Friction Welding of Dissimilar Plastic Polymer Materials | 483988a6f25b3d6a636943df348fa6ec


This book describes crucial aspects related to the additive and subtractive manufacturing of different composites. The first half of this book mainly deals with the various types of composite fabrication methods along with the introduction, features and mechanisms and also the processing of composite materials via additive manufacturing route. Also, the thermal, mechanical, physical and chemical properties relevant to the processing of composite materials are included in the chapters. The second half of this book primarily demonstrates an extensive section on the different types of additive manufacturing.
processes like selective laser sintering, selective laser melting, stereolithography, fused deposition modeling and material jetting used to fabricate the metals and polymers. Also, the chapters address the complete description of fabrication processes for metal matrix composites and polymer matrix composites. Moreover, the different methods adopted such as short peening, micro-machining, heat-treatment and solution treatment to improve the surface improvement are well discussed. This book gives many helps to researchers and students in the fields of the additive and subtractive manufacturing of different composites. This book provides information on complexities, peculiarities, and limitations of various molding processes, and the comparative advantages and disadvantages of the possible plastic products manufacturing techniques, to permit an ideal match of good design and processing. As the Guest Editor of this Special Issue entitled "Science, Characterization, and Technology of Joining and Welding" of Metals, I am pleased to have this book published by MDPI. Joining, including welding, soldering, brazing, and assembly, is an essential requirement in manufacturing processes and is classified as a secondary manufacturing process. This Special Issue of Metals includes technical and review papers on, but not limited to, different aspects of joining and welding, including welding technologies (i.e., fusion-based welding and solid-state welding), characterization, metallurgy and materials science, quality control, and design and numerical simulation. This Special Issue also includes the joining of different materials, including metal and non-metals (polymers and composites), including 17 peer-reviewed papers from several researchers all around the globe (China, Germany, Brazil, South Korea, Slovakia, USA, Taiwan, Canada, and India). As of this date (April 2020), the papers in this Special Issue have been cited 47 times by other researchers, which I think is an eminent number and shows the high quality of the published papers in this Issue. This Special Issue includes a large diversity of various subjects in the field of joining: laser welding, friction stir welding, diffusion bonding, multipass welding, rotary friction-welding, friction bit joining, adhesive bonding, weldbonding, simulation and experimentation, metal/FRP joints, welding simulation, plasma–TIG coupled arc welding, liquation cracking, soldering, resin bonding, microstructural characteristics, brazing, and friction stir butt and scarf welding. I would like to sincerely thank all the researchers who contributed to this Special Issue for their high-quality research. I also would like to acknowledge Mr. Toliver Guo, Senior Assistant Editor at MDPI, who continuously and tirelessly contributed toward this Special Issue by assisting me with inviting the authors and the follow ups. I think this Special Issue will enhance our knowledge and understanding in the field of joining and assembly. I would like to dedicate this book to my wife, Mehrnoosh, for her continued support and encouragement. This volume presents research papers on additive manufacturing (popularly
known as 3D printing) and joining which were presented during the 7th International and 28th All India Manufacturing Technology, Design and Research conference 2018 (AIMTDR 2018). The contents of this volume present the latest technological advancements for improving the efficiency, accuracy and speed of the additive manufacturing process and in fusion and solid-state welding technologies, with a variety of technologies, including fused deposition modelling, poly jet 3D printing, weld deposition based technology, selective laser melting and important welding technologies being covered. This volume will be of interest to academicians, researchers, and practicing engineers alike. Within manufacturing, welding is by far the most widely used fabrication method used for production, leading to a rise in research and development activities pertaining to the welding and joining of different, similar, and dissimilar combinations of the metals. This book addresses recent advances in various welding processes across the domain, including arc welding and solid-state welding process, as well as experimental processes. The content is structured to update readers about the working principle, predicaments in existing process, innovations to overcome these problems, and direct industrial and practical applications. Key Features: Describes recent developments in welding technology, engineering, and science Discusses advanced computational techniques for procedure development Reviews recent trends of implementing DOE and meta-heuristics optimization techniques for setting accurate parameters Addresses related theoretical, practical, and industrial aspects Includes all the aspects of welding, such as arc welding, solid state welding, and weld overlay This book presents a collection of chapters on various aspects of futuristic composite materials, from manufacturing challenges to materials characterization. The book covers the scientific basis of processing and synthesizing futuristic composites, including the prerequisite theoretical background and latest fabrication techniques. The book also discusses industrial applications of composites, such as in aerospace, automotive, and sports equipment. This book will serve as a valuable guide for researchers and professionals working in the area of futuristic lightweight materials. The focus of this book is the chemistry of environmental engineering and its applications, with a special emphasis on the use of polymers in this field. It explores the creation and use of polymers with special properties such as viscoelasticity and interpenetrating networks; examples of which include the creation of polymer-modified asphalt as well as polymers with bacterial adhesion properties. The text contains the issues of polymerization methods, recycling methods, wastewater treatment, types of contaminants, such as microplastics, organic dyes, and pharmaceutical residues. After a detailed overview of polymers in Chapter 1, their special properties are discussed in the following chapter. Among the topics is the importance of polymers to water purification procedures, since their use in
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the formation of reverse osmosis membranes do not show biofouling. Chapter 3 details special processing methods, such as atom transfer radical polymerization, enzymatic polymerization, plasma treatment, and several other methods, can be used to meet the urgent demands of industrial applications. Chapter 4 addresses the important environmental issue of recycling methods as they relate to several types of materials such as PET bottles, tire rubbers, asphalt compositions, and other engineering resins. And wastewater treatment is detailed in Chapter 5, in which the types of contaminants, such as microplastics, organic dyes and pharmaceutical residues, are described and special methods for their proper removal are detailed along with types of adsorbents, including biosorbents. Still another important issue for environmental engineering chemistry is pesticides. Chapter 6 is a thorough description of the development and fabrication of special sensors for the detection of certain pesticides. A detailed presentation of the electrical uses of polymer-based composites is given in Chapter 7, which include photovoltaic materials, solar cells, energy storage and dielectric applications, light-emitting polymers, and fast-charging batteries. And recent issues relating to food engineering, such as food ingredient tracing, protein engineering, biosensors and electronic tongues, are presented in Chapter 8. Finally, polymers used for medical applications are described in Chapter 9. These applications include drug delivery, tissue engineering, porous coatings and also the special methods used to fabricate such materials. This report considers each of the most important thermoplastic materials in turn, and explains the characteristics which affect the choice of pre-treatment, joining method and adhesives. Thermosetting materials are considered as a single group with essentially similar properties with respect to bonding. Many practical examples are provided by some 387 references and abstracts which have been selected from the Rapra Polymer Library database to complete the report. This three-volume set addresses a new knowledge of function materials, their processing, and their characterizations. "Functional and Smart Materials", covered the synthesis and fabrication route of functional and smart materials for universal applications such as material science, mechanical engineering, manufacturing, metrology, nanotechnology, physics, chemical, biology, chemistry, civil engineering, and food science. "Advanced Manufacturing and Processing Technology" covers the advanced manufacturing technologies includes coating, deposition, cladding, nanotechnology, surface finishing, precision machining, processing, and emerging advanced manufacturing technologies for processing of materials for functional applications. "Characterization, Testing, Measurement and Metrology" covered the application of new and advanced characterization techniques to investigate and analysis the processed materials. This book provides an overview of friction stir welding and friction stir spot welding with a focus on aluminium to aluminium and
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aluminium to copper. It also discusses experimental results for friction stir spot welding between aluminium and copper, offering a good foundation for researchers wishing to conduct more investigations on FSSW Al/Cu. Presenting full methodologies for manufacturing and case studies on FSSW Al/Cu, which can be duplicated and used for industrial purposes, it also provides a starting point for researchers and experts in the field to investigate the FSSW process in detail. A variant of the friction stir welding process (FSW), friction stir spot welding (FSSW) is a relatively new joining technique and has been used in a variety of sectors, such as the automotive and aerospace industries. The book describes the microstructural evolution, chemical and mechanical properties of FSW and FSSW, including a number of case studies. No book has been published that gives a detailed description of all the types of plastic materials used in medical devices, the unique requirements that the materials need to comply with and the ways standard plastics can be modified to meet such needs. This book will start with an introduction to medical devices, their classification and some of the regulations (both US and global) that affect their design, production and sale. A couple of chapters will focus on all the requirements that plastics need to meet for medical device applications. The subsequent chapters describe the various types of plastic materials, their properties profiles, the advantages and disadvantages for medical device applications, the techniques by which their properties can be enhanced, and real-world examples of their use. Comparative tables will allow readers to find the right classes of materials suitable for their applications or new product development needs. This book is a printed edition of the Special Issue "Advances in Welding Metal Alloys, Dissimilar Metals and Additively Manufactured Parts" that was published in Metals. A hands-on guide to choosing and using old and new technologies for joining plastics and elastomers. Includes detailed discussions of over 25 techniques used to join plastics to themselves and to other materials. Advantages and disadvantages of each technique along with detailed discussions of applications are presented. A second section is organized by material and provides details of using different processes with over 50 generic families of plastics and how different techniques and operating parameters affect weld strength and other criteria. This book is an excellent reference and an invaluable resource for novice and expert alike in determining the best joining technique for their application and providing guidance in how to design and prepare for production. This book presents the select proceedings of the International Conference on Functional Material, Manufacturing and Performances (ICFMMP) 2019. The book primarily covers recent research, theories, and practices relevant to surface engineering and processing of materials. It focuses on the lesser-known technologies and advanced manufacturing methods which may not be standardized yet but are highly beneficial to material
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and manufacturing industrial engineers. The book includes current advances in the field of coating, deposition, cladding, nanotechnology, surface finishing, precision machining, processing, and emerging advanced manufacturing technologies which enhance the performance of materials in terms of corrosion, wear and fatigue. The book can be a valuable reference for beginners, researchers, and professionals interested in materials processing and allied fields. This volume presents selected papers from the 2nd International Conference on Mechanical, Manufacturing and Process Plant Engineering (ICM MPE 2016) which was held from 23rd to 24th November, 2016 in Kuala Lumpur, Malaysia. The proceedings discuss genuine problems of joining technologies that are heart of manufacturing sectors. It discusses the findings of experimental and numerical works from soldering, arc welding to solid state joining technology that faced by current industry. Friction welding is one of the most productive metal joining processes, yet this technology has not been applied in this country. This research is an effort to design and fabricate a low cost friction welding machine based on the basic operation principles. The structural frames, the driving system, the hydraulic system and the electrical control system were constructed to fulfill the requirements of welding with a flexible parameters. The result was an automatic welding system, capable of welding metal rods or equivalent of diameter ranged between 6.0 mm to 16 mm. The performance tests showed that similar and dissimilar metals can be welded at plastic temperature, without the need of any consumable. In the welding of similar metal; such as steel, stainless steel or aluminium, the macrograph and micrograph of the weldment showed that the weld zone is very narrow and has perfect fusion. The grain structure is very fine and distributed in concentric pattern. The tensile and bending test verified that the weld has good strength and ductility. The micro-vickers hardness test showed that there is a gradual hardness distribution across the selection of weldment. The friction welding process is simple and fast, it has the potential of handling high production at low cost. The technology of friction welding machine is thus made available for Malaysian metal industry to build on their own, the complete system. Guiding engineering and technology students for over five decades, DeGarmo's Materials and Processes in Manufacturing provides a comprehensive introduction to manufacturing materials, systems, and processes. Coverage of materials focuses on properties and behavior, favoring a practical approach over complex mathematics; analytical equations and mathematical models are only presented when they strengthen comprehension and provide clarity. Material production processes are examined in the context of practical application to promote efficient understanding of basic principles, and broad coverage of manufacturing processes illustrates the mechanisms of each while exploring their respective advantages and limitations. Aiming for both accessibility and
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completeness, this text offers introductory students a comprehensive guide to material behavior and selection, measurement and inspection, machining, fabrication, molding, fastening, and other important processes using plastics, ceramics, composites, and ferrous and nonferrous metals and alloys. This extensive overview of the field gives students a solid foundation for advanced study in any area of engineering, manufacturing, and technology. The evolution of mechanical properties and its characterization is important to the weld quality whose further analysis requires mechanical property and microstructure correlation. Present book addresses the basic understanding of the Friction Stir Welding (FSW) process that includes effect of various process parameters on the quality of welded joints. It discusses about various problems related to the welding of dissimilar aluminium alloys including influence of FSW process parameters on the microstructure and mechanical properties of such alloys. A s a case study, effect of important process parameters on joint quality of dissimilar aluminium alloys is included.

The fundamental idea of manufacturing or production is to create, (or produce), something that has a useful form. There are four basic production processes for producing desired shape of a product. These are casting, machining, joining (welding, mechanical fasteners, etc.), and forming processes. Casting process exploit the fluidity of a metal in liquid state as it takes shape and solidifies in a mould. Machining processes provide desired shape with good accuracy and precision but tend to waste material in the generation of removed portions. Joining processes permit complex shapes to be constructed from simpler components and have a wide domain of applications. Forming processes exploit a remarkable property of metals, which is their ability to flow plastically in the solid state without deterioration of their properties. With the application of suitable pressures, the material is moved to obtain the desired shape with almost no wastage. This book on Manufacturing Technology will give you a detailed understanding of manufacturing processes such as casting, joining, and forming. The combination of distinct materials is a key issue in modern industry, whereas the driving concept is to design parts with the right material in the right place. In this framework, a great deal of attention is directed towards dissimilar welding and joining technologies. In the automotive sector, for instance, the concept of “tailored blanks”, introduced in the last decade, has further highlighted the necessity to weld dissimilar materials. As far as the aeronautic field is concerned, most structures are built combining very different materials and alloys, in order to match lightweight and structural performance requirements. In this framework, the application of fusion welding techniques, namely, tungsten inert gas or laser welding, is quite challenging due to the difference in physical properties, in particular the melting point, between adjoining materials. On the other hand, solid-state welding methods, such as the friction stir welding as well as linear
friction welding processes, have already proved to be capable of manufacturing sound Al-Cu, Al-Ti, Al-SS, and Al-Mg joints, to cite but a few. Recently, promising results have also been obtained using hybrid methods. Considering the novelty of the topic, many relevant issues are still open, and many research groups are continuously publishing valuable results. The aim of this book is to finalize the latest contributions on this topic. This book focuses on strengthening and joining materials by means of plastic deformation, gathering extended research papers presented at the AIM TDR 2016 conference. Plastic deformation is used in materials processing to improve the strength of the material. For example, the rod/screw used to connect the cooker handle to the main body has to be strong and sustainable; such rods can be strengthened by plastic deformation (using multi-stage forming operations etc.). Similarly, joining by means of plastic deformation is highly valuable since it avoids the material and environmental degradation often caused by fusion welding processes. The book discusses various processing techniques in which plastic deformation is used to strengthen materials - e.g. in equal channel angular extrusion, autofrettage etc., or to join materials without melting them - e.g. in friction stir processing, riveting etc. Offering an extensive guide, the book includes chapters on roll bonding, equal channel angular pressing, autofrettage, friction stir processing/welding, magnetic pulse welding, and riveting - processes used to strengthen and join a variety of materials for lightweight applications and sustainable manufacturing. The contents of this book will be useful to researchers and practitioners alike. This book covers the rapidly growing area of friction stir welding. It also addresses the use of the technology for other types of materials processing, including superplastic forming, casting modification, and surface treatments. The book has been prepared to serve as the first general reference on friction stir technology. Information is provided on tools, machines, process modeling, material flow, microstructural development and properties. Materials addressed include aluminum alloys, titanium alloys, steels, nickel-base alloys, and copper alloys. The chapters have been written by the leading experts in this field, representing leading industrial companies and university and government research institutions. This book disseminates recent research, theories, and practices relevant to the areas of surface engineering and the processing of materials for functional applications in the aerospace, automobile, and biomedical industries. The book focuses on the hidden technologies and advanced manufacturing methods that may not be standardized by research institutions but are greatly beneficial to material and manufacturing industrial engineers in many ways. It details projects, research activities, and innovations in a global platform to strengthen the knowledge of the concerned community. The book covers surface engineering including coating, deposition, cladding, nanotechnology, surface finishing, precision
machining, processing, and emerging advanced manufacturing technologies to enhance the performance of materials in terms of corrosion, wear, and fatigue. The book captures the emerging areas of materials science and advanced manufacturing engineering and presents recent trends in research for researchers, field engineers, and academic professionals. Joining of dissimilar materials is one of the most essential needs of industries. There are various welding methods that have been developed to obtain suitable joints in various applications. However, friction welding is a solid state joining technique which utilizes the heat generated rubbing of two faying surfaces for the coalescence of the material. In the present study, an experimental setup was designed in order to achieve friction welding of plastically deformed Al 6082 and Al 6063 aluminium. Samples were welded under different burn off lengths and different rotational speeds. The tensile strength, impact strength, Vickers micro hardness and SEM analysis of the welded joints were determined and evaluated on the results obtained from experimentations, the graphs were plotted. The experimental results indicate that burn off length and rotational speed has a significant effect on the mechanical properties of the joint and it is possible to increase the quality of the welded joint by selecting the optimum burn off lengths and rotational speeds. In the automotive industry, the need to reduce vehicle weight has given rise to extensive research efforts to develop aluminum and magnesium alloys for structural car body parts. In aerospace, the move toward composite airframe structures urged an increased use of formable titanium alloys. In steel research, there are ongoing efforts to design novel damage-controlled forming processes for a new generation of efficient and reliable lightweight steel components. All these materials, and more, constitute today’s research mission for lightweight structures. They provide a fertile materials science research field aiming to achieve a better understanding of the interplay between industrial processing, microstructure development, and the resulting material properties. Advancements in the Processing, Characterization, and Application of Lightweight Materials provides the recent advancements in the lightweight materials processing, manufacturing, and characterization. This book identifies the need for modern tools and techniques for designing lightweight materials and addresses multidisciplinary approaches for applying their use. Covering topics such as numerical optimization, fatigue characterization, and process evaluation, this text is an essential resource for materials engineers, manufacturers, practitioners, engineers, academicians, chief research officers, researchers, students, and vice presidents of research in government, industry, and academia. There has been a great deal of progress in additive manufacturing (AM) during the past two decades and recent developments have been highlighted by many researchers. However, until now, there has been a limit to what is available for beginners in a step-by-step format,
Friction stir welding (FSW) is a highly important and recently developed joining technology that produces a solid phase bond. It uses a rotating tool to generate frictional heat that causes material of the components to be welded to soften without reaching the melting point and allows the tool to move along the weld line. Plasticized material is transferred from the leading edge to trailing edge of the tool probe, leaving a solid phase bond between the two parts.

Friction stir welding: from basics to applications reviews the fundamentals of the process and how it is used in industrial applications. Part one discusses general issues with chapters on topics such as basic process overview, material deformation and joint formation in friction stir welding, inspection and quality control and friction stir welding equipment requirements and machinery descriptions as well as industrial applications of friction stir welding. A chapter giving an outlook on the future of friction stir welding is included in Part one. Part two reviews the variables in friction stir welding including residual stresses in friction stir welding, effects and defects of friction stir welds, modelling thermal properties in friction stir welding and metallurgy and weld performance. With its distinguished editors and international team of contributors, Friction stir welding: from basics to applications is a standard reference for mechanical, welding and materials engineers in the aerospace, automotive, railway, shipbuilding, nuclear and other metal fabrication industries, particularly those that use aluminium alloys. Provides essential information on topics such as basic process overview, materials deformation and joint formation in friction stir welding Inspection and quality control and friction stir welding equipment requirements are discussed as well as industrial applications of friction stir welding Reviews the variables involved in friction stir welding including residual stresses, effects and defects of friction stir welds, modelling thermal properties, metallurgy and weld performanceThis book provides information on complexities, peculiarities, and limitations of various molding processes, and the comparative advantages and disadvantages of the possible plastic products manufacturing techniques, to permit an ideal match of good design and processing. Encyclopedia of Renewable and Sustainable Materials provides a comprehensive
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overview, covering research and development on all aspects of renewable, recyclable and sustainable materials. The use of renewable and sustainable materials in building construction, the automotive sector, energy, textiles and others can create markets for agricultural products and additional revenue streams for farmers, as well as significantly reduce carbon dioxide (CO2) emissions, manufacturing energy requirements, manufacturing costs and waste. This book provides researchers, students and professionals in materials science and engineering with tactics and information as they face increasingly complex challenges around the development, selection and use of construction and manufacturing materials. Covers a broad range of topics not available elsewhere in one resource Arranged thematically for ease of navigation Discusses key features on processing, use, application and the environmental benefits of renewable and sustainable materials Contains a special focus on sustainability that will lead to the reduction of carbon emissions and enhance protection of the natural environment with regard to sustainable materials Joining of Materials and Structures is the first and only complete and highly readable treatment of the options for joining conventional materials and the structures they comprise in conventional and unconventional ways, and for joining emerging materials and structures in novel ways. Joining by mechanical fasteners, integral designed-or-formed-in features, adhesives, welding, brazing, soldering, thermal spraying, and hybrid processes are addressed as processes and technologies, as are issues associated with the joining of metals, ceramics (including cement and concrete) glass, plastics, and composites (including wood), as well as, for the first time anywhere, living tissue. While focused on materials issues, issues related to joint design, production processing, quality assurance, process economics, and joint performance in service are not ignored. The book is written for engineers, from an in-training student to a seasoned practitioner by an engineer who chose to teach after years of practice. By reading and referring to this book, the solutions to joining problems will be within one's grasp. Key Features: Unprecedented coverage of all joining options (from lashings to lasers) in 10 chapters Uniquely complete coverage of all materials, including living tissues, in 6 chapters Richly illustrated with 76 photographs and 233 illustrations or plots Practice Questions and Problems for use as a text or for reviewing to aid for comprehension * Coverage all of major joining technologies, including welding, soldering, brazing, adhesive and cement bonding, pressure fusion, riveting, bolting, snap-fits, and more * Organized by both joining techniques and materials types, including metals, non-metals, ceramics and glasses, composites, biomaterials, and living tissue * A n ideal reference for design engineers, students, package and product designers, manufacturers, machinists, materials scientistsThe second book in the Plastic Injection Molding series addresses the basics and the fine points of plastics materials
and product design phases of the thermoplastic injection molding process. Complex technical matter is presented in clear, sequential narrative bites. The primary objective of the Asia-Pacific Conference on Engineering Plasticity and Its Applications (AEPA) is to provide a free forum for exchanging ideas and introducing the latest research findings in the field of engineering plasticity. This conference is unique among the related conferences in that it provides a forum for all fields of plasticity so that multi-disciplinary research works are encouraged. This proceedings volume consists of papers presented at AEPA 2008, and covers the following categories in all fields of engineering plasticity: constitutive modeling; damage, fracture, fatigue and failure; dynamic loading and crash dynamics; engineering applications and case studies; experimental and numerical techniques; molecular dynamics; nano, meso, micro and crystal plasticity; phase transformations; plastic instability and strain localization; plasticity in advanced materials; plasticity in materials processing technology; plasticity in tribology; porous, cellular and composite materials; structural plasticity; superplasticity; and time-dependent deformation. Ranging from nanoscale to macroscale applications of engineering plasticity, this book touches upon fields as diverse as mechanical engineering, materials science, physics, chemistry and civil engineering.

Friction welding (FW) is a fairly recent technique that utilizes a non-consumable welding tool to generate frictional heat and plastic deformation at the welding location, thereby affecting the formation of a joint while the material is in solid state. The principal advantage of frictional welding, being a solid state process, low distortion, absence of melt-related defects and high joint strength, even in those alloys that are considered non-weldable by conventional welding techniques. The technique can produce joints utilizing equipment based on traditional machine tool technologies, and it has been used to weld a variety of similar and dissimilar alloys as well as for welding metal matrix composites and for repairing the existing joints. Replacement of fastened joints with FW welded joints can lead to significant weight and cost savings, attractive propositions for many industries. This document reviews some of the FW work performed to date, presents a brief account of mechanical testing of welded joints, tackles the issue of generating joint allowables, and offers some remarks and observation.

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