Epub free Fundamentals composites manufacturing materials applications [PDF]

Fundamentals of Composites Manufacturing, Second Edition Composites Manufacturing Principles of the Manufacturing of Composite Materials Manufacturing of Polymer Composites Advances in Composites Manufacturing and Process Design Advanced Composites Manufacturing Process Modeling in Composites Manufacturing Manufacturing Processes for Advanced Composites Handbook of Composite Fabrication Composite Manufacturing Technology Composite Materials Fundamentals of Composites Manufacturing Principles of the Manufacturing of Composite Materials Polymers and Composites Manufacturing Design and Manufacture of Structural Composites Fiber-Reinforced Composites Composites for Automotive, Truck and Mass Transit Wood Composites Drilling of Composite Materials Carbon Fibre Composites Manufacturing Technology and Applications Fundamentals of Composite Manufacturing: Materials, Methods and Applications Composite Materials: Advances in Materials Science and Engineering Futuristic Composites Enabling Automation of Composite Manufacturing through the Use of Off-The-Shelf Solutions Handbook of Composites from Renewable Materials, Design and Manufacturing Ceramic Matrix Composites Fiber-reinforced Composites CT Scan Generated Material Twins for Composites Manufacturing in Industry 4.0 Machining Technology for Composite Materials Additive Manufacturing of Aerospace Composite Structures Economics of Composites Metal Matrix Composites ASC Series on Advances in Composite Materials Green Composites Design and Manufacture of Textile Composites Hybrid Fiber Composites A Guide to Modeling Thermoplastic Composite Manufacturing Processes Flow and Rheology in Polymer Composites Manufacturing Glass Fibre-Reinforced Polymer Composites Green Composites Manufacturing

Fundamentals of Composites Manufacturing, Second Edition

2008

describes advances key information case studies and examples that can broaden your knowledge of composites materials and manufacturing methods this text deals with composites manufacturing methods providing tips for getting the best results that weigh the required material properties against cost and production efficiency an instructor s guide is also available

Composites Manufacturing

2002

annotation mazumdar draws on his experiences as an author lecturer educator and head of a service oriented company providing various products to the composite materials industry in writing this textbook on composites manufacturing the book takes the reader step by step from raw material selection to final part fabrication and recycling specific chapter topics include raw materials for part fabrication material selection guidelines product development design for manufacturing manufacturing techniques process models production planning and manufacturing instructions joining of composite materials machining and cutting of composites cost estimation and recycling of composites the text is suitable for students engineers and researchers working in the composite materials field annotation c book news inc portland or booknews com

Principles of the Manufacturing of Composite Materials

2009

based on 15 years of composites manufacturing instruction the principles of the manufacturing of composite materials is the first text to offer both a practical and analytic approach to composite manufacturing processes it ties together key tools for analyzing the mechanics of composites with the processes whereby composite products are fabricated whether by hand lay up or through automated processes the book outlines the principles of chemistry physics materials science and engineering and shows how these are connected to the design and production of a variety of composites primarily polymeric it thus provides analytic quantitative tools to answer the questions of why certain materials are linked with specific processes and why products are manufactured by one process rather than another all phases of matrix material formation are explained as are practical design details for fabrics autoclaving filament winding pultrusion liquid composite molding hand techniques joints and joint bonding and more a special section is devoted to nanocomposites the book includes exercises for university students and practitioners

Manufacturing of Polymer Composites

2018-04-27

the potential application areas for polymer composites are vast while techniques and methodologies for composites design are relatively well established the knowledge and understanding of post design issues lag far behind this leads to designs and eventually composites with disappointing properties and unnecessarily high cost thus impeding a wider industrial acceptance of polymer composites manufacturing of polymer composites completely covers pre and post design issues while the book enables students to become fully comfortable with composites as a possible materials choice it also provides sufficient knowledge about manufacturing related issues to permit them to avoid common pitfalls and unmanufacturable designs the book is a fully comprehensive text covering all commercially significant materials and manufacturing techniques while at the same time discussing areas of research and development that are nearing commercial reality

Advances in Composites Manufacturing and Process Design

2015-07-29

the manufacturing processes of composite materials are numerous and often complex continuous research into the subject area has made it hugely relevant with new advances enriching our understanding and helping us overcome design and manufacturing challenges advances in composites manufacturing and process design provides comprehensive coverage of all processing techniques in the field with a strong emphasis on recent advances modeling and simulation of the design process part one reviews the advances in composite manufacturing processes and includes detailed coverage of braiding knitting weaving fibre placement draping machining and drilling and 3d composite processes there are also highly informative chapters on thermoplastic and ceramic composite manufacturing processes and repairing composites the mechanical behaviour of reinforcements and the numerical simulation of composite manufacturing processes are examined in part two chapters examine the properties and behaviour of textile reinforcements and resins the final chapters of the book investigate finite element analysis of composite forming numerical simulation of flow processes pultrusion processes and modeling of chemical vapour infiltration processes outlines the advances in the different methods of composite manufacturing processes provides extensive information on the thermo mechanical behavior of reinforcements and composite prepregs reviews numerical simulations of forming and flow processes as well as pultrusion processes and modeling chemical vapor infiltration

Advanced Composites Manufacturing

1997-08-01

a state of the art look at advanced composites processing and manufacturing from leading academic and industry experts advanced composites manufacturing combines cutting edge coverage of the scientific fundamentals of composites processing with an in depth treatment of the major manufacturing processes for advanced composite materials complete with important information on such key issues as new processing areas manufacturing process control deformation forming and cost control strategies this unique reference is essential reading for materials scientists researchers and engineers across a range of industry sectors topics covered include the processing science of reactive polymer composites the processing science of thermoplastic composites the elastic deformation of fiber bundles processing of textile preforms the autoclave processing of composites pultrusion of composites forming of advanced composites filament winding process model for thermosetting matrix composites liquid composite molding process control of thermosetting composites joining of composites cost automation and design

Process Modeling in Composites Manufacturing

2010-07-14

there is a wealth of literature on modeling and simulation of polymer composite manufacturing processes however existing books neglect to provide a systematic explanation of how to formulate and apply science based models in polymer composite manufacturing processes process modeling in composites manufacturing second edition provides tangible m

Manufacturing Processes for Advanced Composites

2003-12-18

one of very few books available to cover this subject area a practical book with a wealth of detail this book covers the major manufacturing processes for polymer matrix composites with an emphasis on continuous fibre reinforced composites it covers the major fabrication processes in detail very few books cover the details of fabrication and assembly processes for composites this book is intended for the engineer who wants to learn more about composite processing any one with some experience in composites should be able to read it the author who has 34 years experience in the aerospace industry has intentionally left out mathematical models for processes so the book will be readable by the general engineer it differs from other books on composites manufacturing in focussing almost solely on manufacturing processes while not attempting to cover materials test methods mechanical properties and other areas of composites

Handbook of Composite Fabrication

2001

this volume is a concise reference book for someone who has just started working in the composites field as well as for technologists already active in the area the chapters in this handbook have been written by experts in their fields and so the information on a particular subject area can be regarded as state of the art each chapter is fully referenced illustrated and includes case studies and applications of polymer composite fabrications

Composite Manufacturing Technology

2012-12-06

some years ago in paisley scotland the international conference on composite materials headed by professor i marshall took place during the conference i presented a paper on the manufacturing and properties of the soviet union s composite materials soviet industry had made great achievements in the manufacturing of composite materials for aerospace and rocket applications for example the fraction of composites predominantly carbon fibre reinforced plastics in the large passenger aircrafts tu 204 and 11 86 is 12 15 of the structure weight the percentage by weight share of composites in military aircraft is greater and the fraction of composites organic fibre reinforced plastics used in military helicopters exceeds a half of the total structure weight the nose parts of most rockets are produced in carbon carbon materials in the soviet spacecraft buran many fuselage tubes are made of boron aluminium composites carbon aluminium is used for space mirrors and gas turbine blades these are just a few examples of applications many participants at the paisley conference suggested that the substantial soviet experience in the field of composite materials should be distilled and presented in the form of a comprehensive reference publication so the idea of the preparation and publication of a six volume work soviet advanced composites technology edited by professor i marshall and me was born

Composite Materials

2005

this volume reviews a wide range of processing methods which are currently being used for plastics and composites special focus lies on advancements in automation in development of machines and new software for modeling new materials for ease in manufacturing and strategies to increase productivity

Fundamentals of Composites Manufacturing

2008

design and manufacture of structural composites provides an overview of the main manufacturing challenges encountered when processing fibre reinforced composite materials composites are

unique in that the material is created at the same time as the structure forming a very close link between the constituents the manufacturing process and the resulting mechanical performance this book takes an in depth look at material choices and the intermediate steps required to convert different fibre and matrix combinations into finished products it provides an insight into recent developments for each of the manufacturing processes covered addressing design cost rate and mechanical performance topics covered include an introduction to composite materials material preforming and conversion moulding digital design and sustainability which addresses waste reduction disassembly and fibre recovery this book has been developed primarily as a teaching resource with contributions from leading experts in the field the content has evolved from courses given by the authors to mechanical engineering and materials science students at both undergraduate and postgraduate levels it also draws upon experience gained during research projects and from leading industry experts it therefore provides non specialists with a valuable introduction to composite manufacturing techniques helping to determine the most suitable manufacturing routes and to understand the challenges associated with the production of high performance composite components provides an overview of the most common manufacturing routes for fibre reinforced composites including the influence of the manufacturing route on mechanical properties production volume and component cost discusses recent advances in composite manufacturing including the use of automation process simulation digital factories and solutions to improve sustainability looks at where the composites sector is heading and discusses some of the challenges faced by end users looking to scale up production and increase the uptake of fibre reinforced composites for structural applications

Principles of the Manufacturing of Composite Materials

2009

this edition provides comprehensive discussions of all aspects of fiber reinforced composites including materials mechanics properties test methods manufacturing and design

Polymers and Composites Manufacturing

2020-02-24

this textbook is a step by step introduction to nanocomposite materials using methods familiar to materials science students and engineers it covers all nanoparticle types including flakes nanotubes and nanoparticulates it provides the basics for composites with reinforcements ranging from microns to nanometers

Design and Manufacture of Structural Composites

2022-11-30

wood composites as part of wood engineering materials has been reaching a constant developing trend being used on a wide range of applications and becoming worldwide as a very promising alternate material face to traditional building materials such as concrete metal and plastics in this part of the series are treated aspects among which advances functionalities in laminates the activation of natural fibres the natural matrix and others industrials manufacturing research advances for wood material as composite

Fiber-Reinforced Composites

2008

nowadays the use of composite materials has increased in various areas of science and technology due to their special properties namely for these application in aircraft automotive defence and aerospace industries as well others advanced industries drilling is a frequently practised machining process in modern industry owing to the need for component assembly in composite structures this book aims to provide the research and review studies in drilling of composite materials the first three chapters provide information on delamination and damage reduction in drilling of composite materials the following two chapters deal with influence of machining parameters on the delamination the sixth chapter is focused on modelling of drilling aluminium matrix composites using artificial neural networks the chapter seventh is dedicated study of analysis of delamination in drilling wood composite medium density fibreboards finally the last chapter of this book is focused on studies on composite drilling the state of the art the present research book can be used as for final undergraduate engineering course for example mechanical manufacturing materials etc or as a subject on machining composites at the postgraduate level also this research book can serve as a useful reference for academics manufacturing and materials researchers manufacturing materials and mechanical engineers professional in composites technology and related industries

Composites for Automotive, Truck and Mass Transit

2011

a comprehensive reference manual and introduction to composite materials and manufacturing processes carbon fibre composites manufacturing technology and applications provides up to date information on the use of carbon fibre composite materials for a range of established and emerging structural applications broad in scope this unique volume covers component design materials

selection molding processes manufacturing automation joining and assembly techniques cost considerations and more author andrew mills a recognized design specialist with extensive practical experience in the field thoroughly describes the manufacture of advanced lightweight composite components and reviews their application in the aerospace automobile motorsport sports equipment renewable energy and other fields with a focus on the practical aspects of high performance composites manufacturing and applications the text discusses the use of cost efficient materials and manufacturing technology for high performance applications such as commercial and military aircraft sports equipment super cars wind turbine blades boat structures and various others detailed chapters examine the advantages and disadvantages of each manufacturing process covered material tolerances and defects design guidelines for efficient manufacturing emerging manufacturing technology and materials and process performance evaluation combines design considerations for components and structures with materials selection and manufacturing technology covers the use of new lower cost materials and manufacturing techniques in emerging application sectors includes photographs and descriptions of current applications including racing cars yachts bridges bicycles and wave and tidal generators features case studies of design requirements materials and process selection and the benefits and challenges of various applications presents materials design data tables of approximate cost and figures and flow diagrams of production processes carbon fibre composites manufacturing technology and applications is a valuable reference for materials design and manufacturing engineers and is an excellent textbook for advanced undergraduate and graduate courses materials mechanical aerospace automotive and manufacturing engineering

Wood Composites

2017-09-11

a composite material is formed by joining two or more materials with different physical and chemical properties to form a new material with desired characteristics the new material formed might be stronger and lighter than the constituent materials some everyday examples of composites are papier mâché plywood and translucent concrete on the basis of the type of matrix they can be classified into metal ceramic matrix composite metal matrix composite sandwich structured composite and monolithic structured composite manufacturing processes for composites include tufting winding and z pinning carbon fibre composites and kevlar are being extensively used in automobile aerospace and military applications to create lightweight machines and equipment this book traces the progress of this field and highlights some of its key concepts and applications it will also provide interesting topics for research which interested readers can take up a number of latest researches have been included in this book to keep the readers up to date with the global concepts in this area of study

Drilling of Composite Materials

2009

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

Carbon Fibre Composites Manufacturing Technology and Applications

2022-03-07

composite materials offer an appealing combination of low weight and high strength that is especially sought after in high performance applications the use of composite materials has and is continuing to increase and the use of the material has been shown to provide substantial weight savings in for example aircraft design with an increased use of composite materials follows an increased demand for cost efficient manufacturing methods composite products are in many cases manufactured either by manual operations or by the use of complex automated solutions associated with high investment costs the objective for this research is to explore an approach to develop automated composite manufacturing based on commercially available off the shelf solutions as an alternative to the existing automated solutions for composite manufacturing the research which was carried out in collaboration with industrial partners within the aerospace sector is based on a demonstrator centered research approach three conceptual demonstrators focusing on three different manufacturing methods and a number of physical demonstrators are used to show that off the shelf solutions can be used for automated manufacturing of composite products two aspects that affect if it is possible to use off the shelf solutions for automated composite manufacturing are the rigorous quality standards used by the aerospace industry and the great variety in product properties and material properties that is associated with composite manufacturing the advantages in using off the shelf solutions has shown to be that the solutions generally are associated with low investments and that published information about the solutions and the solutions themselves is generally available for evaluation and testing when working with the demonstrators it has been shown to be useful to break down a manufacturing system into basic tasks and consider off the shelf solutions for each particular task this approach facilitates the search for a suitable off the shelf solution to solve a particular task however each of the separate tasks can affect other areas of the manufacturing system and an overall systems perspective is required to find solutions that are compatible with the entire manufacturing system

Fundamentals of Composite Manufacturing: Materials, Methods and Applications

1989

this unique multidisciplinary 8 volume set focuses on the emerging issues concerning synthesis characterization design manufacturing and various other aspects of composite materials from renewable materials and provides a shared platform for both researcher and industry the handbook of composites from renewable materials comprises a set of 8 individual volumes that brings an interdisciplinary perspective to accomplish a more detailed understanding of the interplay between the synthesis structure characterization processing applications and performance of these advanced materials the handbook comprises 169 chapters from world renowned experts covering a multitude of natural polymers reinforcement fillers and biodegradable materials volume 2 is solely focused on the design and manufacturing of renewable materials some of the important topics include but not limited to design and manufacturing of high performance green composites manufacturing of high performance biomass based polyesters by rheological approach components design of fibrous composite materials design and manufacturing of bio based sandwich structures design and manufacture of biodegradable products from renewable resources manufacturing and characterization of quicklime filled metal alloy composites for single row deep groove ball bearing manufacturing of composites from chicken feathers and poly vinyl chloride production of porous carbons from resorcinol formaldehyde gels applications composites using agricultural wastes manufacturing of rice wastes based natural fiber polymer composites from thermosetting vs thermoplastic matrices thermoplastic polymeric composites natural fiber reinforced pla composites rigid closed cell pur foams containing polyols derived from renewable resources preparation and application of the composite from alginate recent developments in biocomposites of bombyx mori silk fibroin design and manufacturing of natural fiber synthetic fiber reinforced polymer hybrid composites natural fiber composite strengthening solution for structural beam component for enhanced flexural strength high pressure resin transfer molding of epoxy resins from renewable sources cork based structural composites the use of wheat straw as an agricultural waste in composites for semi structural applications and design manufacturing of sustainable composites

Composite Materials: Advances in Materials Science and Engineering

2021-11-16

composite materials are engineered from two or more constituents with significantly altered physical or chemical properties within the finished structure due to their special mechanical and physical properties they have the potential to replace conventional materials this book written by

experts from all over the world presents fundamentals and recent advances on ceramic matrix composites

Futuristic Composites

2018-09-26

this book highlights a novel and robust platform in the form of in situ characterization setup for creating x ray computed tomography xct based textile material twins in this hybrid experimental numerical platform xct images of different complex fibrous reinforcements at different levels of compaction are acquired the images are converted into computational models for resin flow simulations the capabilities of this hybrid framework are applied to a variety of reinforcements used in liquid composite molding processes such as 2d 3d fabrics and dry tapes this book is a milestone in the development of virtual manufacturing protocols using material twins of textiles providing a step closer to the digitalization of advanced composites used in manufacturing processes for industry 4 0

Enabling Automation of Composite Manufacturing through the Use of Off-The-Shelf Solutions

2014-11-10

machining processes play an important role in the manufacture of a wide variety of components while the processes required for metal components are well established they cannot always be applied to composite materials which instead require new and innovative techniques machining technology for composite materials provides an extensive overview and analysis of both traditional and non traditional methods of machining for different composite materials the traditional methods of turning drilling and grinding are discussed in part one which also contains chapters analysing cutting forces tool wear and surface quality part two covers non traditional methods for machining composite materials including electrical discharge and laser machining among others finally part three contains chapters that deal with special topics in machining processes for composite materials such as cryogenic machining and processes for wood based composites with its renowned editor and distinguished team of international contributors machining technology for composite materials is an essential reference particularly for process designers and tool and production engineers in the field of composite manufacturing but also for all those involved in the fabrication and assembly of composite structures including the aerospace marine civil and leisure industry sectors provides an extensive overview of machining methods for composite materials chapters analyse cutting forces tool wear and surface quality cryogenic machining and processes for wood based composites are discussed

Handbook of Composites from Renewable Materials, Design and Manufacturing

2017-03-03

additive manufacturing of aerospace composite structures fabrication and reliability introduces the reader to the current state of technologies involved in processing and design of polymer reinforced fiber composites using additive manufacturing s automated fiber placement methods through ten seminal sae international papers currently the material layup strategy in terms of process selection and manufacturability is usually not prioritized in the design phase engineers do not have a good way to see how their design choices can affect the manufacturing process beyond their initial structural level considerations the result is typically a large amount of experimental testing necessary to qualify the materials and structures typified in the classical building block approach such an environment makes mistakes difficult to solve and should redesign be required obtaining reliable information is hard to piece together additive manufacturing of aerospace composite structures fabrication and reliability approaches the question of quality in these structures from a hands on solution driven perspective

Ceramic Matrix Composites

2016-06-20

this essential information captures the state of the composites industry to assist engineering technical professionals in charting a course for achieving economic success the material characteristics of composites their applications and complex composites manufacturing processes depend on many factors these are all fully considered and presented to meet the challenges that face this marketplace the expert panel of writers from various industry segments i e commercial military aerospace wind energy automotive and bicycle industries address fundamental topics and explore the affordability of composites from raw material to end of life disposal costs with skilled perspectives that include material characteristics and economics of composite structure complex manufacturing and specifics of assembly methods applications for composites product and human health safety and environmental impacts the authors provide strong basic economics concepts that are directly applied to the composites industry the content conveys both the reality of the industry as well as the trends and constantly emerging challenges that impact the cost of composites and are necessary for return on investment as well as enabling the full potential of composites

Fiber-reinforced Composites

1988

metal matrix composites mmc s have found an increased use in various industries due to their special mechanical and physical properties they are a composite material with at least two constituent parts one being a metal and are made by dispersing a reinforcing material into a metal matrix the markets are telecommunications automotive power semiconductor opto electronics military and aerospace heavy transportation space systems and satellites medical and industrial lighting applications within these markets include microwave micro electronic packaging laser diode hb led s and advanced radar

CT Scan Generated Material Twins for Composites Manufacturing in Industry 4.0

2020-10-06

contains 16 original papers on the processing and manufacturing of thermoset and thermoplastic composites in this book nine chapters cover modeling and process parameters for many shapes of thermosets using rtm vartm and crtm

Machining Technology for Composite Materials

2011-11-28

textile composites encompass a rather narrow range of materials based on three dimensional reinforcements produced using specialist equipment this book describes the design manufacture and applications of textile composites the intention is to describe the broad range of polymer composite materials with textile reinforcements from woven and non crimp commodity fabrics to 3 d textiles and their applications the book gives particular attention to the modelling of textile structures composites manufacturing methods and subsequent component performance this practical book is an invaluable guide for manufacturers of polymer composite components end users and designers structural materials researchers and textile manufacturers involved in the development of new products with textile composites

Additive Manufacturing of Aerospace Composite Structures

2017-05-20

fiber reinforced composites are exceptionally versatile materials whose properties can be tuned to

exhibit a variety of favorable properties such as high tensile strength and resistance against wear or chemical and thermal influences consequently these materials are widely used in various industrial fields such as the aircraft marine and automobile industry after an overview of the general structures and properties of hybrid fiber composites the book focuses on the manufacturing and processing of these materials and their mechanical performance including the elucidation of failure mechanisms a comprehensive chapter on the modeling of hybrid fiber composites from micromechanical properties to macro scale material behavior is followed by a review of applications of these materials in structural engineering packaging and the automotive and aerospace industries

Economics of Composites

2015-09-17

models and experiments for faster less expensive manufacture of thermoplastic partsfocused on simulating thermal defects in thermoplasticstechniques for better molds tooling and equipment book explains methods and coding to create fem based models to optimize process variables and predict dimensional distortions during the manufacture of thermoplastic matrix composite parts after investigating defects such as spring in caused by thermal inconsistencies during manufacture the text offers a step by step approach to simulating and predicting the magnitude of distortion via readily available fe codes models are validated by testing using the example of a multi staged roll formed continuous thermoplastic woven laminate which can be readily extended to a variety of mold geometries information in this book is intended to reduce the need for costly and time consuming re tooling in thermoplastic parts design

Metal Matrix Composites

2014-10-24

this book is aimed at scientists and practicing engineers who are currently exploring or would like to explore the complexity of fabrication processes of polymer composites it deals with the mechanics and modeling aspects of discontinuous and continuous fiber composites and familarizes the engineer with the critical and fundamental issues of material processing and transport phenomena in polymeric composites and their applications in modeling and simulating specific composite manufacturing processes divided into three parts part a deals with the deformation science or rheology of these filled materials it clearly shows the need to characterize their flow behavior before one can draw any conclusions about its processibility during manufacturing part b focuses on development of constitutive equations to describe the flow and deformation behavior of such materials under external processing conditions part c discusses the mathematical models for selected composite processes and their implementation into a computer simulation to analyze the

process behavior the processes represented in part c cover a cross section of important manufacturing processes and maintain a balance between processes that use short fibers and continuous fibrous materials

ASC Series on Advances in Composite Materials

2013

composite materials are engineered materials made from two or more constituents with significantly different physical or chemical properties which remain separate on a macroscopic level within the finished structure due to their special mechanical and physical properties they have the potential to replace conventional materials

Green Composites

2017

in today s society researchers are more focused on cleaner materials production for environmental sustainability this approach aims at reducing waste and the development of materials with enhanced properties and functionality this book focuses on optimizing manufacturing processes for sustainable composite materials it discusses optimum utilization of resources by using minimum effort to save cost and energy

Design and Manufacture of Textile Composites

2006-01-05

Hybrid Fiber Composites

2020-07-02

A Guide to Modeling Thermoplastic Composite Manufacturing Processes

2014-09-09

Flow and Rheology in Polymer Composites Manufacturing

1994-02-17

Glass Fibre-Reinforced Polymer Composites

2020-05-05

Green Composites Manufacturing

2024-05-20

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