fused deposition modelling (FDM) is one of the most extensively developed methods in additive manufacturing. Optimizing printability by improving feedability, nozzle extrusion, and layer deposition is crucial for manufacturing solid oral dosage forms with desirable properties. This work aimed to use HPMCAS to prepare filaments for FDM-3DP using hot-melt extrusion (HME). It explored and demonstrated the effect of HME-filament composition and fabrication on printability by evaluating thermal, mechanical, and thermo-rheological properties. It also showed that the HME-Polymer filament composition used in FDM-3DP manufacture of oral solid dosage forms provides a tailored drug release profile. HME and FDM-3DP were used to prepare HME-filaments and printed objects, respectively. Two diverse ways of improving the mechanical properties of HME-filaments were deduced by changing the formulation to enable feeding through the roller gears of the printer nozzle. These include plasticizing the polymer and adding an insoluble structuring agent (talc) into the formulation. Experimental feedability was predicted using texture analysis results was a function of PEG concentration, and glass-transition temperature (Tg) values of HME-filaments. The melt viscosity of HPMCAS formulations was investigated using a capillary rheometer. The high viscosity of unplasticized HPMCAS was concluded to be an additional restriction for nozzle extrusion. The plasticization of HPMCAS and the addition of talc into the formulation were shown to improve thickness consistency of printed layers (using homogeneous HME-filaments). A good correlation (R2=0.9546) between the solidification threshold and Tg of HME-filaments was also established. Drug-loaded and placebo HPMCAS-based formulations were shown to be successfully printed, with the former providing tailored drug release profiles based on variation of internal geometry (infill).

Biography

Valentyn Mohylyuk is a pharmaceutical scientist with industrial and academic experience. He has got his BS degree in Pharmaceutical Technology at the National University of Pharmacy (2002, Ukraine) and his PhD degree in Pharmaceutical Sciences at Shupyk National Medical Academy of Postgraduate Education (2016, Ukraine). Since 2002 Dr V. Mohylyuk worked in Ukrainian full-cycle pharmaceutical companies such as Farmak (2002-03), Borshchahivskiy CPP (2003-07), Arterium Corp. (2007-11), Unipharma (2014-16) and held positions related to the development, scale-up, putting into operations and manufacturing of dosage forms. His experience at universities is including working in the research groups at Freie Universität Berlin (2012-13; Germany), the University of Hertfordshire (2017-19; UK), and Queen's University Belfast (since 2019; UK). Dr V. Mohylyuk is focused on the development of complicated oral dosage forms formulations with tailored drug release incl. taste-masked, immediate-, sustained- and delayed-release formulations, as well as with enhanced solubility and permeability.

BLENDED STRUCTURAL OPTIMIZATION FOR WIRE-AND-ARC ADDITIVE MANUFACTURING IN CONSTRUCTION

Vittoria Laghi, Giada Gasparini, Michele Palermo, Tomaso Trombetti and Lidiana Arrè

DICAM – University of Bologna, Italy

Abstract:

Current manufacturing techniques in the construction sector are slow, expensive and constrained in terms of architectural shapes. In other manufacturing sectors (such as automotive, aerospace) the use of automated construction systems significantly improved the safety, speed, quality and complexity of the products. In order to realize real-scale structural elements for construction applications without ideally any geometrical constraints either in size or shape, the most suitable manufacturing solution for metallic elements is a DED process referred to as Wire-and-Arc Additive Manufacturing (WAAM). The main advantage of WAAM relies on the possibility to create new shapes and forms following the breakthrough design tools for modern architecture as algorithm-aided design. At the same time, the printed part ensures high structural performances with reduced material use with respect to the conventional solution. The study presents a new approach called "blended" structural optimization, which blends topology optimization with basic principles of structural design and manufacturing constraints proper of WAAM technology, towards the realization of new efficient structural elements. The approach is applied to a case study of a I-type stainless steel beam on a multi-storey frame building. The approach could pave the way towards an efficient use of WAAM process to produce a new generation of structurally optimized elements for construction, with a more conscious use of the optimization tools and an efficient application of metal 3D printing.

Biography

Vittoria Laghi is a lecturer at Massachusetts Institute of Technology, post-doctoral fellow at Structural Design Department of University of Bologna in Italy and visiting researcher at TU Braunschweig in Germany.

Dr. Laghi attended the PhD program in Structural and Environmental Health Monitoring and Management – SEHM2 at the University of Bologna for the Department of Structural Design. She graduated at University of Bologna (Italy) in 2016, and her Master Thesis has been partially developed at University of California Berkeley, where she also attended one semester as an exchange student.

Her research mainly focuses on the structural applications of steel 3D printing technologies, with particular interest in Wire-and-Arc Additive Manufacturing. Part of her doctoral activity has been developed in Amsterdam (with an internship at MX3D) and at TU Delft, Netherlands. She recently joined TU Braunschweig as visiting post-doctoral researcher to study large-scale 3D printing solutions for construction. Her previous background includes among others: earthquake-resistant design, insulating concrete form solutions, structural optimization applications, retrofitting solutions for masonry structures and energy dissipating systems for frame structures.

She authored more than 30 peer-reviewed publications and conference proceedings. Recently, she co-deposited two patents for innovative mobile 3D printing solutions and innovative lattice structural elements to reduce the environmental impact of metal structures.

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Note

Forthcoming Events

International Conference on **Biomaterials and Biodevices**
September 25-26, 2023 | Paris, France

2nd International Conference on **Neurology and Brain Disorders**
November 2-3, 2023 | London, UK

Internarional Conference on **Hematology and Blood Disorders**
November 6-7, 2023 | Paris, France

European Conference on **Human Genetics**
November 6-7, 2023 | Paris, France

International Conference on **Gynecology and Obstetrics**
November 6-7, 2023 | Dubai, UAE

International Conference on **Biomedical Science and Engineering**
November 6-8, 2023 | Dubai, UAE

International Conference on **Clinical Case Reports**
November 8-9, 2023 | Dubai, UAE

2nd International Conference on **Materials Science & Engineering**
November 8-9, 2023 | Dubai, UAE

2nd European Congress on **Chemistry and Applied Sciences**
November 9-10, 2023 | Paris, France

2nd International Conference on **Catalysis & Chemical Engineering**
November 9-10, 2023 | Paris, France

European Congress on **Renewable Energy and Sustainable Development**
November 16-17, 2023 | Rome, Italy

European Congress on **Biopolymers and Bioplastics**
November 16-17, 2023 | Rome, Italy

2nd International Conference on **Nanomaterials and Nanotechnology**
November 20-21, 2023 | Vienna, Austria

2nd European Congress on **Microbiology**
November 20-21, 2023 | Vienna, Austria

2nd International Conference on **Infectious Diseases**
November 20-21, 2023 | Vienna, Austria

2nd International Conference on **Addiction & Psychiatry**
November 20-21, 2023 | Vienna, Austria