

Lecture Notes in Mechanical Engineering

Lecture Notes in Mechanical Engineering (LNME) publishes the latest developments in Mechanical Engineering—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNME. Volumes published in LNME embrace all aspects, subfields and new challenges of mechanical engineering. Topics in the series include:

- Engineering Design
- Machinery and Machine Elements
- Mechanical Structures and Stress Analysis
- Automotive Engineering
- Engine Technology
- Aerospace Technology and Astronautics
- Nanotechnology and Microengineering
- Control, Robotics, Mechatronics
- MEMS
- Theoretical and Applied Mechanics
- Dynamical Systems, Control
- Fluid Mechanics
- Engineering Thermodynamics, Heat and Mass Transfer
- Manufacturing
- Precision Engineering, Instrumentation, Measurement
- Materials Engineering
- Tribology and Surface Technology

To submit a proposal or request further information, please contact: Dr. Leontina Di Cecco leontina.dicecco@springer.com or Li Shen li.shen@springer.com.

Please check the Springer Tracts in Mechanical Engineering at <http://www.springer.com/series/11693> if you are interested in monographs, textbooks or edited books. To submit a proposal, please contact leontina.dicecco@springer.com and li.shen@springer.com.

More information about this series at <http://www.springer.com/series/11236>

K. S. Vijay Sekar · Manoj Gupta
A. Arockiarajan
Editors

Advances in Manufacturing Processes

Select Proceedings of ICEMMM 2018

 Springer

Editors

K. S. Vijay Sekar
SSN College of Engineering
Chennai, India

A. Arockiarajan
Department of Applied Mechanics
Indian Institute of Technology Madras
Chennai, India

Manoj Gupta
Department of Mechanical Engineering
National University of Singapore
Singapore, Singapore

ISSN 2195-4356 ISSN 2195-4364 (electronic)
Lecture Notes in Mechanical Engineering
ISBN 978-981-13-1723-1 ISBN 978-981-13-1724-8 (eBook)
<https://doi.org/10.1007/978-981-13-1724-8>

Library of Congress Control Number: 2018948831

© Springer Nature Singapore Pte Ltd. 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

The Two-day International Conference on “Engineering Materials, Metallurgy and Manufacturing” (ICEMMM 2018) is organized by the Department of Mechanical Engineering, SSN College of Engineering, Kalavakkam, Chennai. The advent of the digital age is seeing a robust growth of research in smart materials and technologies, while the manufacturing processes ensure in making these new age products and prototypes. The need for energy savings, environment protection, and green-rated processes are further accelerators in the right direction. We are therefore happy to organize the International Conference on Engineering Materials, Metallurgy and Manufacturing (ICEMMM 2018) on February 15–16, 2018, in our esteemed institution. The aim and scope of the conference is to provide a robust platform for academicians, researchers, scientists, and students to present their ongoing research work in cutting-edge areas of materials, metallurgy, and manufacturing. It is also the endeavor of this conference to bring to the forefront the seminal research works in these key areas by eminent scholars worldwide and provide them with an opportunity to share their success stories with an earnest audience. This conference hopes to provide enough food for thought on challenges faced by the industry and eagerly awaits the amalgamation of ideas and solutions to address the current and future requirements. We sincerely hope all the delegates will cherish the exchange of new ideas and reap considerable benefits from the face-to-face interaction and potential future networking.

Chennai, India
Singapore
Chennai, India

K. S. Vijay Sekar
Manoj Gupta
A. Arockiarajan

Acknowledgements

We express our gratitude to the management of SSN Institutions for giving us the opportunity to organize this important conference and also thank all the delegates for making this event a grand success. We thank the keynote speakers, conference chairs, advisory, program, and technical committees, reviewers, colleagues, college administration, our friends, students, and well-wishers for making this event a memorable one. We thank Springer publications for having consented to publish our papers through two book volumes. We thank one and all.

About the Institution

SSN Institutions, founded by Padma Bhushan Dr. Shiv Nadar, Chairman, HCL Technologies, stand out as a premier center for higher learning with a mission of pursuing excellence in education and research. These institutions, with their diverse and dynamic community of students, offer a distinctive combination of some of the finest graduate, undergraduate, and research programs, accomplished faculty, world-class facilities, and a residential campus set on a sprawling 250 acres of sylvan surroundings. SSN Institutions provide a variety of stimulating environments for intellectual development, freethinking, and personal growth, challenging its students with dynamic learning opportunity and equipping them with the skills, insights, attitudes, and practical experiences that are necessary to take up responsibilities in the society. While students at SSN immerse themselves in academics, the college has a lot in store for them outside the classroom. Student life includes participation in sports, recreational and cocurricular activities, and cultural. In short, at SSN, students will find an academic and social environment where everyone—from faculty members to students—help shape their future. SSN is a home to aesthetically designed buildings with the state-of-the-art computer and Internet facilities, modern workshops, seminar halls, auditoriums, well-stocked libraries, and sports and games fields in addition to an indoor stadium with gymnasium. As an exemplary institution for learning, SSN follows an admission policy that strongly favors merit, even as it enables access to education for students from all strata of society through appropriate scholarships. The institution boasts of a strong alumni network with alumni events held every year serving as a platform for the past students to get back to SSN and share their experiences with its present fellow students. With so much to offer, it is only natural that the students of SSN get a unique opportunity to carve a niche for themselves in their chosen field of study that enables them to become well-rounded and discerning citizens, fully qualified for their chosen professions in the workplace.

Smart India Hackathon 2017: SSN was selected as one of the 26 nodal centers in India for conducting the grand finale of the Smart India Hackathon 2017, world's largest hackathon event organized by the Ministry of HRD, India. Two teams from

SSN won the first prize and the third prize under the Ministry of Skill Development and Postal Services, respectively.

NIRF rankings: SSN secured the all India 27th rank in the engineering category in the NIRF ranking system constituted by the Ministry of HRD. SSN College of Engineering was also accredited by NAAC with an A+ Grade in 2017.

About the Department

The Department of Mechanical Engineering was established in the year 2007. It offers a UG program in mechanical engineering and PG programs in manufacturing engineering and energy engineering.

The department is also recognized as a nodal research center for pursuing M.S. (By Research) and Ph.D. under Anna University, Chennai, for pursuing doctoral research works. The department has got 34 well-qualified and experienced faculty members, out of which 29 are Ph.D. degree holders and the remaining 5 are on the verge of completing their Ph.D. degrees. The department has 29 recognized Ph.D. supervisors and 103 Ph.D. research scholars registered under Anna University, Chennai, out of which 19 are full-time scholars and 84 are part-time scholars.

The faculty members and students actively engage in research and constantly publish papers in reputed international journals. The department regularly organizes national and international conferences and workshops in emerging areas. The department also has Industry Institute Partnership Cell (IIPC) for enhancing the relationship between the institute and industry.

The department has well-equipped laboratories with research facilities like friction stir welding, material processing, composite machining, cryogenic machining, and vibration analysis. Faculty members are actively involved in executing a number of R&D projects for government agencies like Department of Science and Technology (DST), All India Council for Technical Education (AICTE), and Naval Research Board (NRB) to the tune of more than 2.5 crores.

The major research areas are friction stir welding, metal cutting, composites, FEA, CFD, vibration analysis, nanotechnology, robotics, heat transfer, alternate fuels, thermal energy storage, and vapor absorption refrigeration systems.

About the Conference—ICEMMM 2018

The Two-day International Conference on “Engineering Materials, Metallurgy and Manufacturing” (ICEMMM 2018) is organized by the Department of Mechanical Engineering, SSN College of Engineering, Kalavakkam, Chennai. The principal objective of ICEMMM 2018 is to provide a neutral platform for researchers, engineers, academicians, and industrial professionals from all over the world to present their research results and development activities in materials, metallurgy, and manufacturing technology. This conference provides opportunity for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations, and to find global partners for future collaboration. It is proposed to have several parallel sessions with invited keynote lectures by eminent academicians and experts from various fields. The selected papers will be published in the Lecture Notes in Mechanical Engineering (Springer publications). The papers have been selected from diverse fields like composite materials, welding metallurgy, powder metallurgy, tribology, conventional and advanced machining, metal forming processes, additive manufacturing, coating, and surface engineering. The conference hopes to bring out the multi-disciplinary fields of materials, metallurgy, and manufacturing under a single roof.



President's Message



One of the perennial problems being faced by the industry today is the spiraling manufacturing costs led by higher material cost and extraction costs. It has been the endeavor of the academia to find lasting solutions to these problems.

With this background, I am happy that the Department of Mechanical Engineering is conducting an International Conference on Engineering Materials, Metallurgy and Manufacturing—ICEMMM2018, on 15 and 16 February 2018. This conference will not only encourage knowledge sharing but also prove to be a platform for brainstorming ideas that will shape the Metallurgy and Material Science industry in future.

Research is an important facet of life at SSN and SSN researchers are working on finding practical solutions to a wide range of research problems. This conference aims at promoting exchange of ideas, building mutually rewarding collaborations and providing exposure and motivation to the budding researchers. I am sure this conference will be an enriching and inspiring experience for everyone involved.

I wish the organizers of the conference the very best and also warmly welcome all the participants. I am sure all the delegates will have a comfortable stay at the SSN campus and will take back lasting memories to cherish in future.

Ms. Kala Vijayakumar
President, SSN Institutions

Principal's Message



In today's world, it has become preminent to constantly be networked and connected to stay abreast of the technical field and in this connection, academic conferences help in promoting and sharing of research findings and provide new avenues for all stakeholders.

SSN College of Engineering values its academic as well as research knowledge as its greatest wealth. A number of national and international conferences in various domains are conducted on a regular basis to feed the changing technological environment around us. These meetings encourage new ideas to be exchanged in a multitude of engineering domains amongst contemporary researchers. The magnitude of these efforts have increased over time and resulted in a higher level of thinking and execution which helps today's engineers navigate their lives and careers.

I take immense pleasure in welcoming the delegates of the International Conference on Engineering Materials, Metallurgy and Manufacturing—ICEMMM2018, organized by the Department of Mechanical Engineering on 15 and 16 February 2018. The conference aims to promote cutting edge research in futuristic areas of material, metallurgy and manufacturing. I am sure that, this platform will be an enriching experience for the delegates and the confluence of ideas will develop solutions to the problems faced by the industry.

I express my gratitude to the advisory committee, organizing committee, keynote speakers, session chairs, review committee, contributing authors and conference participants for their efforts in making this conference a grand success. I wish all the delegates an eventful two days at the conference as well as at their stay on campus.

Dr. S. Salivahanan
Principal, SSNCE

HOD's Message



Any Engineer is associated with the task of developing solutions. Solutions come through appropriate selection of materials and processing technology. With the entire world being invited to “Make in India”, manufacturing technologies play a major role. Newer applications demand newer materials. The advent of new materials necessitate corresponding developments in material processing technology. Advances in metallurgy enable better and efficient processing of materials.

Thus materials, metallurgy and manufacturing are three major aspects of importance to any mechanical engineer. I am happy to note that these are being covered by ICEMMM2018. Wishing the Conveners Dr. K. S. Vijay Sekar and Dr. A. K. Lakshminarayanan, and the Co-conveners Dr. L. Poovazhagan, Dr. M. Dhananchezian and Dr. K. Jayakumar, for a successful event.

Dr. V. E. Annamalai
Professor and Head, Mechanical Engineering, SSNCE

Conveners' Message



Dr. K. S. Vijay Sekar
Convener



Dr. A. K. Lakshminarayanan
Convener



Dr. L. Poovazhagan
Co-Convener



Dr. M. Dhananchezian
Co-Convener



Dr. K. Jayakumar
Co-Convener

The advent of the digital age is seeing a robust growth of research in smart materials and technologies while the manufacturing processes ensure in making these new age products and prototypes. The need for energy savings, environment protection, green rated processes are further accelerators in the right direction. We are therefore happy to organize the International Conference on Engineering Materials, Metallurgy and Manufacturing—ICEMMM2018, on February 15–16, 2018 in our esteemed institution.

The aim and scope of the conference is to provide a robust platform for academicians, researchers, scientists and students to present their ongoing research work in cutting edge areas of materials, metallurgy and manufacturing. It is also the endeavor of this conference to bring to the forefront, the seminal research works in these key areas by eminent scholars worldwide and provide them an opportunity to share their success stories with an earnest audience.

This conference hopes to provide enough food for thought on challenges faced by the industry and eagerly awaits the amalgamation of ideas and solutions to address the current and future requirement. We sincerely hope all the delegates will cherish the exchange of new ideas and reap considerable benefits from the face to face interaction and potential future networking. We express our gratitude to the management of SSN Institutions for giving us the opportunity to organize this important conference and also thank all the delegates for making this event a grand success. We also thank the Keynote speakers, Conference chairs, Advisory,

Program and Technical committees, Reviewers, Colleagues, the College administration, our friends, students and well-wishers for making this event a memorable one.

We thank one and all.

Keynote: I

The Promise of Magnesium (Composite) Technology for Sustainable Planet Earth



Dr. Manoj Gupta

Department of Mechanical Engineering, National University of Singapore, Singapore

Email: mpegm@nus.edu.sg

The development of technology for producing sustainable energy sources replacing fossil fuels is the vital subject imposed on researchers. A recent analysis has confirmed that the conversion of solar energy into electricity by solar cells is one of the most promising renewable energy technologies. Among the solar cells, nanoporous semiconductor based dye-sensitized solar cells (DSSCs) have gained much interest in recent years because of their low production costs and ease of fabrication. The performance of this type of solar cells depends on the semiconductor material, morphology, structure of the sensitizing molecules and redox mediator used. The interfacial recombination of the electrons injected by the sensitizer with the cations of the dye molecule or redox couple limits the efficiency of the DSSCs. It has been found that the coating of insulating layer on nanoporous semiconductor oxide material greatly suppresses the recombination in DSSCs and thereby increases the overall cell efficiency. The coating of insulating shell layer on

the core semiconductor oxide material may be an interesting approach to reduce the interfacial recombination in DSSCs. Therefore, our recent research has been focused on the development of core/shell structured nanomaterials by various solution growth techniques. In this study, we report a widely applicable and relatively simple approach for the successful preparation of core/shell structured semiconductor oxide thin films. Further, the promising applications of this core/shell structured nanomaterials will also be discussed.

Keynote: II

Design and Analysis of Structures Made of Long Fiber Reinforced Polymer Composites



Dr. Idapalapati Sridhar

School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore

Email: MSridhar@ntu.edu.sg

Wood based natural composite materials are exploited by humans since ancient times for several load-bearing structures. Material intensive modern day aeroplanes, ships and wind-turbine blades are designed and fabricated with long glass or carbon fiber reinforced polymer composites leading to high specific strength and stiff designs. In this presentation, after a brief introduction to composite materials, design and analysis of sandwich structures comprising composite laminates as facesheets and polymeric foams as cores under static and impact loading conditions will be discussed. The competing failure modes of facesheet failure, core shear and localised core indentation failures through upper-bound analytical solutions, finite element based numerical solutions and their comparison with experimental measurements will be presented. A case study on the design and analysis of composite adhesive bonded joints under static and fatigue loading will be discussed for primary structures and as a tool for composites repair will be discussed.

Keynote: III

A-TIG Welding and Its Effect on Performance of the Stainless Steel Weld Joints



Dr. M. Vasudevan

Head, Advanced Welding Processes and Modeling Section,
Materials Development and Technology Division Professor, Homi Bhabha
National Institute
Indira Gandhi Centre for Atomic Research, Kalpakkam

Email: dev@igcar.gov.in

Activated Tungsten Inert Gas (A-TIG) welding process has been developed for stainless steels which overcome the major limitations of TIG welding. Significant improvement in penetration performance over 300% has been achieved by A-TIG welding and variable weld penetration during autogenous TIG welding has been overcome. The mechanism causing the improvement in penetration in stainless steels has been identified as the reversal of marangoni flow in the weld pool caused by dissolved oxygen (surface active element) from the activated flux. The weld bead width is reduced and the weld bead profile is improved due to arc constriction caused by the activated flux. A-TIG welding process has been successfully employed for fabricating type 304 LN stainless steel, 316 LN stainless steel, Duplex stainless steel and 409 ferritic stainless steel weld joints. Significant improvement in

mechanical properties, corrosion resistance, large reductions in residual stresses and distortion and cost of fabrication have been demonstrated for the above stainless steel weld joints. A-TIG welding is already found applications in the nuclear industry for improving the performance of weld joints and reduce the cost of fabrication. A-TIG welding has greater potential for welding of structural components made of stainless steels.

Committee Members

Chief Patron

Dr. Shiv Nadar, Founder, HCL and SSN Institutions

Patrons

Ms. Kala Vijayakumar, President, SSN Institutions

Dr. S. Salivahanan, Principal, SSNCE

General Co-chairs

Dr. P. Ramasamy, Dean (Research)

Conference Chair

Dr. V. E. Annamalai, Professor and Head, Mechanical Engineering

Conveners

Dr. K. S. Vijay Sekar, Associate Professor

Dr. A. K. Lakshminarayanan, Associate Professor

Co-conveners

Dr. L. Poovazhagan, Associate Professor

Dr. M. Dhananchezian, Associate Professor

Dr. K. Jayakumar, Associate Professor

Technical Committee

Dr. S. R. Koteswara Rao, Professor

Dr. S. Vijayan, Associate Professor

Dr. B. Anand Ronald, Associate Professor

Dr. K. Babu, Associate Professor

Dr. K. Rajkumar, Associate Professor

Dr. D. Ananthapadmanaban, Associate Professor

Dr. K. L. Hari Krishna, Associate Professor

Dr. R. Damodaram, Associate Professor

Mrs. R. Rajeswari, Assistant Professor

Mr. R. Vimal Samsingh, Assistant Professor

Program Committee

Dr. N. Nallusamy, Professor
 Dr. K. Subbaiah, Professor
 Dr. N. Lakshmi Narasimhan, Associate Professor
 Dr. M. Selvaraj, Associate Professor
 Dr. K. S. Jayakumar, Associate Professor
 Dr. M. Suresh, Associate Professor
 Dr. M. S. Alphin, Associate Professor
 Dr. S. Suresh Kumar, Associate Professor
 Dr. S. Rajkumar, Associate Professor
 Dr. R. Prakash, Associate Professor
 Dr. A. S. Ramana, Associate Professor
 Dr. M. Nalla Mohamed, Associate Professor
 Dr. G. Satheesh Kumar, Associate Professor
 Dr. G. Selvakumar, Associate Professor
 Dr. S. Soma Sundaram, Associate Professor
 Mr. D. Ebenezer, Assistant Professor
 Mr. B. Jayakishan, Assistant Professor
 Mr. C. Arun Prakash, Assistant Professor

International Advisory Committee

Dr. K. Prasad Rao, Research Professor, University of Utah, USA
 Dr. J. Paulo Davim, Professor, University of Aveiro, Portugal
 Dr. N. Krishnan, Professor, Charles Darwin University, Australia
 Dr. Ramana V. Grandhi, Distinguished Professor, Wright State University, USA
 Dr. Sinin Hamdan, Professor, University of Malaysia
 Dr. R. Ganesan, Professor, Concordia University, Montreal, Canada
 Dr. Dulce M. Rodrigue, Professor, University of Coimbra, Portugal
 Dr. K. Elangovan, Professor, Ibri College of Technology, Oman
 Dr. R. Mohd Amri B. Lajis, Universiti Tun Hussein Onn Malaysia (UTHM)
 Dr. S. Parasuraman, Professor, Monash University, Malaysia
 Dr. Mustafizur Rahman, Professor, NUS, Singapore
 Dr. M. V. Venkatasamy Ready, Professor, NUS, Singapore
 Dr. George Totten, Research Professor, Portland State University, Portland, Oregon
 Dr. Esther Akinlabi, Professor, University of Johannesburg, South Africa
 Dr. Hakeem Amuda, Associate Professor, University of Lagos, Nigeria
 Dr. Sathish Jothi, Lecturer, Swansea University, UK
 Dr. B. Prabhu, Coherent, Inc., Santa Clara, USA
 Dr. Ramkumar Kandasamy, Volvo Construction Equipment, Sweden
 Dr. Khalid Rafi, UL International Singapore Pte Ltd., Singapore
 Dr. Kumar Kandasamy, R&D Manager, Oerlikon, USA

National Advisory Committee

Dr. G. Madhusudhan Reddy, Outstanding Scientist, DMRL
 Dr. B. Venkataraman, Outstanding Scientist, IGCAR

Dr. V. Balasubramanian, Professor and Director,
CEMAJOR, Annamalai University
Dr. M. Vasudevan, Scientist “H”, IGCAR
Dr. N. Sridhar, Scientist “F”, NMRL, Mumbai
Dr. G. Rajendran, Scientist “G”, CVRDE
Dr. T. Ramprabhu, Scientist, DRDO
Dr. M. Kumarasubramanian, AGM, TIII
Dr. A. Rajadurai, Professor, MIT, Anna University
Dr. M. Kamaraj, Professor, IITM
Dr. T. S. Sampath Kumar, Professor, IIT Madras
Dr. S. Aravindan, Professor, IIT Delhi
Dr. Phani Kumar, Professor, IIT Madras
Dr. S. Ganesh Sundara Raman, Professor, IIT Madras
Dr. K. C. Hari Kumar, Professor, IIT Madras
Dr. Narayan Prabhu, Professor, NIT Surathkal
Dr. K. Kalaichelvan, Professor, Anna University, Chennai
Dr. Raju, Professor, Anna University
Dr. P. Kuppan, Professor, VIT University
Dr. Vaddi Seshagiri Rao, Principal, St. Joseph’s College of Engineering
Dr. V. Paramasivam, Hindustan University
Dr. T. Sornakumar, Professor, Thiagarajar College of Engineering
Dr. N. Murugan, Professor, PSG College of Technology
Dr. T. Senthilvelan, Professor, Pondicherry Engineering College
Dr. A. Noorul Haq, Professor, NIT Trichy
Dr. K. V. Sreenivas Rao, Professor, Siddaganga Institute of Technology
Dr. M. Pradeep Kumar, Associate Professor, Anna University
Dr. P. Chakravarthy, Associate Professor, IIST Trivandrum
Dr. K. Balachandar, Associate Professor, SASTRA University, Tanjore
Dr. R. V. S. Prasad, G.E., Oil & Gas—John F. Welch Technology Center (JFWTC)

Contents

Development of Finite Element Model to Predict Temperature and Residual Stress Distribution in Gas Tungsten Arc Welded AA 5059 Aluminium Alloy Joints	1
Babu Narayanasamy, Karunakaran Narayan and Balasubramanian Viswalingam	
Strain Analysis of AA6063 Aluminum Alloy by Tube Hydroforming Process	13
A. S. Selvakumar, B. Surya Rajan, M. A. Sai Balaji and B. Selvaraj	
Performance Indices of Hot Liquid Sodium-Exposed Sacrificial Surface Layers in Fast Breeder Reactors	23
K. Mohammed Haneefa, Manu Santhanam and F. C. Parida	
Turning Studies on A356-TiB₂/TiC In Situ Reinforced Composites	37
Ismail Kakaravada, A. Mahamani and V. Pandurangadu	
Optimization of Dissimilar Friction Stir Welding Process Parameters of AA5083-H111 and AA6082-T6 by CCD-RSM Technique	49
H. M. Anil Kumar, V. Venkata Raman, S. P. Shanmughanathan, Jacob John and U. Mohammed Iqbal	
Effect of Flushing on Electrochemical Micromachining of Copper and Inconel 718 Alloy	61
K. Pooranachandran, J. Deepak, P. Hariharan and B. Mouliprasanth	
Comparative Study of Cutting Fluid Application Methods to Improve Machining Conditions During Surface Grinding on AISI 1040 Steel	71
I. Kantharaj, M. Sekar, X. Ajay Vasanth and S. Mohanasundaram	

Influence of Friction Coefficient and Failure Model in 3D FEA Simulation of Drilling of Glass Fiber Reinforced Polymer Composites	81
C. Prakash and K. S. Vijay Sekar	
Surface Characteristics of Drilled Holes in Al–TiB₂ Metal Matrix Composites Using Electric Discharge Machine	91
N. Sathiya Narayanan, J. Hari Vignesh, R. I. Navin, S. Ramesh Kumar, P. Dinesh Babu and N. Pradeesh	
Development of an Expert System to Monitor Casting Defects in Foundries	101
D. Ananthapadmanaban and Amartya Karthik	
Influence of Design Parameters on Composite and Noncomposite Space Truss Structure Analysed Using ANSYS	111
P. Sangeetha, R. Senthil and P. Naveen Kumar	
Improve the Wear Property of En19 Steel by Boronizing Process	123
D. Kumaravel and K. Arunkumar	
Reduction of Wrinkling Defect in Deep Drawing Process	133
D. Kumaravel and K. Venkatesh	
Surface Roughness Evaluation of Milled Surfaces by Image Processing of Speckle and White-Light Images	141
J. Mahashar Ali, H. Siddhi Jailani and M. Murugan	
On Processing of Ni–WC8Co-based Composite Clads on Austenitic Stainless Steel Through Microwave Energy	153
D. Singh, S. Kaushal, D. Gupta, H. L. Bhowmick and V. Jain	
Application of TOPSIS to Optimize EDM Process Parameters for Small-Hole Drilling of Inconel 718	163
S. Rajamanickam and J. Prasanna	
Tool Wear Analysis While Creating Blind Holes on Float Glass Using Conventional Drilling: A Multi-shaped Tools Study	175
A. Sharma, V. Jain and D. Gupta	
Effect of Surface Modification Using GTAW as Heat Source and Cryogenic Treatment on the Surface Hardness and Its Prediction Using Artificial Neural Network	185
M. K. Chanthini and Sanjivi Arul	
Laser Cladding of Nickel Powder on AISI 202 Stainless Steel and Optimization of the Process Parameters	197
S. Martin Vinoth, P. Dinesh Babu, P. Marimuthu and Sandesh S. Phalke	

Damage Sensing Through Electrical Resistive Measurement Using Electrospun PVDF-CNF Sensor 205
 M. S. Nisha and P. Siva Kota Reddy

Investigations on Fabrication Techniques of Aluminium-Based Porous Material 219
 Daljeet Singh, Ankesh Mittal, Vivek Jain, Dheeraj Gupta and V. K. Singla

Optimization of Electrical Parameters for Machining of Ti-6Al-4V Through TOPSIS Approach 229
 T. Praveena and J. Prasanna

A Study on Machinability of Leather Using CO₂-Based Laser Beam Machining Process 239
 S. Vasanth and T. Muthuramalingam

Structural Health Monitoring of Glass Fiber Reinforced Polymer Using Nanofiber Sensor 245
 M. S. Nisha, P. Faruk Khan and K. V. Ravali

A Sensitization Studies on the Metallurgical and Corrosion Behavior of AISI 304 SS Welds 257
 M. Kumar, A. Sharma and A. S. Shahi

A Study on Friction Stir Welding of Al6061-ZrB₂ Metal Matrix Composites 267
 T. V. Christy, D. Emmanuel Sam Franklin, R. Nelson and S. Mohanasundaram

Analysis of Machinability on WEDM Processed Titanium Alloy with Coated Electrodes 279
 A. Ramamurthy and T. Muthuramalingam

Multi-response Optimization of Machining Parameters in EDM Using Square-Shaped Nonferrous Electrode 287
 S. Ganapathy, P. Balasubramanian, T. Senthilvelan and R. Kumar

Analysis and Optimization on Functionally Graded Rotating Disk Using Grey Relational Method 297
 P. Tharun, M. Dharshan Siddarth, D. Prakash and K. Babu

Investigation on the Process Parameters of Double-Sided Friction Stir Welded AA6082-T₆ Joints with Different Tool Pins Using Response Surface Methodology 309
 S. Vignesh, P. Dinesh Babu, M. Nalla Mohamed, S. Martin Vinoth, G. Surya and S. Dinesh

Interfacial Science in Metal–Ceramic Joining for Thermoelectric Module	321
S. Stalin, K. Kalaichelvan and T. Sujitha	
Experimental Investigation of Spherical Core Sandwich Structure by Beam Flexure	333
V. Pandyaraj and A. Rajadurai	
Parameter Design and Analysis in Friction Welding of Brass Material Using Grey Relational Analysis	341
C. Shanjeevi, J. Thamilarasan and N. Balaji	
Multi-objective Optimization Using Taguchi’s Loss Function-Based Principal Component Analysis in Electrochemical Discharge Machining of Micro-channels on Borosilicate Glass with Direct and Hybrid Electrolytes	349
Jinka Ranganayakulu and P. V. Srihari	
Flutter Analysis of Supersonic Low Aspect Ratio Composite Wings Using FSI Methodology	361
T. Babin and N. Sangeetha	
Experimental Analysis of Surface Roughness of Duplex Stainless Steel in Milling Operation	373
D. Philip Selvaraj	
Optimization of Machining Parameters of Inconel 718 by WEDM Using Response Surface Methodology	383
S. Senkathir, R. Aravind, R. Manoj Samson and A. C. Arun Raj	
Analysis and Evaluation of Different Heat Treatment Fixture Designs Inspired from 3D Infill Patterns	393
P. Sasikiran and J. Nagarjun	
Stress Analysis on Functionally Graded Spur Gear	403
V. Aravind, S. Adharsh, D. Prakash and K. Babu	
Experimental Investigation on Heat Transfer Analysis of Fins	413
A. S. Ramana and J. Arun Jacob Packianathan	
Multi-response Optimization of Process Parameters in Laser Drilling of AA6061-TiB₂/ZrB₂ In Situ Composite Produced by K₂TiF₆-KBF₄-K₂ZrF₆ Reaction System	421
A. Mahamani and V. V. Anantha Chakravarthy	
Influence of Nanoparticles-Suspended Electrolyte on Machinability of Stainless Steel 430 Using Electrochemical Micro-machining Process	433
T. Geethapriyan, T. Muthuramalingam, S. Vasanth, J. Thavamani and Vignesh Hariharan Srinivasan	

Influence of Tool Electrodes on Machinability of Stainless Steel 420 Using Electrochemical Micromachining Process 441
 T. Geethapriyan, Poovazhagan Lakshmanan, M. Prakash, U. Mohammed Iqbal and S. Suraj

Parametric Optimization of Abrasive Water jet Machining Process on Inconel 600 Using Two Different Abrasive Grain Sizes 457
 T. Geethapriyan, R. Manoj Samson, A. C. Arun Raj, S. Senkathi and C. Gunasekar

Experimental Investigation of Electrochemical Micro-machining Process Parameters on Stainless Steel 316 Using Sodium Chloride Electrolyte 471
 T. Geethapriyan, R. Manoj Samson, J. Thavamani, A. C. Arun Raj and Bharadwaj Reddy Pulagam

Optimization of Machining Parameters on Laser Beam Machining of Titanium Alloy (Ti 3Al-2.5V) Using Taguchi Method 481
 R. Manoj Samson, T. Geethapriyan, S. Senkathir, Ashwin Ashok and Aditya Rajesh

Parametric Optimization of Abrasive Water Jet Machining of Beryllium Copper Using Taguchi Grey Relational Analysis 501
 R. Manoj Samson, T. Geethapriyan, A. C. Arun Raj, Ashwin Ashok and Aditya Rajesh

Investigation of Surface Damages in Hole Making on Luffa/Jute/Glass Reinforced Plastics 521
 R. Vinayagamoorthy, Ankur Sharma, Vignesh Iyer and G. Navneeth

Defect Rectification in Forging Operation and Optimizing the Process Parameters 533
 M. D. Vijaya Kumar and U. Vignesh Kumar

Wire Electrical Discharge Machining Integrity Studies on the Aluminium Nanocomposite 543
 K. Rajkumar, L. Poovazhagan, G. Selvakumar and B. Muthukumar

Influence of Multi-hole Technique on Fabrication of Surface Nanocomposite by Friction Stir Processing 555
 Parumandla Naresh and Adepu Kumar

Accelerated Testing Model Prediction of Fatigue Life of AA5083-H111—AA6061-T6 Friction Stir Weldment 573
 K. Rajkumar, A. Gnanavelbabu and K. M. Nambiraj

Development of Mathematical Models and Evaluation of the Optimal Process Parameters for Laser Surface Hardening of Low Alloy Steel Using Elitist Non-dominated Sorting Genetic Algorithm	583
S. Vignesh, G. Muthukumar, P. Dinesh Babu, K. P. Arulshri, R. Sivabalakrishnan and G. Surya	
Effectiveness of Cryogenic Cooling in Turning of Inconel 625 Alloy	591
M. Dhananchezian	
Crashworthiness Analysis of a Novel Aluminum Bi-tubular Corrugated Tube—Experimental Study	599
Arameh Eyvazian, Sara Najafian, Hozhabr Mozafari and A. Praveen Kumar	
Design Analysis and Optimization of Electric Solenoid Shroud for Starter Motor Used in Mild Hybrid Passenger Car	609
Varatharaj Neelakandan, Thulasirajan Ganesan and Praveen Chakrapani Rao	
Shock and Vibration Prevention Using Angular Mounts with Different Types of Oil-Based Elastomers	619
Sudheer Kumar Battula, P. Rama Murthy Raju and Ch Ratnam	
Retrofitting of RC Beams Using Polymer Ferrocement Laminates—Laboratory Model Study and Finite Element Analysis	631
R. Manoharan, R. Rajkumar, B. Gokula Krishnan and R. Aravindh	
Comparative Evaluation TIG and FS Welding of Cast Al–Mg–Sc Alloy	647
K. Subbaiah	
Effect of Continuous and Pulsed Current Tungsten Inert Gas Welding of Cast Al–Mg–Sc Alloy	653
D. Arunkumar and K. Subbaiah	
Tool Pin Profile Studies on Friction Stir Welded Joints of AA5052-H32 and AA6061-T6 Aluminum Alloys	663
S. Balamurugan and K. Subbaiah	

About the Editors

Dr. K. S. Vijay Sekar obtained his Ph.D. in mechanical engineering from Anna University, Chennai, India, specializing in finite element analysis in machining. He has 22 years of teaching experience, 12 years of research experience, and successfully guided more than 25 postgraduate projects and 35 undergraduate projects in his long career. He received the Cognizant award for the Best Faculty of SSN College of Engineering for the year 2014–2015. He has published 25 research papers in international and national journals, and his research work has been presented at 20 international and national conferences. He has published a patent, and his areas of interest include studies on the machinability of composite materials and superalloys and the use of finite element tools to understand machining characteristics and optimize the manufacturing process.

Dr. Manoj Gupta is a former Head of Materials Division of the Mechanical Engineering Department and Director designate of Materials Science and Engineering Initiative at NUS, Singapore. He completed his Ph.D. at the University of California, Irvine, USA, and postdoctoral research at the University of Alberta, Canada. In August 2017, he was named among the top 1% scientist of the world by the Universal Scientific Education and Research Network. He pioneered the disintegrated melt deposition technique and the hybrid microwave sintering technique, an energy-efficient solid-state processing method of synthesizing alloys/micro-/nanocomposites. He has published over 490 articles in peer-reviewed journals and owns two US patents. He is a multiple award winner and has also co-authored six books.

Dr. A. Arockiarajan obtained his Ph.D. from the University of Kaiserslautern, Germany, with specialization in finite element modeling of ferroelectrics. He has industrial experience with Tata Motors, India, and Infineon, Germany. He is currently an associate professor in the Department of Applied Mechanics, Indian Institute of Technology Madras. His research interests include smart materials, ferroelectrics, electro-active polymers, piezo-composites, constitutive modeling, and numerical techniques. He serves as a consultant for various industries such as

BHEL, Rane NSK, Concord Electroceramics. He has published over 70 articles in international peer-reviewed journals in the areas of smart materials and composites. He is an associate fellow of the Indian National Academy of Engineering. He has also received the Young Engineer Award from INAE and ISSS Young Scientist Award from the Institute for Smart Structures and Systems (ISSS).