EMERGING TECHNOLOGIES IN AUTOMOTIVE AND MECHANICAL SCIENCES

Volume II

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PREFACE

We're excited to release the second volume of our book, Emerging Technologies in Automotive and Mechanical Sciences, Volume II. This book is a collection of book chapters written by respected experts in the fields of Automobile and Mechanical Engineering. The articles cover a wide range of topics and go deep enough to meet the need for a level that is both complete and interesting. It is a collection of information about progress and changes in the field of Automobile and Mechanical Engineering. We hope that students, teachers, researchers, scientists, and policymakers will find this book much more useful because it is focused on applications and inducements from different fields of study. The articles in the book were written by well-known academics and researchers. Our thanks and appreciation go out to the experts and researchers whose work helped make this book better. We'd like to thank our publisher, Scientific Research Reports, Chennai, India, for putting together this book with so much good information.

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Chapter 5

Incorporating 3D Printing Technology into Mass Production

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Abstract

The capacity to physically shape items using 3D printing technology has led to its adoption in domains as disparate as the manufacturing sector, the medical area, and the creative arts. In order to examine 3D printing's potential in the automotive, aerospace, and electrical industries, this article examines the technology's moulding idea and process flow.

Keywords: 3D Printing, Manufacturing industry, Application, Process flow.

1. Introduction

Rapid prototyping and additive manufacturing are other names for the 3D printing process, which builds objects layer by layer using materials like adhesives, metal powders, and polymers based on three-dimensional models. The term "debarring processing" refers to the conventional methods of removing defects and surplus material by means of cutting, turning, milling, and grinding.

Complex work piece shapes are frequently challenging to process and sometimes impossible. As a result of its layer-by-layer construction, 3D printing technology drastically decreases production times, enables structures that are difficult or

impossible to manufacture with conventional procedures, and makes optimal use of available resources. By the use of 3D printing technology, products of any complex shape may be created without the normal design and manufacturing challenges. This has increased the significance of 3D printing [1] in the manufacturing sector.

2. Reliability of technologies for 3D printing

When it comes to 3D printing, the United States and Europe have been at the forefront of innovation. Despite Europe's investment in 3D printing, the United States remains the global front runner in this field at the moment. There is already a well-established market for 3D printing in the United States and Europe. Some sectors that may benefit from low-cost, high-efficiency customized components produced in small quantities by 3D printing technology are consumer electronics, aircraft, and automotive [2]. The United States has taken the lead in developing, producing, and marketing 3D printing technologies (equipment). The majority of the market is controlled by companies like 3D Systems and Sratays.

The first consumer-grade 3D televisions hit shelves in the late '80s. Professor Yan Yongnian of Tsinghua University was an early proponent of fast prototyping technology in China, establishing a laser rapid prototyping facility in 1988. Xi'an Jiaotong University has created its own supplemental materials, including a unique curing method and a selection of 3D printer nozzles. Printing accuracy with this technique is 0.1 mm.

Microelectronics and opto electronics manufacturing might benefit from a jet device created at China's University of Science and Technology. Indigenous peoples have developed some of the world's most cutting-edge technologies. Laser direct metal processing technology has advanced quickly and can now satisfy the demands of specific parts' mechanical qualities. Large titanium alloy structural parts can be

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formed via laser direct manufacturing, which offers a wide range of potential applications due to its short flow and low cost [3].

3. Process is as follows throughout the 3D printing process

Stereolithography (SLA), fused deposition modeling (FDM), selective powder material sintering (SLS), laminated object manufacture (LOM), and selective powder bonding (3D Printing) are just a few examples of the many types of 3D printing technologies now in use.

The technique consists of four stages: three-dimensional modeling, processing, prototyping, and finishing.

Three-dimensional representation: The additive manufacturing process relies entirely on data from a 3D CAD model. In order to begin the additive manufacturing process, a 3D CAD model of the product must be created. The STL file format is widely supported these days. To recreate the original 3D data model or solid model, all you need is a sequence of small triangular planes.

Pre processing: Cutting the 3D model in the direction of the moulding height with a series of planes separated at the same distance apart allows you to extract 2d contour information of the cutting layer. More precise and time-consuming the molding process is, the less effective it becomes at lower spacing heights.

Prototyping: Material for each layer is stacked and bonded using a forming head and a computer-controlled, two-dimensional scanning movement that tracks the contour data of the layer's cross-section. The final product is a three-dimensional solid. Nozzles or laser heads may both do the job of forming.

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Post-treatment: Post-treatment processes aim to improve product longevity and surface quality. Fixing, grinding, post-curing, peeling, polishing, and coating are all part of the method.

4. Utilization 3D printing in industrial sectors

There are benefits to putting 3D printing into use. Manufacturing saddles is essential to the vehicle industry. The creation of new models may now be completed at a fraction of the time and cost thanks to the widespread use of 3D printing technology, which has been acknowledged by almost every major manufacturer.

BMW, a German manufacturer, uses 3D printing to raise productivity, boost morale, and ensure consistency in processes [5]. To improve its balance, quality, and comfort, for instance, the installation handheld device of one model abandoned its original solid form in favor of an inner thin rib structure, reducing its weight by 1.3 kg.

Hyundai Motor Corporation uses the FDM 3D printing technology developed by the US company Stratasys [6] for the purpose of analyzing, evaluating, and testing aerodynamic performance. In his capacity as chief engineer of the department that specializes in automated technologies, TaeSunByun emphasized the importance of the space's precision and consistency for design inspection. To meet these criteria, we recommend using the FDM Maxum technique and ABS technical plastics. An accuracy of 0.75mm is possible up to 1382mm [7].

Due to the usage of rare and exotic materials, stringent design requirements, perfect geometry, and outmoded production techniques, aerospace manufacturing is infamous for its high prices, lengthy lead times, and rigorous quality standards [8]. There are significant time and money savings that may be achieved via the direct or indirect production of items utilizing 3D printing technology.

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Aerospace parts are often complicated systems operating in a restricted environment, but the SLA model can be used straight away in the wind tunnel test, and the intake line may be manufactured for testing with a full evaluation of its manufacturability provided. Components of engines, such as turbine blades and impellers, may be made as one-offs with the help of auxiliary technologies like fast sand casting and investment casting, which also allow for the fabrication of prototypes for testing purposes.

Precision casting is essential in the production of several engine parts for the aerospace industry. It takes a lot of time and money to make high-precision wood molds using the conventional method [9]. The investment casting master mold may be 3D printed from a 3D CAD digital model, potentially saving both time and money. Complex CAD digital models may be converted into master models for investment casting with the use of 3D printing in a timely and cost-effective manner [10].

The pace at which electrical items are updated is increasing in tandem with both consumption and the amount of consumers actively seeking individualized lifestyles. The market for electrical product shell parts and components has expanded greatly in recent years due to functional enhancements, structural modifications, and constantly enhanced aesthetic design.

Since the first hair dryer introduced plastic components, there has been a greater emphasis on innovation. It's possible that the user's comprehension of the design concept and the designer's goal would improve as a result of the prototype's construction, which would then facilitate the product's commercialization. Several of the plastic parts needed in the manufacturing of the first edition for evaluation, assembly, and performance testing might be made utilizing rapid prototyping employing 3D printing technology, which could save development time and increase the success rate.

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5. Conclusion

Some of the specific benefits of 3D printing technology in industrial manufacturing include the ability to produce components made of complex and difficult-to-machine materials, the elimination of the need for costly forging industrial infrastructure and molds, a shorter design cycle, and greater material utilization. The importance, versatility, and pervasiveness of industrial production have piqued the interest of top researchers throughout the globe.

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