

Lecture Notes in Mechanical Engineering

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

Advances in Manufacturing Processes

Select Proceedings of ICEMMM 2018

 Springer

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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

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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

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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

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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

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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

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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.

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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

RETRACTED CHAPTER: 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	