

**Proceedings of
ASME 2022 International Mechanical
Engineering Congress and Exposition
(IMECE2022)**

Volume 3

**October 30-November 3, 2022
Columbus, Ohio**

Conference Sponsor
American Society of
Mechanical Engineers

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Two Park Avenue * New York, N.Y. 10016

© 2022, The American Society of Mechanical Engineers, 2 Park Avenue, New York, NY 10016, USA
(www.asme.org)

All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

INFORMATION CONTAINED IN THIS WORK HAS BEEN OBTAINED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS FROM SOURCES BELIEVED TO BE RELIABLE. HOWEVER, NEITHER ASME NOR ITS AUTHORS OR EDITORS GUARANTEE THE ACCURACY OR COMPLETENESS OF ANY INFORMATION PUBLISHED IN THIS WORK. NEITHER ASME NOR ITS AUTHORS AND EDITORS SHALL BE RESPONSIBLE FOR ANY ERRORS, OMISSIONS, OR DAMAGES ARISING OUT OF THE USE OF THIS INFORMATION. THE WORK IS PUBLISHED WITH THE UNDERSTANDING THAT ASME AND ITS AUTHORS AND EDITORS ARE SUPPLYING INFORMATION BUT ARE NOT ATTEMPTING TO RENDER ENGINEERING OR OTHER PROFESSIONAL SERVICES. IF SUCH ENGINEERING OR PROFESSIONAL SERVICES ARE REQUIRED, THE ASSISTANCE OF AN APPROPRIATE PROFESSIONAL SHOULD BE SOUGHT.

ASME shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B7.1.3). Statement from the Bylaws.

For authorization to photocopy material for internal or personal use under those circumstances not falling within the fair use provisions of the Copyright Act, contact the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923, tel: 978-750-8400, www.copyright.com.

Requests for special permission or bulk reproduction should be addressed to the ASME Publishing Department, or submitted online at: <https://www.asme.org/publications-submissions/journals/information-for-authors/journalguidelines/rights-and-permissions>

ISBN: 978-0-7918-8665-6

TABLE OF CONTENTS

Bactericidal Effects of Micropillars: A Molecular Dynamics Study 1 <i>Akash Singh, Yumeng Li</i>	1
Characterization of Additively Manufactured Beta Materials 7 <i>Efrem Dawit Dana, Subha Kumpaty, Jordan Weston</i>	7
Inhomogeneous Microstructure due to Non-Uniform Solidification Rate in NiTi Triply Periodic Minimal Surface (TPMS) Structures Fabricated via Laser Powder Bed Fusion 14 <i>Shahadat Hussain, Ali N. Alagha, Wael Zaki</i>	14
Additive Manufacturing With Ceramic Slurries 21 <i>Margaret Nowicki, Sara Sheward, Lane Zuchowski, Seth Addeo, Owen States, Oreofeoluwa Omolade, Steven Andreen, Nicholas Ku, Lionel Vargas-Gonzalez, Jennifer Bennett</i>	21
Auxetic Metamaterial Development With Commercial Finite Element Tools 31 <i>Casey Corrado, William Skelton, Alexander Angilella, Kristine Rosford</i>	31
Novel Thermal Coating for High-Speed Airplanes 39 <i>Abinash Satapathy, Lakshay Battu, Liam Watson, Nazanin Rajabi, Jungkyu Park</i>	39
Using Freeze-Casting Method to Create Lamellar Copper Structures - An Experimental Study of the Freezing Behavior of Cupric Oxide Colloidal Suspensions 44 <i>Christopher Kasprzak, Christina Hoffman, Ruey-Hung Chen, Liang Zhu, Ronghui Ma</i>	44
Statistical Analysis of Strain Rate Dependency of the Mechanical Properties of Unidirectional CFRE Materials 49 <i>Charbel Y. Seif, Ilige S. Hage, Re-Mi Hage, Ahmad M. R. Baydoun, Ramsey F. Hamade</i>	49
Investigation of the Acoustic Performance of Plantain (Musa Paradisiacal) Fibre Reinforced Epoxy Biocomposite 55 <i>Patrick Imoisili, Emeka Nwanna, George Enebe, Tien-Chien Jen</i>	55
Design and Development of Novel [alpha]-SiAlON/Co and [alpha]-SiAlON/TiCN Composites for Cutting Tool Inserts 60 <i>Amer D. Alotaibi, Abba A. Abubakar, S. Sohail Akhtar, Abbas S. Hakeem, Khaled S. Al-Athel, Abul Fazal M. Arif</i>	60
A Study on the Effect of Graphene on the Vibrational and Flame Retardant Characteristics of the GFRP Composites 69 <i>Thangapandian Nagamalai, Ragavanantham Shanmugam, Thirumal Azhagan Murugan, Mohanavel Vinayagam, Seth Dennison</i>	69
Effects of the CNT Network Size and Interphase on Mode I Fracture of Buckypaper Nanocomposites 73 <i>Masoud Yekani Fard, Rohan Raman, Yesenia Orozco, Aditi Tata</i>	73
Evaluation of Graded Recycled Glass/Epoxy Composite 79 <i>Ahmed H. Hegazy, Mahmoud E. Abd El-Latief, Omar Khalaf, Mostafa Shazly</i>	79
Cellulose Nanofibers (CNF)/Carbon Fiber Composites With Enhanced Flexural Strength for Structural Applications 87 <i>Siddharth Bhaganagar, Pias Kumar Biswas, Mangilal Agarwal, Hamid Dalir</i>	87

The Effect of Multi-Stage Age Treatment on Mechanical Properties of 7075 Al Alloy	92
<i>A. H. M. E. Rahman, Issam Abu-Mahfouz, Amit Banerjee, Johnmark Wisniewski</i>	
Development of a Predictive Model and Optimization for the Kerf Properties and Delamination Length in AWJM of Kevlar Epoxy Composite.....	96
<i>Puneet Kumar, Sachin Salunkhe, Ragavanantham Shanmugam, Basanta Kumar Bhuyan, Anil Kumar Dahiya, Yuvaraj N.</i>	
Accelerated Structural Design of Cellular Materials for Compressive Deformation Using a Machine-Learning	103
<i>Jinlan Song, Aoi Takagi, Genki Mitsuhashi, Kohei Saito, Kazuma Ogata, Takeru Miyagawa, Akio Yonezu</i>	
Studies on Fatigue Damage Progression in Post-Impacted CFRP Composite Through Passive Thermography and Stiffness Measurement	110
<i>Raghu V. Prakash</i>	
Investigation of Mechanical Properties of Combinatorial Ti-Cu Film Using MD Simulation With Neural Network Potential	118
<i>Takeru Miyagawa, Yugo Sakai, Akio Yonezu, Kazuki Mori, Nobuhiko Kato, Keiji Ishibashi</i>	
A Green and Sustainable Approach for Carbon Steel Acidic Corrosion Inhibition Using Agricultural Waste: Experimental and Theoretical Studies	124
<i>Omotayo Sanni, Jianwei Ren, Tien-Chien Jen</i>	
Continuous Stereolithography 3D Printing of Multi-Network Hydrogels in Triply Periodic Minimal Structures (TPMS) With Tunable Mechanical Strength for Energy Absorption.....	130
<i>Zipeng Guo, Ruizhe Yang, Jun Liu, Jason Armstrong, Ruogang Zhao, Chi Zhou</i>	
Effects of Infill on the Additive Manufacturing of Piezoresistive Pressure Sensors	138
<i>James D. Banks, Meysam Khaleghian, Anahita Emami</i>	
Study on Heat Resistance of PLA Based Biodegradable Injection Molded Components	145
<i>Can Yang, Ruifeng Chen, Jianzhong Xie, Zuguang Ding, Yang Shu, Xiao-Hong Yin</i>	
Thermo-Mechanical Behavior of Multi-Layer Deposition for Wire Arc Additive Manufacturing of Structural Steel: Wire Arc Additive Manufacturing	151
<i>Amrithesh Kumar, Swarup Bag, V. C. Srivastava, M. Ruhul Amin</i>	
Crystalline Phase Changes due to High-Speed Projectiles Impact on 304L Steel.....	162
<i>Muna Slewa</i>	
Analysis on Mechanical Properties and Corrosion Behavior of Friction Stir Processing of Commercially Pure-Titanium	169
<i>Senthil Kumar Velukkudi Santhanam, Joshua Richard Jeyarajan, Sathish Kumar Manivannan, Joseph Beski Jayamanickam, Raman Kuppusamy, Nitin Nambi</i>	
Microstructure Evolution and R-Phase Transformation in NiTi Shape Memory Alloy Processed by Constrained Groove Pressing and Ageing Treatment	178
<i>Akhil Bhardwaj, Devanshi Mathur, Kunthal Oswal, Amit Kumar Gupta</i>	
Evaluation of Weld Quality Through Non-Destructive Testing and Weld Property Analysis of Friction Stir Welded AA2014 Under Submerged Condition	187
<i>Senthil Kumar Velukkudi Santhanam, Harinivas Selvaraju, Mystica Augustine Michael Duke</i>	

On the Micromechanical Properties of Conventional and 3D-Printed Rebar.....	194
<i>Seyed M. Allameh, Alexis Eckart, Jose Fonseca Lopez, Roger Miller, Avery Lenihan, Hadi Allameh</i>	
Exploring the Potential Role of Prunus Domestica in Corrosion Inhibition of AA6063-T5 Aluminium Alloy in Sodium Chloride Media	202
<i>Omotayo Sanni, Jianwei Ren, Tien-Chien Jen</i>	
Experimental Investigation on Severe Plastic Deformation of AA7075 Alloy at Elevated Temperature.....	209
<i>Lakshman Rao Kolla, Amit Kumar Gupta, Devanshi Mathur, Akhil Bhardwaj</i>	
Production of Date Palm Nanoparticle Reinforced Composites and Characterization of Their Mechanical Properties	215
<i>Mahmoud Al-Safy, Nasr Al Hinai, Khalid Alzebdeh</i>	
Investigating the Thermal and Mechanical Properties of Polyurethane Urea Nanocomposites for Subsea Applications.....	223
<i>Chinyere Okolo, Ahmed Elmarakbi, Martin Birkett</i>	
Material Behavior of Hydrophobic Yb ₂ O ₃ and Photocatalytic TiO ₂ Coatings in HVAC Water Cooling Towers: A Case Study	228
<i>Khaled Saleh Al-Athel, Turky Aldossary, Syed Sohail Akhtar</i>	
Non-Destructive Infrared Thermographic Curing Analysis of Polymer Composites	237
<i>Md Ashiqur Rahman, Javier Becerril, Dipannita Ghosh, Nazmul Islam, Ali Ashraf</i>	
Machine Learning Potentials for Graphene	242
<i>Akash Singh, Yumeng Li</i>	
Comparison of Ballistic Impact Simulations Using Different Constitutive Material Models of Concrete	252
<i>Chris Duncan, Richard Allen Perkins, Daniel Johnson, Mei Chandler, Robert Moser, Jesse Sherburn, Youssef Hammi</i>	
Impact of Imperfect Kolsky Bar Experiments Across Different Scales Using Finite Elements.....	261
<i>Thomas Hannah, Reuben H. Kraft, Valerie Martin, Steve Ellis</i>	
Preparation of Hybrid Alkaline Cement Based on Natural Zeolite As Sustainable Building Material.....	268
<i>Mauricio Cornejo, Haci Baykara, Natividad Garcia, Juan Garces, Walter Correa, Cecibel Frere, Julio Torres</i>	
Molecular Dynamics Simulation of the Effect of Hydrogen on the Interaction Between Dislocations in Alpha-Iron	274
<i>Sunday Temitope Oyinbo, Tien-Chien Jen</i>	
Development of an Artificial Neural Network (ANN) Constitutive Model for Mechanical Metamaterials	282
<i>Arif Hussain, Amir Hosein Sakhaei, Mahmood Shafiee</i>	
Effect of Cell-Wall Angle on the Mechanical Properties of 3D-Printed Hierarchical Re-Entrant Honeycomb	290
<i>Chi Zhan, Mingzhe Li, Weiyi Lu</i>	
Mechanical Characterization of Thermally Insulated Composites	296
<i>Michael P. Smith, Paul V. Cavallaro, Jacob D. O'Donnell, Eric A. Warner, Nicholas A. Valm, Nick Gencarelle</i>	

Stochastic Analysis of the Carbon Nanotube Network Interphase in Dry and Pre-Infused Bucky paper.....	303
<i>Masoud Yekani Fard, Samuel Perrino, Conor Hedman</i>	
Body Armor - Current and Potential Materials.....	308
<i>Nishant Thakkar, Davide Piovesan, Scott Steinbrink</i>	
Blast-Resistant Ballistic Materials.....	319
<i>Nishant Thakkar</i>	
Implementation of ANN Modeling Techniques and Genetic Algorithm in the Diameter Prediction of MWCNTs/Epoxy Nanofibers for CFRP Structures.....	326
<i>Pias Kumar Biswas, Pradnya Zende, Hamid Dalir, Mangilal Agarwal</i>	
Effect of Interleaved MWCNTs Bucky paper on the Mechanical Properties of Non-Crimp Carbon Fiber Composites.....	333
<i>Vishwas Jadhav, Ajit D. Kelkar</i>	
Effect of Metastructure Design on the Performance of Pressure Sensors	339
<i>Huan Zhao, Julia E. Huddy, William J. Scheideler, Yan Li</i>	
Experimental and Numerical Investigation of the Influence of Crack Front Orientation in Mode I Plane Strain Fracture Toughness of a Vero Material System via Poly Jet Additive Manufacturing	346
<i>Vishwanath Khapper, Ram V. Mohan</i>	
Prediction of Porosity and its Mechanisms in Metal Additive Manufacturing	354
<i>Ram V. Mohan, Nikhil Ingle</i>	
A Molecular Dynamics Study on the Piezoelectric Properties of Bulk ZnS and Nanobelts.....	357
<i>Iyad Hijazi, Rui Xie, Regis Houachissi</i>	
Structure-Resistance Relationship of 3D Printed Electrically Conductive Woodpile-Structured Metamaterials	367
<i>Hayk Vasilyan, Oginne Lapuz, Rahmat Agung Susantyoko, Ahmad Almheiri, Mozah Alyammahi</i>	
Thermo-Mechanical Analysis of a Composite Tapered-Land Hydrodynamic Thrust Bearing Sector Manufactured Using Fused Filament Fabrication	376
<i>Isaiah Yasko, Lloyd Furuta, Collier Fais, Muhammad Ali, Brian Wisner</i>	
Experimental Investigation of Fixed-Geometry Thrust Bearing Taper Geometry on Critical Operating Parameters	383
<i>Collier Fais, Isaiah Yasko, Anbara Lutfullaeva, Muhammad Ali, Rick Walker</i>	
Effects of Surface Finish and Molecular Structure on the Lubricating Ability of Borate-Based Protic Ionic Liquids	391
<i>Alfonso Sierra, Hope Scott, Darwin Pray, Zachary Polus, Patricia Iglesias</i>	
Development and Implementation of a High-Temperature FDM Machine for Additive Manufacturing of Thermoplastics.....	397
<i>Christopher Billings, Mrinal Saha, Yingtao Liu</i>	
Energy Harvesting and Wing Morphing Design Using Piezoelectric Macro Fiber Composites	404
<i>Md Saifuddin Ahmed Atique, Cai Xia Yang</i>	

Mitigation of Thrust Deterioration at a High Flapping Frequency of a 2D Airfoil in Forwarding Flight Conditions Using Asymmetric Flapping Strokes	418
<i>Jit Sinha, Sohan Roy, Sunil Manohar Dash</i>	
Thermo-Mechanical Properties of SiC-Mineral Binder Composites for Space Applications.....	427
<i>Sujithra Chandrasekaran, Ahmed El-Ghannam, James A. Monroe, Chengying Xu</i>	
A Topology Optimization Methodology With Vibration Constraint for an Aerospace Bracket Design.....	435
<i>Huseyin Karabiyik, Osman Eroglu, Muhammed Metin Eskimez, Berk Oncu Oncul, Muhammet Tayyip Yilmaz, Istemihan Gokdag, Recep M. Gorgularslan</i>	
Heterogeneous Beam Element Based on Timoshenko Beam Model.....	446
<i>Rong Chiu, Wenbin Yu</i>	
Predicting Motion of Engine-Ingested Particles Using Deep Neural Networks.....	457
<i>Travis Bowman, Cairen Miranda, John Palmore Jr.</i>	
A Digital Twin Framework for Mechanical Testing Powered by Machine Learning	473
<i>Muge Kahya, Cem Soyleyici, Mete Bakir, Hakki Ozgur Unver</i>	
Uncertainty Quantification in Material Properties of Additively Manufactured Materials for Application in Topology Optimization.....	480
<i>Zahra Kazemi, Craig A. Steeves</i>	
Supervised and Unsupervised Deep Learning Applications for Visual SLAM: A Review.....	487
<i>Uchechi Faithful Ukaegbu, Lagouge Kwanda Tartibu, Chee Wah Lim</i>	
Evaluation of Deep Learning Networks for Predicting Truss Topology Optimization Results	494
<i>Recep M. Gorgularslan, Gorkem Can Ates</i>	
Unsupervised Machine Learning Algorithms for Analysis of Low Velocity Impact Damage in Composite Structures From CT Image Data.....	504
<i>Olesya I. Zhupanska, Pavlo A. Krokhmal</i>	
On the Accuracy and Efficiency of Convolutional Neural Networks for Element-Wise Refinement of FEM Models	510
<i>Marco Petrolo, Pierluigi Iannotti, Alfonso Pagani, Erasmo Carrera</i>	
A Dynamics Model of Locomotive Mechanism Drilling Into Lunar Regolith.....	519
<i>Zihao Yuan, Ruinan Mu, Jiafeng Yang, Ke Wang, Haifeng Zhao</i>	
Prediction of Sectional Collapse of Thin-Walled Structure Under Pure Bending by Nonlinear Composite Beam Theory	527
<i>Fang Jiang, Wenbin Yu</i>	
An Evolutionary Aeroelastic Design Approach for Spars and Ribs of Flying Wing Aircraft.....	537
<i>Mojtaba Moshtaghzadeh, Natalia Rangel, Adrian Bejan, Pezhman Mardanpour</i>	
Bolt Loosening Detection for a Steel Frame Multi-Story Structure Based on Deep Learning and Digital Image Processing.....	546
<i>Yadian Zhao, Zhenglin Yang, Chao Xu</i>	
Thermo-Mechanical Process Modeling of Additive Friction Stir Deposition of Ti-6Al-4V Alloy	553
<i>Gazi Abu Raihan, Uttam K. Chakravarty</i>	

Numerical Analysis of the Vibration of Slender Beams	563
<i>Pratik Sarker, Uttam K.. Chakravarty</i>	
Experimental Model for Rotor Disk Vortex Interference Effects on Quadcopter UAV Thrust Performance.....	574
<i>Emma San Martin, Richard Melnyk</i>	
Urban Air Mobility: Design of a Virtual Reality Testbed and Experiments for Human Factors Evaluation.....	583
<i>Praveen Shankar, Panadda Marayong, Thomas Strybel, Vernol Battiste, Hanson Nguyen, Justin Cheung, Jesus Viramontes</i>	
Additive Manufacturing Process-Induced Wing Skin Deformation and Effects on Aerodynamic Performance.....	592
<i>Justin D. Valenti, Joseph Barolai, Julia A. Cole, Michael A. Yukish</i>	
CFD Analysis of the Combustion of Hydrogen Fuel on a CFM56-3 Combustor.....	603
<i>Rafael Domingues, Francisco Brojo, Pedro Oliveira</i>	
Impact Damage Evaluations in a Composite Laminate Using Guided Wave-Based Simulation	613
<i>Linqi Zhuang, Adarsh Chaurasia, Ali Najafi</i>	
Nonlinear Transient Response of Isotropic and Composite Structures With Variable Kinematic Beam and Plate Finite Elements.....	620
<i>Rodolfo Azzara, Matteo Filippi, Alfonso Pagani, Erasmo Carrera</i>	
Model Order Reduction of Scramjet Isolator Shock Dynamics During Unstart	628
<i>Jack Sullivan, Datta Gaitonde</i>	
Experimental Study of a Novel 4 Stroke Spark Ignition Geared-Hypocycloid Engine.....	638
<i>Alexandre Nunes, Francisco Brojo</i>	
Vision Based Safe Navigation of UAV for Overhead Line Inspection Enabled by Virtual Safety Bubble	643
<i>Rufaidah Salim, Mahmoud Rezk, Mohammed Minhas Anzil, Nawal AlJasmi, Amit Shukla</i>	
Hybrid-Electric Propulsion Solutions for UAV Application.....	651
<i>Diogo Marto, Francisco Brojo</i>	
Vision-Based Autonomous Inspection of Vertical Structures Using Unmanned Aerial Vehicle (UAV).....	657
<i>Ayush Gupta, Amit Shukla, Amit Kumar, Ashok Kumar Shivratri</i>	
Vision-Based Horizontal Structure Tracking and Inspection via Unmanned Aerial Vehicle.....	663
<i>Amit Kumar, Amit Shukla, Ayush Gupta, Ashok Kumar Shivratri</i>	
Trajectory Tracking in the Image Frame for Autonomous Navigation of UAV in UAV-AGV Multi-Agent System	668
<i>Ashok Kumar Sivarathri, Amit Shukla, Ayush Gupta, Amit Kumar</i>	
A Novel Fuzzy-BELBIC Structure for the Adaptive Control of Satellite Attitude.....	674
<i>Kosar Safari, Farhad Imani</i>	

Author Index