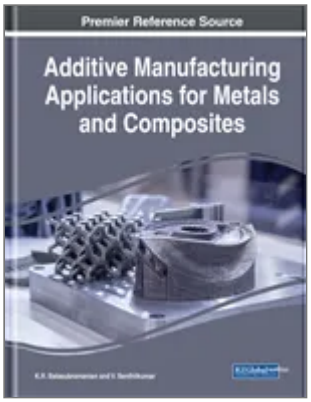


Metal-Arc Welding Technologies for Additive Manufacturing of Metals and Composites

Fredrick M. Mwema (niversity of Johannesburg, South Africa & Dedan Kimathi University of Technology, Kenya) and Esther T. Akinlabi (Pan African University for Life and Earth Sciences, Ibadan, Nigeria)

Source Title: Additive Manufacturing Applications for Metals and Composites (/book/additive-manufacturing-applications-metals-composites/244329)

Pages: 12

DOI: 10.4018/978-1-7998-4054-1.ch005

Abstract

Additive manufacturing (AM) technology has been extensively embraced due to its capability to produce components at lower cost while achieving complex detail. There has been considerable emphasis on the development of low-cost AM technologies and investigation of production of various materials (metals, polymers, etc.) through AM processes. The most developed techniques for AM of products include stereolithography (SLA), fused deposition modelling (FDM), laser technologies, wire-arc welding techniques, and so forth. In this chapter, a review of the wire-arc welding-based technologies for AM is provided in two-fold perspective: (1) the advancement of the arc welding process as an additive manufacturing technology and (2) the progress in the production of metal/alloys and composites through these technologies. The chapter will provide important insights into the application of arc welding technology in additive manufacturing of metals and composites for advanced applications in the era of Industry 4.0.

Chapter Preview

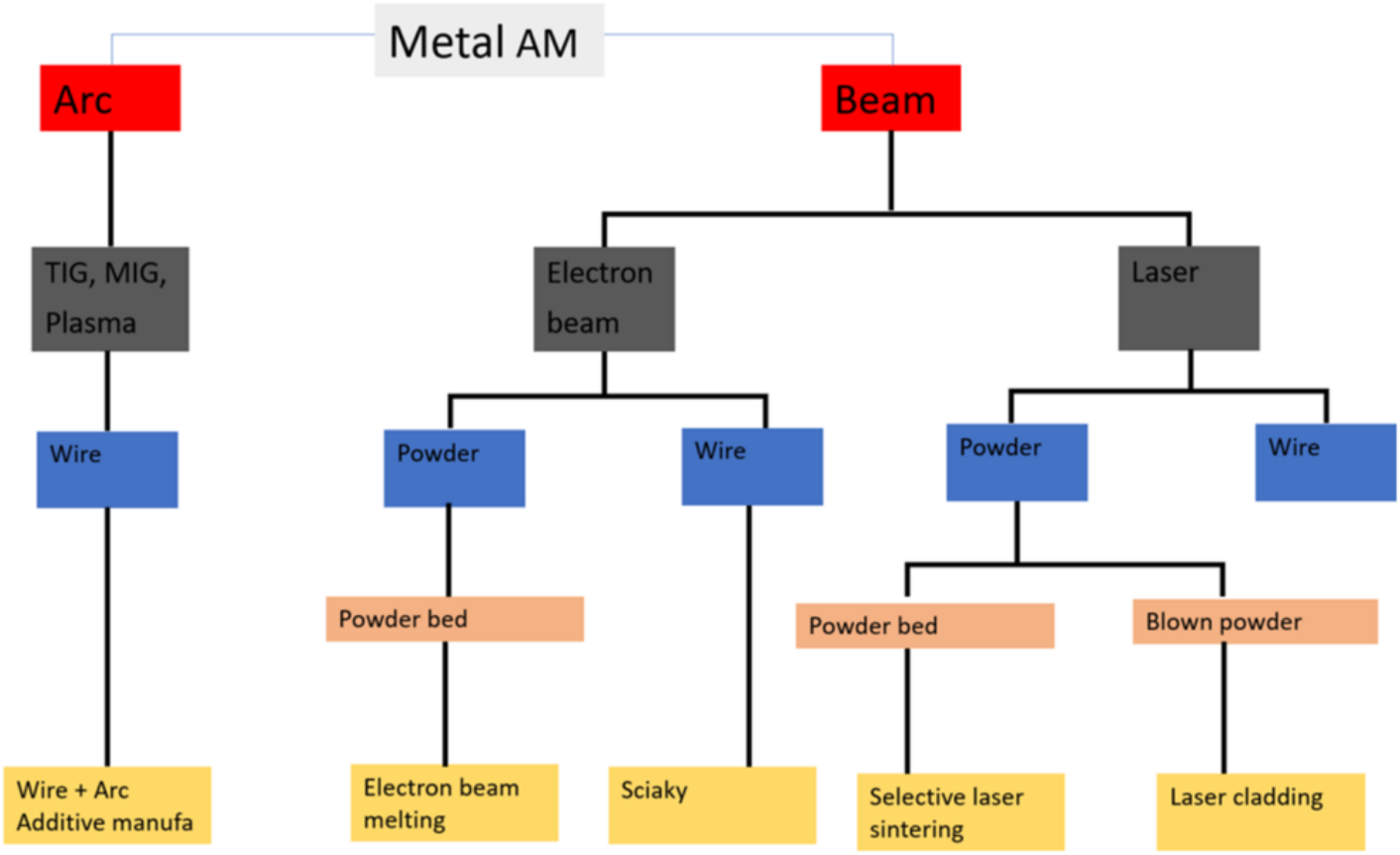
Top

Introduction

The additive manufacturing (AM) technology (also known as rapid prototyping, additive process and 3D printing), which involves production of 3D parts via layering of materials, has advanced over time. As such, several techniques are in existence for AM processing of metals, composites, and polymers. The choice of the manufacturing technology depends on the functionality, cost and dimensional accuracy of the 3D components. In most existing market problems require manufacturing solutions which can produce 3D parts tight dimensional and shape accuracy (Klobčar, Lindič, & Bušić, 2018). Additive manufacturing of plastics and polymers, through fused deposition modelling (FDM), (such as PLA, ABS, graphene-doped PLA, etc.) is the most developed technology. The plastic 3D printers have become so affordable such that most households in Western world and Asia own at least one. The FDM technology is user-friendly, cheap and simple to learn (Mwema, & Akinlabi, 2020). However, the technology is challenged by dimensional accuracy, high roughness and lack of finer details, although continuous research is ongoing on improvement for FDM for production of 3D parts for advanced applications such as in biomedical, etc. (Katti, Sharma, & Katti, 2017).

There are several methods in existence for metal and composite additive manufacturing and these methods are classified based on the source of heat and they include, beam (laser and electron beam) and arc (tungsten inert gas (TIG), metal arc inert gas (MIG), and Plasma arc welding (PAW)) (Klobčar et al., 2018). A chart detailing these classifications is shown in Figure 1, although metal AM process can further be classified as reported by Ding et al. (Ding, Pan, Cuiuri, & Li, 2015). A lot of work is currently being advanced in laser-based AM of parts through selective laser sintering, laser metal deposition and laser cladding (Graf, Marko, Petrat, Gumenyuk, & Rethmeier, 2018; Mahamood, Akinlabi, Shukla, & Pityana, 2012). However, laser-based technologies are expensive and require extensive knowledge and experience as compared to arc-based technologies. The metal-arc welding additive technology proves to be easily adopted, especially in the developing world due to the simplicity and availability of the systems. Additionally, the method allows for fabrication of larger parts as compared to laser and electron beam AM processes. In this article therefore, the focus is on the metal-arc welding-based additive manufacturing technology for fabrication of metallic and composite parts, with emphasis on the various techniques and progress in research on the technology. The method is also evaluated for its future and place in Industry 4.0 for fabrication of high-end products.

Figure 1. Classifications of additive manufacturing methods for metal fabrication (https://igiprodst.blob.core.windows.net:443/source-content/9781799840541_244329/978-1-7998-4054-1.ch005.f01.png?sv=2015-12-11&sr=c&sig=c7Z5ygNGlUfSnB8Pl7vB4TCXMdRTLAeYi31Z%2FLyRsBA%3D&se=2020-08-09T08%3A55%3A56Z&sp=r)



(adapted from Klobčar et al., 2018).

Complete Chapter List

Search this Book: Full text search terms

Reset

Table of Contents	View Full PDF (/pdf.aspx?tid=258172&ptid=244329&ctid=15&t=Table of Contents&isxn=9781799840541)
Detailed Table of Contents	View Full PDF (/pdf.aspx?tid=258173&ptid=244329&ctid=15&t=Detailed Table of Contents&isxn=9781799840541)

Preface

View Full PDF (/pdf.aspx?tid=258174&ptid=244329&ctid=15&t=Preface&isxn=9781799840541)

Chapter 1 **$37.50**

Introduction to Additive Manufacturing (/chapter/introduction-to-additive-manufacturing/258175) (pages 1-24)

K. R. Balasubramanian, V. Senthilkumar, Divakar Senthilvel

Sample PDF (/viewtitlesample.aspx?id=258175&ptid=244329&t=Introduction to Additive Manufacturing&isxn=9781799840541)

Chapter 2 **$37.50**

Processes and Application in Additive Manufacturing: Practices in Aerospace, Automobile, Medical, and Electronic Industries (/chapter/processes-and-application-in-additive-manufacturing/258176) (pages 25-47)

Ajit Behera

Sample PDF (/viewtitlesample.aspx?id=258176&ptid=244329&t=Processes and Application in Additive Manufacturing: Practices in Aerospace, Automobile, Medical, and Electronic Industries&isxn=9781799840541)

Chapter 3 **$37.50**

Additive Manufacturing of Nickel-Based Super Alloys for Aero Engine Applications : SLM of Inconel (/chapter/additive-manufacturing-of-nickel-based-super-alloys-for-aero-engine-applications-/258177) (pages 48-70)

Raja A., Mythreyi O. V., Jayaganthan R.

Sample PDF (/viewtitlesample.aspx?id=258177&ptid=244329&t=Additive Manufacturing of Nickel-Based Super Alloys for Aero Engine Applications : SLM of Inconel&isxn=9781799840541)

Chapter 4 **$37.50**

Insights on Laser Additive Manufacturing of Invar 36 (/chapter/insights-on-laser-additive-manufacturing-of-invar-36/258178) (pages 71-93)

Mostafa Yakout, M. A. Elbestawi

Sample PDF (/viewtitlesample.aspx?id=258178&ptid=244329&t=Insights on Laser Additive Manufacturing of Invar 36&isxn=9781799840541)

Chapter 5 **$37.50**

Metal-Arc Welding Technologies for Additive Manufacturing of Metals and Composites (/chapter/metal-arc-welding-technologies-for-additive-manufacturing-of-metals-and-composites/258179) (pages 94-105)

Fredrick M. Mwema, Esther T. Akinlabi

Sample PDF (/viewtitlesample.aspx?id=258179&ptid=244329&t=Metal-Arc Welding Technologies for Additive Manufacturing of Metals and Composites&isxn=9781799840541)

Chapter 6 **$37.50**

Wire + Arc Additive Manufacturing of Metals: State of the Art and Challenges (/chapter/wire--arc-additive-manufacturing-of-metals/258180) (pages 106-126)

Krishna Kishore Mugada, Aravindan Sivanandam, Ravi Kumar Digavalli

Sample PDF (/viewtitlesample.aspx?id=258180&ptid=244329&t=Wire + Arc Additive Manufacturing of Metals: State of the Art and Challenges&isxn=9781799840541)

Chapter 7 **$37.50**

Additive Manufacturing of Multi-Material and Composite Parts (/chapter/additive-manufacturing-of-multi-material-and-composite-parts/258181) (pages 127-146)

V. Senthilkumar, Velmurugan C., K. R. Balasubramanian, M. Kumaran

Sample PDF (/viewtitlesample.aspx?id=258181&ptid=244329&t=Additive Manufacturing of Multi-Material and Composite Parts&isxn=9781799840541)

Chapter 8 **$37.50**

Direct Laser Fabrication of Compositionally Complex Materials: Challenges and Prospects (/chapter/direct-laser-fabrication-of-compositionally-complex-materials/258182) (pages 147-163)

Jithin Joseph

Sample PDF (/viewtitlesample.aspx?id=258182&ptid=244329&t=Direct Laser Fabrication of Compositionally Complex Materials: Challenges and Prospects&isxn=9781799840541)

Chapter 9 **$37.50**

What Is Design for Additive Manufacturing (DfAM)? (/chapter/what-is-design-for-additive-manufacturing-dfam/258183) (pages 164-186)

Seung Hwan Joo, Sung Mo Lee, Jin Ho Yoo, Hyeon Jin Son, Seung Ho Lee

Sample PDF (/viewtitlesample.aspx?id=258183&ptid=244329&t=What Is Design for Additive Manufacturing (DfAM)?&isxn=9781799840541)

Chapter 10 **$37.50**

Optimization and Simulation of Additive Manufacturing Processes: Challenges and Opportunities – A Review (/chapter/optimization-and-simulation-of-additive-manufacturing-processes/258184) (pages 187-209)

Deepak Kumar Sahini, Joyjeet Ghose, Sanjay Kumar Jha, Ajit Behera, Animesh Mandal

Sample PDF (/viewtitlesample.aspx?id=258184&ptid=244329&t=Optimization and Simulation of Additive Manufacturing Processes: Challenges and Opportunities – A Review&isxn=9781799840541)

Chapter 11 **$37.50**

Simulation Applications for Industrial and Medical Products Additive Manufacturing (/chapter/simulation-applications-for-industrial-and-medical-products-additive-manufacturing/258185) (pages 210-234)

Seung Hwan Joo, Sung Mo Lee, Jin Ho Yoo, Hyeon Jin Son, Seung Ho Lee

Sample PDF (/viewtitlesample.aspx?id=258185&ptid=244329&t=Simulation Applications for Industrial and Medical Products Additive Manufacturing&isxn=9781799840541)

Chapter 12 **$37.50**

Multiscale Modeling of the Laser Additive Manufacturing Process (/chapter/multiscale-modeling-of-the-laser-additive-manufacturing-process/258186) (pages 235-248)

Seshadev Sahoo, Jyotirmoy Nandy

Sample PDF (/viewtitlesample.aspx?id=258186&ptid=244329&t=Multiscale Modeling of the Laser Additive Manufacturing Process&isxn=9781799840541)

Chapter 13 **$37.50**

Powder Bed Fusion Additive Manufacturing of Ni-Based Superalloys: Applications, Characteristics, and Limitations (/chapter/powder-bed-fusion-additive-manufacturing-of-ni-based-superalloys/258187) (pages 249-270)

Evren Yasa, Ozgur Poyraz

Sample PDF (/viewtitlesample.aspx?id=258187&ptid=244329&t=Powder Bed Fusion Additive Manufacturing of Ni-Based Superalloys: Applications, Characteristics, and Limitations&isxn=9781799840541)

Chapter 14 **$37.50**

Laser Additive Manufacturing in Industry 4.0: Overview, Applications, and Scenario in Developing Economies (/chapter/laser-additive-manufacturing-in-industry-40/258188) (pages 271-295)

Christ P. Paul, Arackal N. Jinoop, Saurav K. Nayak, Alini C. Paul

Sample PDF (/viewtitlesample.aspx?id=258188&ptid=244329&t=Laser Additive Manufacturing in Industry 4.0: Overview, Applications, and Scenario in Developing Economies&isxn=9781799840541)

About the Contributors

View Full PDF (/pdf.aspx?tid=258190&ptid=244329&ctid=17&t=About the Contributors&isxn=9781799840541)

Index

View Full PDF (/pdf.aspx?tid=258191&ptid=244329&ctid=17&t=Index&isxn=9781799840541)

Learn More
About IGI Global (/about/) | Partnerships (/about/partnerships/) | COPE Membership (/about/memberships/cope/) | Contact (/contact/) | Job Opportunities (/about/staff/job-opportunities/) | FAQ (/faq/) | Management Team (/about/staff/)

Resources For
Librarians (/librarians/) | Authors/Editors (/publish/) | Distributors (/distributors/) | Instructors (/course-adoption/) | Translators (/about/rights-permissions/translation-rights/) | Editorial Services (/editorial-service-partners/)

Media Center
Webinars (/symposium/) | Blogs (/newsroom/) | Catalogs (/catalogs/) | Newsletters (/newsletters/)

Policies
Privacy Policy (/about/rights-permissions/privacy-policy/) | Cookie & Tracking Notice (/cookies-agreement/) | Fair Use Policy (/about/rights-permissions/content-reuse/) | Ethics and Malpractice (/about/rights-permissions/ethics-malpractice/)

(http://www.facebook.com/pages/IGI-Global/138206739534176?ref=sgm) (http://twitter.com/igiglobal) (https://www.linkedin.com/company/igi-global) (http://www.world-forgotten-children.org)

(https://publicationethics.org/category/publisher/igi-global)