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Editorial

Additive Manufacturing—Process Optimisation

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The realm of Additive Manufacturing (AM), often referred to as 3D printing, encompasses a broad spectrum of applications and methodologies, each contributing distinctively to the progress of this dynamic field. This book, a curated compilation of twelve articles, offers a comprehensive exploration of AM, delineating its multifaceted applications across varied sectors. The collection presents an academic discourse, analysing the intricate nuances and technical advancements within AM. It delves into the core aspects of design, material innovation, and process optimization, illustrating the field's adaptability and impact. The articles included in this Special Issue, selected for their contribution to the body of knowledge, reflect the depth and breadth of AM, from industrial applications in aerospace and medical fields to research-oriented pursuits in material development and prototyping. This Special Issue not only showcases the current state of AM but also provides insights into its evolving trends, underscoring its significance in contemporary and future technological landscapes.

"Design for Additive Manufacturing: Recent Innovations and Future Directions" presented by Egan et al. [1] delves into the intersection of design and AM technologies, highlighting advancements in diverse engineering applications, including aerospace, automotive, construction, and medicine. It underscores the importance of integrating material processes and constraints in the design phase to optimize AM's capabilities for specific applications.

In "A Review of the Current State of the Art of PEEK Composite Based 3D-Printed Biomedical Scaffolds", Surendran et al. [2] the focus shifts to biomedical applications, particularly the use of Polyether Ether Ketone (PEEK) composites in scaffold development for tissue engineering. This review illuminates the potential of PEEK-based composites as a next-generation bioactive material, emphasizing their biocompatibility and mechanical properties.

"An Assembly-Oriented Design Framework for Additive Manufacturing", Sossou et al. [3] offers a novel design perspective, concentrating on the assembly level. It discusses how AM can be utilized to design complex, performant products, exploring the concept of AM-based architecture minimization, including part consolidation and assembly free mechanisms.

"Caffeine–Acrylic Resin DLP-Manufactured Composite as a Modern Biomaterial" presented by Tomczak et al. [4] examines the innovative combination of caffeine with acrylic resin using digital light processing (DLP) for transdermal drug delivery. This study explores the mechanical properties and release capabilities of the composite, contributing significantly to the field of composite drug delivery systems.

The study titled "Dimensional Accuracy of Electron Beam Powder Bed Fusion with Ti-6Al-4V" by Bol et al. [5] delves into the precision of the electron beam powder bed fusion process, particularly focusing on Ti-6Al-4V specimens. It emphasizes the importance of understanding key process parameters to optimize AM for better dimensional accuracy.

"By Visualizing the Deformation with Mechanoluminescent Particles, Additive Manufacturing Offers a Practical Alternative to Stress and Strain Simulation", Einbergs et al. [6] introduces an innovative approach to stress analysis in mechanical components. This article describes the utilization of mechanoluminescent materials in 3D printing, offering a novel method for the real-time evaluation of complex forces.

"A Novel Feature-Based Manufacturability Assessment System for Evaluating Selective Laser Melting and Subtractive Manufacturing Injection Moulding Tool Inserts", El

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Kashouty et al. [7] discusses the development of a feature-based manufacturability assessment system. This system integrates selective laser melting with subtractive manufacturing, focusing on the geometrical complexities of tool inserts.

In “A Structural and Thermal Comparative Review of 3D-Printed Wall Shapes”, Bello et al. [8] the structural and thermal performance of various 3D-printed wall shapes in the concrete printing industry is analysed. This review utilizes simulation tools to study different wall types, contributing to a deeper understanding of 3D-printed structures in construction.

The article “Effects of Raster Angle on the Elasticity of 3D-Printed Polylactic Acid and Polyethylene Terephthalate Glycol”, Albadrani et al. [9] explores the impact of the raster angle on the mechanical properties of 3D-printed materials, providing valuable insights for optimizing 3D printing parameters for enhanced product performance.

“Rheological Behaviour of ABS/Metal Composites with Improved Thermal Conductivity for Additive Manufacturing”, Moritz et al. [10] investigates the properties of metal-reinforced polymer composites, particularly focusing on their thermal and mechanical characteristics. This study provides foundational knowledge for the development of composites with optimized processability and properties.

“Development and Performance Evaluation of Fibrous Pseudoplastic Quaternary Cement Systems for Aerial Additive Manufacturing”, Dams et al. [11] presents a novel cementitious material developed for aerial additive manufacturing. It highlights the material’s viability for in situ construction using UAVs, emphasizing its potential to revolutionize the construction industry.

Finally, “Enhancement of Fatigue Life of Polylactic Acid Components through Post-Printing Heat Treatment” presented by Jimenez et al. [12] addresses the improvement in fatigue resistance in 3D-printed components. This study demonstrates the potential of post-printing heat treatment to enhance the structural reliability of 3D-printed parts, especially in dynamic load scenarios.

Together, these articles provide a multifaceted view of AM, showcasing its versatility, adaptability, and transformative potential across various industries. From biomedical scaffolds to aerospace components, the breadth of AM’s applications is vast, offering endless possibilities for innovation and optimization. As AM continues to evolve, its integration with emerging technologies like machine learning and bio-inspired design promises to unveil new horizons in manufacturing and design.

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