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A critical review on Classification of materials used in 3D printing process

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ABSTRACT

In recent years, 3D printing technology has demonstrated its usefulness in a variety of fields because it provides faster, easier, and less expensive solutions, as well as the ability to build a variety of complicated configurations that must overlap many traditional production processes. It has gained attention from all around the globe as a developing method for producing complex three-dimensional products applicable in several industries, like aerospace, automotive, healthcare, biomedical, construction, food, and textile. The key advantages of 3D printing are design freedom, design customization, waste reduction, the capacity to build complicated structures, and quick prototyping. Using 3D CAD models and 3D printers, different types of materials can be printed layer over layer. Metals and alloys, ceramics, polymers, composites, smart materials, concrete, and biomaterials are often utilized in 3D printing technologies. In this article, we go through a wide selection of materials applied in 3D printing. Applications of 3D printed products made of different materials and different processes of 3D techniques are also described in the article and concluded with suggestions for future research in this field. New researchers and industrial people on 3D printing would benefit from the outcomes of this article.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Thermo-Fluids and System Design.

1. Introduction

Manufacturing sectors have a critical problem in producing customized products at a nominal cost and in a short time. To address these issues, 3D printing is a rapidly evolving manufacturing technology. 3D printing combined with 3D CAD modeling is a promising future approach for producing a variety of basic and complicated structures [1]. 3D printing is a kind of additive manufacturing that can transform a geometrical model into a physical product by laying materials layer over layer. Initially named stereolithography (SLA), the technique was established by Charles Hull in 1986 and is now being utilised by researchers to produce several newer processes and materials for a variety of purposes [2]. Because it provides cost-effective and durable products with flexible designs, reduced material waste, ease of access, speedy design, and production, 3D printing is being used as a small-scale manufacturing technique in addition to prototypes. Aviation, automotive, defense, medical research, civil engineering, and ocean engineering are just a few of the sectors that have adopted 3D printing technology. As technology progresses, more materials are being utilised in 3D printing, including metals and alloys, polymers, ceramics, composites, smart materials, biomaterials, concrete, and more. [2–4]. These materials are simple to print with 3D printers, and each process is tailored to create a certain substance.

Three decades ago, 3D printing was developed, and it has evolved in four major ways: design, material, method, and application [5]. We begin by creating a basic design for the component we want to represent in 3D printing, which is an additive manufacturing approach [6]. Designing software that can be utilised with 3D printers was used to create the design. The software then generates a special file(.stl) that is sent to the 3D printer. The 3D printer interprets the file(.stl) and produces the product by stacking one layer on top of another [7]. To construct a component, almost every 3D printing technique employs layers. Instead of reading the pieces as a whole, 3D printers interpret them as a single 2D layer at the moment [8]. Fig. 1 shows the process flowchart of the 3D printing method.

The necessity for producing complex objects with high resolutions prompted the development of 3D printing technology. Pow-

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