Chapter 2
An Overview of 3D Printing (Additive Manufacturing in Powder-Based Methods) Materials, Methods, Mechanical Properties, and Applications

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ABSTRACT

The multi-component alloys with special technique of additive manufacturing or 3D printing creates the novel material to enhance the mechanical characteristics, excellent formability, and maximum potency. Because these techniques were able to compose the layer-by-layer process with various materials like titanium, nickel alloys, and aluminium matrix materials, for creating the complex based geometry shapes, this additive technique recreates the material with layer-by-layer on the substrate with the help of powder materials with selected process parameters. The selected materials of additive manufacturing possess oxidation performances, creep resistances, high hardness, hydrogen properties, compressive strength, and tensile strength are in maximum level, and the post-heat treatments are well built on the substrate layers. Therefore, this chapter was utilized to identify the correctness of manufacturing procedures, selection of materials, and application-oriented areas.

DOI: 10.4018/978-1-6684-7412-9.ch002

1. INTRODUCTION

Over the past decades, manufactured products were produced in shortened time among the product design and fabricated components with available materials. This condition was well suited to additive manufacturing, and this method was used to fabricate products by adding them together with a layer-by-layer process. It is also referred to 3D printing technique (Kirstie et al., 2022). In 1980, 3D printing was initiated to develop products with a broad focus with rapid methods and create innovative products per the design concept. Therefore, 3D printing is the most appropriate technique to produce the components. There are various fields clinched to produce various components. Gadget products, tissue development, polymer-based printed materials, gems, frameworks for structuring, and mechanical components were produced with this technique (Srinivasan et al., 2021).

Additive manufacturing possesses an energetic segment of mechanical enhancement, impels the production rate, increases product development, and innovative methods as an uprising technique. Before the production of the component, design is the mandatory process for every operation. Especially in additive manufacturing, the product will be designed by CAD software and then moved to a 3D printer which gives the right customized product with the efficient structure of the product and yet with printing products that could not be composed with traditional production methods (Kolade et al., 2022). Simultaneously, complex-based parts may manufacture with reduced fabricating time, fewer expenses, and superfluous materials. As per the precondition model with computer-based design, 3D printed components were made with layer by layer process. It is a standard procedure for additive manufacturing because this method effortlessly achieves fabrication. Also, this method concerns the straight response of its constructive states, such as rapid prototyping and built modified parts (Jadhav & Jadhav, 2022).

Currently, this method has the most effective manufacturing system. The materials are engaged with matrix materials like ceramics, polymers, and composites in the upcoming applications, namely gadgets, food technology, aerospace, automation, clinical industries, and medical equipment (Kalashnikov et al., 2022). Additive manufacturing forms the physical components from prescribed design formats by establishing materials more quickly. This method is usually employed in the real world to compose mass production industries with customization methods like medicine, aircraft, motor vehicles, farming, and train units (Piedra-Cascón et al., 2021).

The present manufacturing flows utilized 3D printing techniques for cutting-edge innovations among the scope of component establishing and prototyping techniques. The mutual development of industrialization and educational society's interest in improving additive manufacturing by spectacularly utilizing the advantageous method resulted in conquering the industry 4.0 aims (Kermavnar et al., 2021). In the subtractive fabrication technique, perplexed structure geometry is possible and repetitive when utilizing 3D printing techniques. This technique differentiated the modeling with the 3D interface is transformed into the completed products with energy-saving material through layer by other layers (Francis Dave, 2021).

This review paper mainly focused on analyzing the 3D printing methods of powder-based techniques with different types and their mechanical properties, characterization studies, and related applications were reviewed. So far, this research was not reviewed by earlier research, and it would be beneficial to create the fabricated components and analyze the mechanical performances for future researchers.