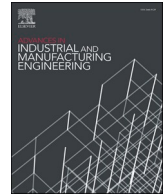


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Book Review

Fundamentals of Laser Powder Bed Fusion of Metals, 1st Edition. Elsevier (2021). 676 pp Igor Yadroitsev, Ina Yadroitsava, Anton Du Plessis, Eric MacDonald, ISBN: 9780128240908

Laser Powder bed fusion (L-PBF) is one of the most promising additive manufacturing technologies that is making significant inroads enabling the development of functional materials suitable for aerospace, medical, automotive, and other sectors. This is due to the inherent advantage of L-PBF in fabricating highly complex parts due to its layer-by-layer deposition of powdered material at the micron and submicron levels. As such the L-PBF process is highly complex demanding knowledge from a wide range of design experts, metallurgists, mechanical, manufacturing, and chemical engineers, physicists, and computer scientists. The book caters to all these different areas and succeeds in offering a comprehensive understanding of L-PBF processing techniques, quality assurance, application, cost-analysis, and upcoming trends. This makes the book complementary to the existing literature on L-PBF and acts as the most comprehensive reference suitable for students, researchers, technical staff, scientists, engineers, and managers.

The book brings together the fundamentals of L-PBF, its application on the development of functional materials, processability and the resulting properties in a comprehensive manner. The book consists of 24 chapters with an extended companion presentation for each chapter well suited for teaching and presentations. Each chapter features subsections featuring revision summaries and questions as appropriate making them suitable for both independent and guided learning. Each chapter goes well beyond their educational aspiration through their depth of coverage contributed by accomplished researchers in the respective field making the book an impressive volume to act as the best reference for both industry and academia alike.

The book starts with a historic background by Joseph Beaman bringing together the early conception and commercialisation efforts of L-PBF systems. The subsequent chapter by Igor Yadroitsev, Ina Yadroitsava, Anton Du Plessis introduces the different components of the current day L-PBF system ranging from powder feedstock, post-processing, and critical safety aspects. This is followed by a step-by-step guide to the L-PBF process outlining single track formation, melt-pool dynamics process stability, thin-wall formation, and process optimisation.

The next three chapters by Andrey Gusarov, Martin Leary, David Downing, Bill Lozanovski, Jonathan Harris, and Anton Du Plessis bring forward the physics and modelling, design principles and porosity defects in L-PBF in a comprehensive manner. The chapters extend to process stability, thermomechanical behaviour, digital dataflow, optimisation, numerical modelling, and performance optimisation. This is followed by an impressive summary of L-PBF part characteristics such as surface roughness and microstructure as distinctive chapters 7 and 8 respectively. Lameck Mugwagwa et al. summarises the L-PBF parametric

interactions that are leading to residual stresses in Chapter 9, which is otherwise scattered in specialist literature in distinct sources.

Non-destructive (NDT) testing, quality controls, and process monitoring for L-PBF are covered in chapters 10, 11 and 12 by Anton Du Plessis et al., Marco Grasso et al., Sara Bagherifard and Mario Guagliano, respectively. The NDT chapter ranges from the application of X-Ray computed tomography to ultrasonic and thermographic testing to name a few. The need for in-situ process monitoring and the challenges in their adoption for quality control are also established. The post-processing aspects concerning surface deposition, heat treatments and hybrid approaches are also meticulously laid out.

The structural integrity aspects of the materials and components manufactured using L-PBF are comprehensively laid across in three chapters by Pavel Krakhmalev et al., Uwe Zerbst and Mauro Madia, Seyed Razavi et al. covering static and dynamic performance along with the use of energy-based fatigue prediction techniques for complex parts. These chapters build on relevant experimental and theoretical foundations making them well suited for those looking for background knowledge as well as identifying solutions for various challenges associated with L-PBF manufacturing.

Manufacture of lattice structures using L-PBF is comprehensively laid out in Chapter 16 by Mohammad Mirzaali, Abolfazl Azarniya, Saeed Sovizi, Jie Zhou and Amir Zadpoor building on their extensive work on geometry, materials, and process-related cellular materials complemented with a section on computational modelling and application as relevant. This is followed by L-PBF informed bio-inspired design in Chapter 17 by Yash Mistry et al. covering biomimicry, structural hierarchy, and the incorporation of these concepts on structural, thermal and energy absorption. The state-of-the-art standards and methods are covered in the power characterisation Chapter 18 by Robert Groarke, Rajani Vijayaraghavan, Daniel Powell, Allan Rennie, and Dermot Brabazon, which discusses powder reuse, recycling, and safety aspects in addition to the best techniques in powder characterisation for L-PBF.

The following five chapters cover new material development (Chapter 19), recent progress on global standardisation (Chapter 20), industrial application (Chapter 21), economic feasibility (Chapter 22), and cost-benefit analysis along with future trends respectively (Chapter 23). All these aspects are covered in-depth including components for the aerospace industry and high-value low volume product design evolution for bespoke medical devices. Lastly, the book concludes with a practical case study that can be followed to design, print, post-process and inspect a part using L-PBF.

Overall, this is the most comprehensive book regarding laser powdered bed fusion of metals written to date and brings together 24 carefully selected chapters contributed by 59 authors from 14 countries. The book also shares the terminology amongst the diverse users of L-PBF that spans numerous fields while conforming to the ISO/ASTM 52900 standards. The future of L-PBF is exciting, and the focused yet diverse coverage brings all aspects of L-PBF and its application in a way that is

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suitable for undergraduates, postgraduates, researchers, experts from industry and advanced practitioners in the field of metal additive manufacturing. The book is suitable both for guided learning and for advanced reference.

List of authors contributed to the book: *Fundamentals of Laser Powder Bed Fusion of Metals*, 1st Edition, Igor Yadroitsev, Ina Yadroitsava, Anton Du Plessis, Eric MacDonald, Elsevier 2021, pp. 676, ISBN: 9780128240908.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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