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A Review on 3D Printing Technology

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Abstract - *This review paper tells us about the 3d printing technology. And the various types of material which can be used for 3d printing, and the different type of properties of material that which material is used in 3d printing objects. 3d printing is also known as additive manufacturing technology because it uses layer by layer material build up approach for making objects. It is a tool less manufacturing method. It is a high precision & less cost process for making objects. There are different fields where we use 3d printing like medical, automobile, aerospace and manufacturing etc.*

Keyword—3d printing, material used in 3d printing, additive manufacturing, applications.

1. INTRODUCTION

3D printing is also known as additive manufacturing process. Additive manufacturing refers to the manufacturing with the help of layer by layer method, by joining with each other. This technology changes the method of manufacturing in world now any product can be made with simply making its 3D modal or by scanning with the 3D scanner. We uses a CAD file to make objects on software then this file is uploaded to the 3D printer and it is made by printer. It is a tool less manufacturing method, it can be used in where mass production with high accuracy is required. It also requires less energy. Rapid prototyping has a wide range of applications in various fields of human activity: research, engineering, medical industry, military, construction, architecture, fashion, education, the computer industry and many others. [1]

In medical field most common technology used for 3D printing is powder bed fusion. Powder bed fusion is commonly used because it works with a variety of materials used in medical devices, such as titanium and nylon. It is a synthetic thermoplastic linear polyamide and is the most common plastic material. It is a well-known 3D printing filament because of its flexibility, durability, low friction and corrosion resistance.

Nylon is a popular material used in manufacturing of clothes and accessories.

In aerospace industries the first printer uses extrusion additive manufacturing, which builds objects layer by layer out of Acrylonitrile Butadiene Styrene (ABS) plastic. [2]

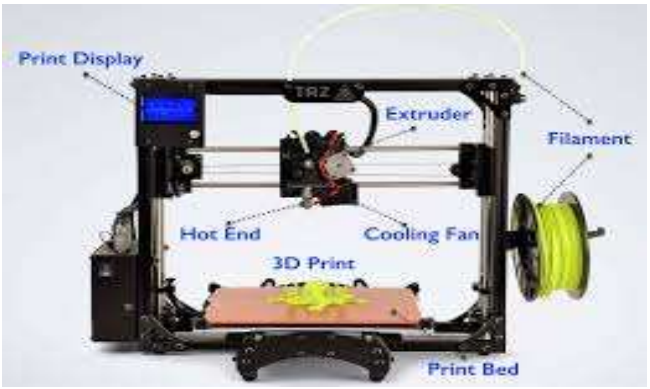

Fig no:- 1 (nomenclature of 3D printing machine)

Metal additive manufacturing can be classified into main two major groups Powder Bed Fusion based technologies (PBF) and Directed Energy Deposition (DED) based technologies. [3]

2. POWDER BED FUSION (PBF):-

Under PBF process, DMLS is an additive manufacturing (AM) or rapid prototyping (RP) process that uses metal powder and a high power laser to sinter together a useable part. This method is capable of producing very dense parts but in order to achieve gas or pressure tightness, post-treatment is often required. Most trade names such as laser sintering, cussing etc. are describing the same process but not different technologies. The process is very similar to an existing AM process called Selective Laser Sintering (SLS), both SLS and DMLS are conceptually the same process, but instead of using polymers or coated metal powders in the case of SLS, DMLS uses polymers or coated metal powders in the case of SLS, DMLS uses uncoated. [4]

Directed Energy Deposition (DED):-

In DED based technologies focused thermal energy is used to fuse materials (powder or wire form) by melting as they are being deposited. Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Free Form Fabrication (EBFFF) and arc based AM are some of the popular DED based technology. [4]

3. PRINCIPAL

There are basic principles on which 3D printer works-

1] Stereo lithography – This process includes photo polymer liquid and ultraviolet light, when UV light strikes with the photo polymer then it solidifies and the modal is made. Stereo lithography is a form of 3-D printing technology used for creating models, prototypes, patterns in a layer by layer fashion using photo polymerization, a process by which light causes chains of molecules to link together, forming polymers. Those polymers then make up the body of a three-dimensional solid. Research in the area had been conducted during the 1970s, but the term was coined by Charles (Chuck) W. Hull in 1986 when he patented the process. He then set up 3D Systems Inc. to commercialize his patent. [5]

2] Fused Deposition Modelling – It consist of a filament roller from which filament is passed between to the two rollers, then it goes to the nozzle in semi liquid form which makes object. In this technique, the model is produced by extruding small beads of material which harden to form layers. A thermoplastic filament or wire that is wound into a coil is unwinding to supply material to an extrusion nozzle head. The nozzle head heats the material up to the certain temperature and turns the flow on and off. Typically the stepper motors are employed to move the extrusion head in the z-direction and adjust the flow according to the requirements. The head can be moved in both horizontal and vertical directions, and control of the mechanism is done by a computer-aided manufacturing (CAM) software package running on a microcontroller. [6]

3] Selective Laser Melting - In this process the powder material used in the printer is melted instead of combining them. [7]

4] Electronic Beam Melting - 3D printers use the electron beam instead of UV rays. [7]

5] Laminated Object Manufacturing - In this process the plastic, paper, or metal are glued together and after that they are cut with laser to give them the desired shape. In it, layers of adhesive-coated Paper, plastic, or metal laminates are successively joined together and cut to appropriate shape with a laser cutter. Objects printed with this technique may be additionally modified by machining after the printing process. The typical layer resolution for this process is defined by material feedstock and usually ranges in thickness from one to a many sheets of paper of a copy. [8]

4. CLASSIFICATION

3D printer's uses different techniques for making objects so that they are available on different price ranges depending upon the use of 3D printer at home use or office use.

They can also classified on the basis of material used in 3D printers to make object, for example FDM Thermoplastics, Photopolymer, WDW materials and chocolate is also used as a material for 3D printing. [9]

They are classified on the basis of their application, now a days 3D printers are used in medical field for making different body organs and parts. They are also used in manufacturing process to make objects for real time conditions. It also used in aerospace applications.

3D printers can also be classified on the basis of their size for example there are some of 3D printers which used for making automobile parts which are small in size, on the other hand some are used for making big sculpture of any human or things. [10]

5. APPLICATION

3D printing is used for manufacturing hearing aids, and some of the automobile parts which requires the greater accuracy. In automobile the buckets of crane.

Now a days aircraft components are made with 3D printers because they are strong enough and light in weight. [11]

They are also used for making artificial eyes, jaw, faces and artificial ears. In AI field there are many use of 3D printing technology.

They are also used in making handgun with 3D printers. And different components of a gun are made with 3D printer.

Nike produces a part of sports shoes with the help of 3D printers. [12]

For making new products in medical and dental industries, the technologies are also utilized to make Patterns for the downstream metal casting of dental crowns and in the manufacture of tools over which plastic is being vacuum formed to make dental aligners.

For the jewellery sector, 3D printing has proved to be particularly disruptive. There is a great deal of interest.

3D printing is used in fashion.3D printed accessories including shoes, headpieces, hats, and bags have all made their way on to global catwalks.

It uses in small level industry because of its high accuracy and low cost. [13]

6. ADVANTAGES

3D printing allows ideas to develop faster. Being able to print a concept on the same day it was designed.

It also provides freedom of design, complexity for free, potential elimination of tooling. [14]

A user can make any complex shape on 3D printer by just making on CAD software or by scanning with 3D scanner. [15]

7. DISADVANTAGES

3D printing technology is currently limited by size constraints. Very large objects are still not feasible when built using 3D printers. [14]

At present, 3D printers can work with approximately 100 different raw materials. Research is required to devise methods to enable 3D printed products to be more durable. [15]

CONCLUSION

Introduction part is about the 3D printing technique that what process is used for making it. It also tells us about the additive manufacturing process, and rapid prototyping. Then it tells us about the different principle methods which can be used for 3D printer which includes stereo lithography, Fused deposition modelling, selective laser melting and many other process. In next paragraph we classified the 3D printers on different criteria. Then different application are discuss which includes medical field, automobile and aerospace industries. Then the advantages and disadvantages of 3D printers are discussed.

Advances in 3D printing technology can significantly change and improve the way we manufacture products and produce goods worldwide. An object is scanned or designed with Computer Aided Design software, then sliced up into thin layers, which can then be printed out to form a solid three dimensional product. As now we all know that 3D printing has application in all the stages of human need.

3D printing includes approximately 100 of materials now a days and the research is going on for increasing the range of material use in this technique.

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