Chapter 1
Glimpses of 3D Printing in the 21st Century

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ABSTRACT

As the ability to fabricate highly complicated computerized geometry makes additive manufacturing a significant technology in the present day, it has a significant impact on both the manufacturing and design industries. As a result of their intrinsic mechanical and anisotropic properties, pure polymer parts which are 3D printed completely have a limited application potential. Their capabilities have been improved by the filler inclusion for more versatility and application. Innovative benefits of 3D printing include simplicity of material modification, low production cost, less waste, and customised geometry. The overview describes the advancement of matrix composites printing technologies for 3D printing materials with improved qualities including its uses in the electronics, automotive, aerospace, and biomedical. In conclusion, the technology of 3D printing is analysed, highlighting its capabilities and shortcomings.

INTRODUCTION

Additive manufacturing has developed rapidly and ceaselessly ever since being brought into the spotlight at the dawn of the 21st century. In the industrial landscape of the world, the influence of 3D printing has been felt in every corner. It is strongly rooted inside Industry 4.0's expanding presence as an essentially futuristic technology that addresses the flaws that conventional manufacturing processes have been battling for decades. Manufacturing and construction are changing at an alarming pace, and additive manufacturing plays an essential role in this transformation. In addition to innovative and sustainable processes, additive manufacturing has led to smarter machines, more efficient management, and more automated operations. With additive manufacturing, multiple layers of materials are sequentially deposited

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in layers to create three-dimensional objects (R.Keshavamurthy et. al. (2018)). The machine functions in accordance with the planned design that is fed in the form of an extensive digital layout. Rapid prototyping and forging intricate geometric things are the two main applications of additive manufacturing. Additive layer manufacturing and 3D printing are two more names for additive manufacturing.

The use of additive manufacturing technology for producing useful parts and goods has increased significantly during the past 20 years. Some standard thermoplastic materials such as polylactic acid (PLA) (Melnikova R et.al. (2014), Tran P et. al. (2017) Al., Tymrak B et.al. (2014)), acrylonitrile butadiene styrene (ABS) (Sun Q et al. (2008)), polycarbonate (PC) (Garcia CR et.al. (2012)), and polyamide (PA) (Caulfield B et. al. (2007)), related to certain thermosetting materials utilised in additive manufacturing. Epoxy resins serve as thermosetting polymers, require heat or ultraviolet radiation to cure properly, they are not recommended for 3D printing. (Gu H et. al., (2016)). Different industries benefit from additive manufacturing in numerous ways. There is considerable potential for lightweight and complex cross-section areas like honeycomb cells to be manufactured using this technology in aerospace and automotive industries. Structural optimization and form finding of light weight structures. There are different parts in composite structures that contain cavities and angles for managing weight to strength ratios. To study the feasibility and functionality of complex structures, architects find it very convenient to model them (Wong KV- et.al. (2012)). Using the technology for 3D printing in museum exhibitions, artifact education, and artifact restoration can facilitate physical concept and visualization learning (Short DB (2015)). An evaluation of the mechanical properties and 3D printed scaffolds' biological properties made from tricalcium phosphate doped with silica and zinc oxide. The lack of strength and load bearing ability of polymer materials limits the application of 3D printing to conceptual prototype design and modelling. Pure polymers' practical applicability is limited by these drawbacks. Matrix and fillers have been added to 3D-printed polymers to improve their structural and functional properties, which is unachievable as a single component. Particles, fibres, and nanomaterials are incorporated into polymer matrix composites because they exhibit high mechanical and physical properties. Casting and moulding, as well as machining, were traditionally used to manufacture polymers and composites with complex geometries (Huang SH et. al. (2013)). Despite being well-organized, these procedures and approaches are unable to govern intricate inner systems. Contrarily, because the design is managed by software, additive manufacturing offers a platform for fabricating intricate geometries with little wastage of materials and excellent accuracy. By making manufacturing convenient and precise, AM technologies revolutionized manufacturing. 3D printing has attracted massive interest from researchers over the last three decades, which has led to a growing interest in new polymer printing techniques and methods. Polymer composites with enhanced desirable properties have achieved remarkable developments in 3D printing in recent years (Vijay Tambrallimath et. al. (2021)).

It is with rapid prototyping that 3D printing has demonstrated its capability to fulfil its original purpose, which was to demonstrate just how useful it is. As machine technology advanced and 3D printer compatible materials became more accessible, the number and quality of producible parts increased. In the past, this technique was mainly used to create temporary artefacts, including such early developmental stages or visual representations of thought processes. Now that AM goods are available individually on store shelves or integrated into larger structures, they can be considered finalized products in and of themselves. Thermoplastics were historically used for AM operations because of their low costs. Material development, however, has become increasingly important to the advancement of 3D printing over the past few years. Additive manufacturing offers qualitative advantages over traditional manufacturing with end-use applications reaching feasibility at an increasing rate.

Experimental Study on Surface Integrity, Dimensional Accuracy, and Micro-Hardness in Thin-Wall Machining of Aluminum Alloy
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