



3d-Printing Aspects And Some Process Apply In Then 3d Printing: Short Overview

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ABSTRACT

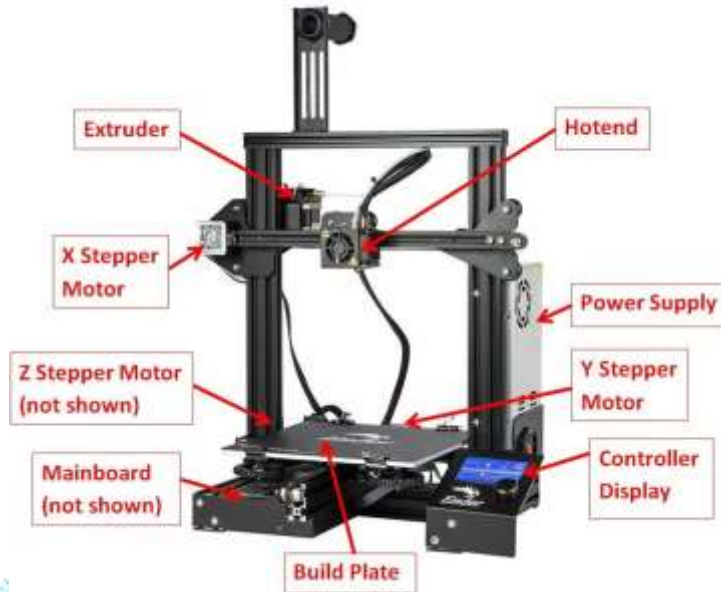
3D printing, also provide as digital fabrication, are a quickly developing technique uses incremental material addition to turn geometrical representations into tangible items. Mass customisation, open source designs, the automobile, locomotive, healthcare, agricultural, and aviation sectors all make extensive use of it. With this technology, material may be deposited layer by layer straight from a computer aided design model. An overview of three dimensional printing technology, their uses, and material used in manufacturing is given in this study.

OVERVIEW

Charles Hull introduced three dimensional printing to the market in 1980. It is a technique that uses incremental material addition to turn geometrical representations into tangible items. It has grown significantly in the last several years and is mostly utilized in the manufacturing of steel bridges for the food and aviation sectors, PGA rocket engines, jewelry collections, 3D printed corneas, and prosthetic heart pumps. Three dimensional printing is a creative and adaptable technology that began with the layer-by-layer creation of three dimensional structures straight from computer-aided design (CAD) designs. It offers promise for a wide range of possibilities. Because three dimensional printing technology can reduce prices and increase manufacturing speed, it has the potential to completely transform industries. It makes the production process more adaptable and responsive by giving customers more control over the finished product and the ability to request that it meet their needs. Because 3D printing facilities are situated closer to the customer, there is less need for international shipping and more control over quality. By providing complete end-to-end service, the use of three dimensional printing technology may help transform business logistics. It is being utilized more and more for open source designs and mass customisation in a variety of industries, including aerospace, automotive, healthcare, and agriculture.

Nevertheless, 3D printing technology has drawbacks, including the ability to produce hazardous goods like blades and a decrease in the amount of manpower required for manufacturing. 3D printing could restricted limited people in order to stop criminals and terrorists from transporting firearms undetected. Furthermore, the simplicity of 3D printing technology makes it simple to produce fake goods.

In conclusion, 3D printing technology is now widely used in many nations and has become a versatile and potent method in advanced production sector. Overview of the many kinds of three dimensional printing technology, their uses, and the materials that are employed in the industrial sector is given in this study.



Types of 3D Printing

ASTM Standard F2792, three dimensional printing methods have developed to serve a variety of purposes. These technology are divided into 7 groups: vat photopolymerization, binding jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, and sheet lamination. It is now simpler to identify the ideal equipment or technology for a certain application since these technologies are not only being used for prototyping but are also being utilized more and more to create a variety of goods.

Binder jetting

A liquid binding agent is selectively deposited onto powder particles using a jet chemical binder in the quick 3D printing technique known as "binder jetting." Large-scale sand products, raw sintered goods, and casting patterns are all produced using this method. A variety of materials, such as metals, sands, polymers, hybrids, and ceramics, may be printed using sand, a non-processable substance. Large items may be printed using binder jetting, which is easy, quick, and affordable.

Directed energy deposition

A printing method called directed energy deposition makes it possible to precisely regulate grain structure and produce high-quality goods. Metals, ceramics, polymers, and metal-based hybrids are among the materials that may be added to or repaired from pre-existing components. Because of its versatility and scalability, this technique—which comprises laser deposition and laser engineered net shaping, or LENS—is becoming more and more common in sectors including manufacturing, transportation, oil and gas, and aerospace. During casting, laser LENS also employs heat energy for melting.

Fused deposition modeling

Different colors and materials for plastics, food, and living cells may be printed using material extrusion-based 3D printing technology. Early in the 1990s, fused deposition modeling (FDM) was created as the first material extrusion technology. The primary material in FDM is polymer, and components are constructed layer by layer using thermoplastic filament that has been heated and extruded. This method may create completely functional product parts at a minimal cost. Ultra-fine beads of thermoplastic are deposited along the extrusion route after it has been heated to a semi-liquid condition. Scaffolding is made of a detachable substance, such as hard plastic, as in the FDM process of creating 3D bone models.

Material deposition

Material deposition is a three dimensional printing technique that uses UV light to selectively deposit to create a component by layer. According to ASTM Standards, this method may be used to a variety of materials, including polymers, ceramics, composites, biologicals, and hybrids, and it yields products with a clean surface finish and excellent dimensional accuracy.

Direct energy deposition

Electron beam melting, selective laser sintering and selective heat sintering printing processes are all used in the Direct energy deposition process. These techniques melt or fuse powdered materials, including metals, ceramics, polymers, composites, and hybrids, using an electron beam or laser. SLS is a high-speed, high-accuracy 3D printing method that was created by Carl Deckard in 1987 and can produce ceramic, metal, and plastic items. While electron beam melting increases energy to heat the material, SHS employs a head thermal print to melt thermoplastic powder. These methods are employed to produce 3D objects with different functionality and surface qualities.

Sheet lamination

In the 3D printing process known as sheet lamination, which includes laminated object manufacturing (LOM) and ultrasonic additive manufacturing (UAM), materials are fused together to make an object. Full-color printing are possible using sheet lamination, which is also recyclable, reasonably priced, and simple to handle. Complex geometrical pieces may be produced with LOM with reduced operating time and fabrication costs. UAM is a novel manufacturing method that combines metal layers from featureless foil material using sound.

Resin 3D printing

A common three dimensional printing method is photopolymerization, which uses ultraviolet (UV) light, lasers, or light to cure photo-reactive polymers. Digital light processing and stereolithography are two examples of photopolymerization-based 3D printing technologies. Photo initiator, irradiate exposure settings, pigments, dyes, and UV absorbers all affect SLA.

Similar to stereolithography, digital light processing is quicker than stereolithography because it uses a traditional light source, such as an arc lamp, with a liquid crystal display screen. Vat photopolymerization parameters include power source, wavelength, and exposure duration.

Initially, liquid materials are utilized, but when subjected to UV radiation, they solidify. For creating high-end items with superior surface details and details, photopolymerization is perfect.

Materials Used for 3D Printing in Industry

Creation gadgets, three dimensional printing needs premium materials that adhere to strict criteria. Suppliers, buyers, and end users develop protocols, specifications, and material control agreements. Functional components made of ceramic, metal, polymers, composites, hybrids, and functionally graded materials (FGMs) can all be produced using this process.

Metals

The usage of metal 3D printing technology is growing across number of industries, including industrial, automotive, aerospace, and medicine. Metals with exceptional physical qualities, such as titanium alloys, cobalt-based alloys, nickel-based alloys, stainless steels, and aluminum alloys, may be utilized for intricate manufacturing processes, ranging from printing human organs to producing aircraft components. Because of their high specific stiffness, robustness, recovery capacity, and heat-treated conditions, cobalt-based alloys are appropriate for use in 3D printed dental applications. Because of their exceptional resistance to corrosion and heat up to 1200°C, nickel-based alloys may be used to make aeronautical components. Titanium alloys are perfect for aircraft components and the biomedical sector because of their ductility, low density, strong resistance to corrosion and oxidation, and suitability for high working temperatures and pressures.

Polymers

Polymer components, ranging from functional constructions with intricate geometries to prototypes, are produced using 3D printing technology. Extruded thermoplastic filaments such as PLA, ABS, PP, and PE may be deposited in layers using fused deposition modeling (FDM). These days, 3D printing uses materials with higher melting temperatures, such as PEEK and PMMA. Because of their low cost, light weight, and processing flexibility, liquid polymer materials particularly those with low melting points are commonly employed. Because they frequently function as inert materials, increase device efficiency, and provide mechanical support in orthopaedic implants, polymers are essential to biomaterials and medical device products.

Ceramics

With the use of concrete and ceramics, three dimensional printing technology may produce 3D printed items free of fractures and huge pores. Ceramics are appropriate for building and construction because they are robust, long-lasting, and fire-resistant. Zirconia, bioactive glasses, and alumina is a few types of ceramic materials. Three dimensional printing technology may be used to process alumina powder, a great ceramic oxide with many uses, to produce intricately formed components with high density and green density. Glass-ceramic and bioactive glass have been processed into dancing pieces using stereolithographic (SLA) machines, which increase the bending strength of the materials. This makes it possible to use bioactive glass in clinical constructions like bones and scaffolds. Solid bulk ceramics with high densities, uniform microstructures, high compression strengths, and bending properties may be produced via stereolithographic ceramic manufacturing (SLCM). Its low radiation sensitivity and thermal neutron absorption, hafnium-free zirconium is a good choice is element tubing in the nuclear power industry.

Composites

Because of their versatility, low weight, and adjustable properties, composite materials like carbon and glass fibers are transforming high-performance industries. Because of its high specific stiffness, strength, resistance to corrosion, and fatigue performance, carbon fibers are employed in aerospace. Because glass fibers are inexpensive and function exceptionally well, they are employed in 3D printing. Fiberglass is perfect for 3D printing applications because of its low thermal expansion coefficient and high heat conductivity.

Responsive materials

In addition to 3D printed objects like soft robotics systems and self-evolving structures, smart materials like shape memory alloys and polymers may change an object's geometry and shape in response to environmental variables like heat and water. Micro-electromechanical devices and biomedical implants may both make use of shape memory alloys like nickel-titanium.

However, factors including density, microstructure repeatability, and transformation temperatures must be taken into account while producing nickel-titanium 3D printed goods. Functional materials known as shape memory polymers (SMP) react to many stimuli, including heat, light, electricity, and chemicals. Complex SMP forms Rapid and simple component creation is made possible by 3D printing technology, and component density, surface roughness, and dimensional accuracy are used to evaluate quality.

Examples of special materials are:

- Food
- Lunar dust
- Textile

APPLICATION

3D printing on oral drug delivery system

Solid oral dosage forms made using 3D printing technology have demonstrated potential in providing novel formulations that get around the drawbacks of conventional drug production methods. Oral dosage forms are frequently created using extrusion-based 3D printing techniques, which have been modified to satisfy patient requirements. These techniques have produced gastro-retentive drug delivery systems, polypills that include the whole dosing regimen, and immediate-release and delayed-release systems. This issue has been addressed by recent 3D printing techniques for oral medication delivery, which provide a versatile platform for drug administration. However, the constrained shape and geometries that can be produced by traditional manufacturing limit the technology's adaptability. Three dimension printing is based on a by layer manufacturing process that makes it possible to create geometric proportions that are not achievable with conventional methods. Injection, fused deposition, and direct compression modeling were used to create an oral pill, contrasting 3D printing with conventional manufacturing techniques. All things considered, 3D printing provides a creative and adaptable method of drug administration.

3D printing in In Dermatology science

Dermatology might undergo a revolution thanks to 3D printing technology, which can produce 3D skin for a variety of uses. Using bio-inks, which are biological components of the skin, researchers at Universidad Carlos III de Madrid have created a bio-printer that can produce real human skin. This technique can manufacture two kinds of skin tissue: therapeutic skin, which is made from a person's own cells, and regular skin, which is made from generic human cells that are mass-produced. The first kind may eventually replace the use of animals in the testing of new cosmetics. The second kind is employed therapeutically, for example, in skin diseases or severe burn transplants. This technology may have a big effect on the skin care and medical sectors.

3DPrinting in Dosage form manufacturing

Medication is taken orally in the form of tablets or capsules, which are printed using a variety of techniques and advanced chemicals. The active pharmaceutical ingredient (API) determines how well medication delivery techniques may be improved. Using binder jet printing technology, Aprelia Pharmaceuticals produced the first oral dispersible tablet of levetiracetam in 2015 to treat seizures. A molecular 3D printer created by the Howard Hughes Medical Institute has fundamentally changed the 3DP medical sector. Tvasta and the Institute of Chemical Technology are working on a technique to use several 3D technologies to produce tablets with regulated drug release. The medical field, three dimension printing technology is used to manufacture a variety of dose forms are different compositions. Inkjet 3DP, Fused Deposition Modelling technique, Selective Laser Sintering technology, and Semi-solid Extrusion procedure Tablets such as Fluorescein, Levetiracetam, and Chlorpheniramine Maleate Tablets are made using technology.

3D printing in organ transplantation

Using bioinks and stem cells, bioprinting techniques enable the production of biological structures. Skin, tissue, or organs can be created by layering these biomaterials. We are now closer to practical and functional solutions, such as human livers, kidneys, and hearts, thanks to recent bioprinting initiatives. In 2016, 3D printed live ear and muscle implants were successfully tested on animals. A group under the direction of Monica Laronda created ovaries in 2017 by using bioprinting to help infertile mice conceive. Northwestern University researchers are currently developing an artificial ovary. In order to produce kidney organoids, a novel method known as proximal tubule bioprinting was developed in 2016. Kidney organoids were produced automatically in 2019 using the Organovo bioprinting technology. These stem cell-based self-organizing structures may be produced in big quantities with ease.

3D printing in facial reconstruction surgery

In order to shape customized implants before surgery, doctors at the Clinical University Hospital in Olsztyn, Poland, employ 3D-printed replicas of their patients' skulls for oral and maxillofacial surgery. For more than 80% of patients with orbital injuries who need orbital floor repair, this method enhances treatment safety and efficacy.

Electric and Electronic Industry

Printing technology is growing across the number of industries, including industry, science, and technology. Structural electronic devices such as electrodes, active electronic materials, and gadgets with mass customisation and adaptable design have all made use of it. Electrode materials may be mass produced quickly and affordably using the Fused Deposition Modelling 3D printing technology, which also makes surface area and pattern modification simple. Eight electrodes can be printed in 30 minutes thanks to the completely automated 3D printing method for 3D electrodes. Because of their intricate functions, active electronic components—like silicon-controlled rectifiers, transistors, diodes, operational amplifiers, LEDs, and batteries—require more sophisticated production procedures than passive ones.

Fabric and Fashion Industry

With the introduction of 3D printed shoes, jewelry, consumer products, and apparel, 3D printing technology is revolutionizing the retail sector. Athlete shoes, custom made shoe, and sneaker are among the many uses for 3D-printed shoes that companies like Adidas, Nike, and New Balance is creating in large quantities. Additionally, 3D printing technology makes it possible to create forms without the need for molds, which makes it possible to print decorations for conventional fabrics and produce clothing utilizing mesh systems. Additionally, it may be used for leather products and accessories including jewelry, watches, and accessories. Main objective of printing is to provide clients with customized and distinctive items rather than to replicate already- existing ones.

Conclusion

This assessment highlights the advantages of 3D printing for people, businesses, and governments as it examines its expanding position in the manufacturing sector. It highlights the need for more data to improve this technology's uptake. An overview of the various 3D printing processes, materials, and manufacturing applications is given in this article. Future studies should concentrate on identifying the many kinds of 3D printers and the materials that work well with them. This will assist businesses and governments in modernizing and enhancing their infrastructure for 3D printing.

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