Chapter 3
Critical Review on 4D Printing:
A Revolutionary Change in Additive Manufacturing

Zeeshan Ali
Navodaya Institute of Technology, Raichur, India

V. Muthuraman
Vels Institute of Science, Technology, and Advanced Studies, India

Madeva Nagaral
Hindustan Aeronautics Limited, Bangalore, India

Samuel Dayanand
Government Engineering College, Gangavathi, India

Sharath Chandra H. S.
NMAM Institute of Technology, India

V. Auradi
Siddaganga Institute of Technology, Tumkur, India

Ansari Faiyaz Ahmed
University of Technology and Applied Sciences, Salalah, Oman

ABSTRACT

Recently, one of the subjects that is receiving significant research attention has been the additive manufacturing (AM) of intelligent materials and structures. A smart material is one that can change its structure and properties in response to an external input, also known as stimuli-responsive materials (SRM). These advantages enable AM-fabricated components to adapt their structural properties in response to environmental factors or human input. In order to include the structural reconfiguration over time in AM processes, a new term, "4D printing," is coined. While still in its infancy, this new subject has drawn a lot of interest since its inception in 2013. It may also produce items that can self-assemble and be repaired and have a variety

DOI: 10.4018/979-8-3693-4111-7.ch003

of uses. In this study, it examines and categorizes prior studies on 4D printing in the aerospace industry in accordance with the triggers that are most likely to activate them. The advantages and applications of the materials used in 4D printing are also covered. A glimpse into 4D printing's future is shown.

INTRODUCTION

When building three-dimensional (3D) items, rapid prototyping (RP), also known as additive manufacturing, combines or solidifies materials using digital data from a three-dimensional model (Ian, 2015). In the late 1980s, Scott Crump, the co-founder of Stratasys and the inventor of fused deposition modelling (FDM), and Chuck Hull, the inventor of stereolithography (SLA), introduced it (One of the largest producers of 3D manufacturing systems and printers for office-based rapid prototyping.)

The advent of 3D printing allowed for a new method of production that could overcome the various limitations of conventional methods of material processing. The main advantages of these technologies are their speedy mock-up and prototype production, which enables testing physical models of any complexity in a fair amount of time for functional and design review. This allows product designers to increase component complexity without noticeably raising lead times or prices.

Currently, 3D printing is used for a variety of things, such as the creation of living biological structures, end-use products, 3D-printed electronics, clothing, food, and medical supplies. Even though additive manufacturing has made remarkable progress, more study is still required to overcome the various obstacles.

During the last several years, there has been a tremendous increase in the range of materials that 3D printing can manufacture. One type of materials that has recently attracted interest is the so-called "Smart Materials" (Also known as Stimulus-responsive Materials). Even after years of research and use, there is still disagreement about what precisely qualifies as Smart Materials. Smart materials, in general, are things that can sense changes in their environment (heat, light, humidity, magnetic field, etc.) and respond positively by changing either their material properties or geometries (Khoo et al., 2015). The potential of smart materials would enable the 3D-fabricated components composed of such materials to evolve in a predetermined manner. Due to this, the concept of "4D Printing (4DP)," which involves structural change over time, is indicated (Figure 1).

4D printing has quickly developed as a result of interdisciplinary research and development in 3D printing, smart materials, and design (Kuang et al., 2019). Despite the fact that 4DP is still in its early stages, it has already become a subset of AM and is receiving a lot of attention from academic institutions in a range of subjects and industries. Trials in a variety of smart device fields are now feasible

Related Content