

3D Printing Technology, Material Used For Printing and its Applications

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Abstract:-This is research paper on the 3D-printer in which reader introduced basic components operation materials used for making objects and applications. Now a day we are growing every day and every second. We adopt new technology with new invention and create new invention and create new things for enjoys life very easily. There are lots of new technologies we adopted in our daily life. In this technology one of them is 3D-printer. This is one of innovation on this we can make many objects.

Keywords: 3-D Printer, Manufacturing, Rapid Prototyping, Application of 3D Printing

1. Introduction^[1]

The birth of 3D-printer was 1974, David E. H. Jones laid out the concept of 3D-printing. In 1984, Chuck Hall of 3D system corporation filled his own patent. The 3D-printing it is the process in which making 3D objects from digital file. In this process objects made by printing layers on one another of specific material until entire object complete. This is one of the best process to create any complex objects in minimum time without complex process and large machines.

2. Basic components of 3D-printer^[1]

2.1 Print bed

The print bed is flat surface where the extruder deposits the filament from solid objects. This bed is heated while printing but it depends upon which filament or material we are going to use. Most of the beds are made of aluminum but now a days there is also glass print beds available.

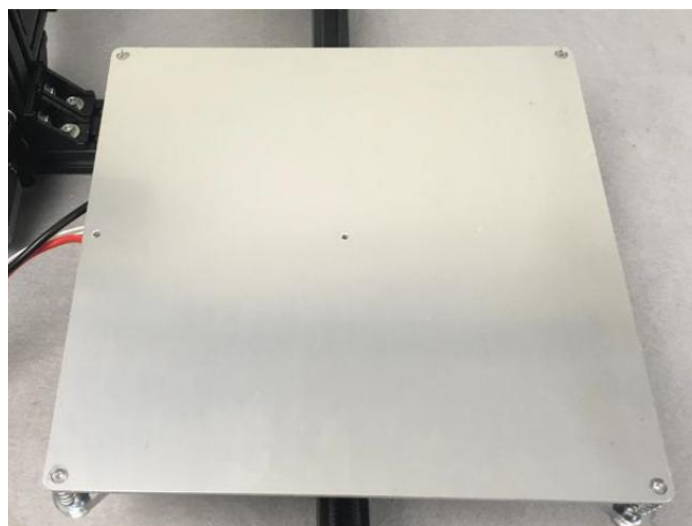


Fig.1 Print bed

2.2 Extruder

The extruder is the part that feeds heated filaments on the bed. This plays very important role in printing objects. Firstly in extruder filament exerts then it is heated. Due to heating filament starts melting and it starts depositing on print bed. Important part of extruder is Nozzle which also commonly known as

named as tip of extruder. Through the nozzle melted filament deposits on the print bed. The size varies from 0.25mm to 0.75mm. the most common size of nozzle is 0.5mm.

The extruder also has two types-

- 1) direct – Filament is fed directly to print bed
- 2) Bowden- Filament is fed from a certain distance.

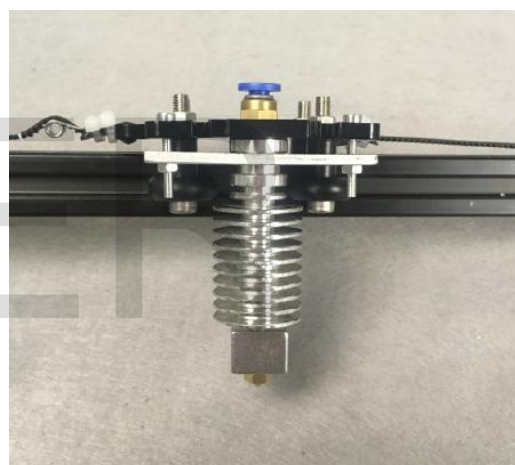


Fig.2 Extruder

2.3 Filament

It is material which is inserted in extruder for making object. Commonly for 3D-printing 1.75mm or 3mm diameter filament is used. This material is in the form of wire which feeds to extruder through motor. The most commonly PLA and ABS material used for printing. Filaments available in various types of material which we will discuss further.

2.4 Mother board or controller board

The mother board or controller board is the brain of the 3D-printer. It directs the motion of components of 3D-printer.

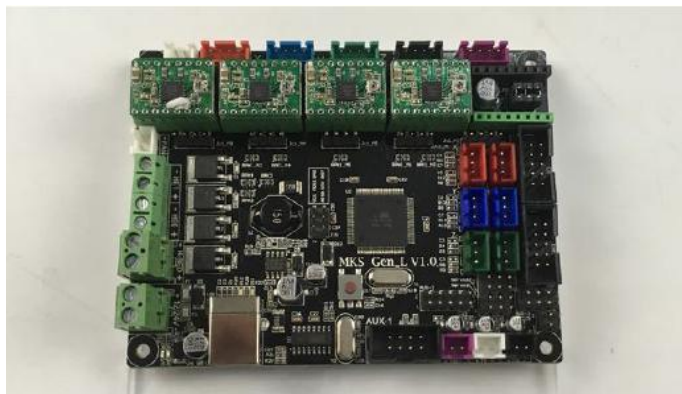


Fig.4 Mother board or controller board

3. Operation of 3D-printer

3.1 Step-1

This step contains drafting of 3D objects which we want to print in CAD software. But we can't use 3D objects file as it is. These files need to be converted into STL file format. There are many software available in the market which can be used for drafting and modeling also. Some of these are Fusion 360, Solid Works, Auto CAD etc. Also nowadays 3D scanners are also available for making programmer files. This program sends to the main board of the printer by using computers also by the pen drives or memory card.

3.2 Step-2

This is the last step of 3D-printing. When the program given to the printer as per requirement material starts to heat in the extruder and filament starts to melt. This melting material is deposited on the print bed as per program and the object is made by depositing materials layer by layer on one another. The layers are horizontal, cross, zigzag way with each other also in hexagonal or honey comb structure.

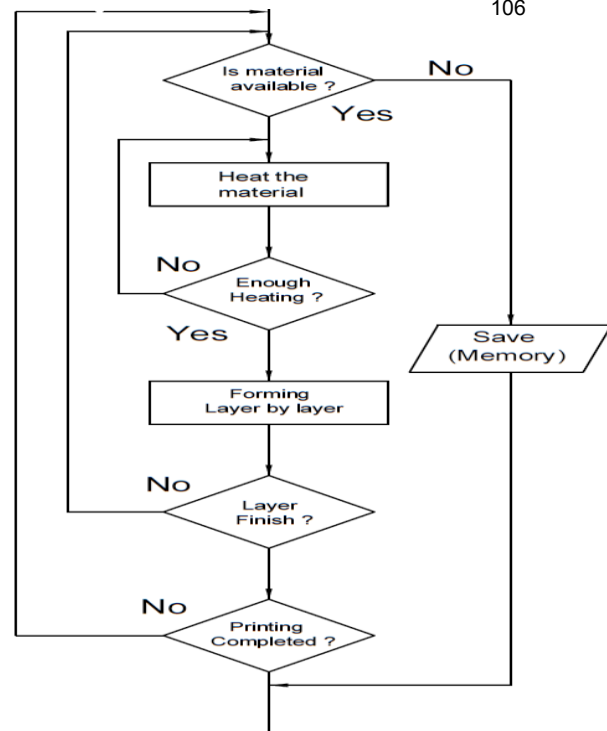


Fig.5 Flow chart of 3D printing operation

4 Materials used in 3D-printing technology^[2]

In the 3D-printing needs high quality materials for making high quality devices. 3D-printers technology is capable of making high quality devices by using of many types of material like metals ceramics and their combination forms.

4.1 Plastic^[3]

This is the most common material used for 3D-printing. This is the most diverse material for 3D Printed toys and household products. This is available in transparent and also in colors like green red yellow etc. Plastic is light in weight also high durability its surface smoothness very well. The types of plastic used in this process are usually made from one of the following materials

- 1) Polyactic acid (PLA)

This is eco-friendly material. PLA is made up of from sugar cone and corn starch therefore biodegradable. This is available in two forms soft and hard. Plastics are made from polyactic acid so it is used in industries hard polyactic acid are stronger and therefore they are used for making ideal products.

- 2) Acrylonitrile butadiene styrene (ABS)

ABS is the best option of home based 3D-printers. It is valued for strength and safety. ABS is available in various colors. This makes the material suitable for products like stickers and toys. ABS is also used to make jewelry and vases.

- 3) Polyvinyl alcohol plastic (PVA)

It is used in low end home printers. It is low cost. This material is used for temporary used items.

- 4) Polycarbonate (PC)

PC is only used on this printer which features nozzle is designed and operates on high temperature. This is less frequently used.

4.2 Powders

Today's 3D-printers use powdered materials to construct objects or products. This powder is melted inside the printer and distributed in layers until the preferred thickness and pattern are made. There are many powders used in printers but most common are

1) Polyamide (Nylon)

Nylon strength and flexibility is very therefore it is used for joining pieces and interlocking parts in 3D models.

2) Alumide

This powder makes the strongest products. This is mainly used for making industrial models and prototypes.

4.3 Metal^[4]

The second most popular material in industry of 3D-printing is metal. The properties of this material is strong hard more life and long lasting life. The properties of metal is good hence we make complex shapes human organs and aerospace's parts. They also make jewelry. Various metals used for products are below

1) Stainless steel-printing out utensils cookware and other items that could ultimately come in contact with water.

2) Bronze -Used for vases and other products.

3) Gold -Printed for jewellery likes ring and earring brackets etc.

4) Nickel-Used for printed coins

5) Aluminium -Used for printed thin metal objects

6) Titanium -It is best option for strong solid fixtures

4.4 Resins

Resins properties are less flexible and strength. This is generally found in transparent black and white but certain printed items are produced in orange red blue and green. This is less used materials used in 3D-printing There are available in three categories

1) High details resins:-These are used for small models

2) Paintable resin :-Used in smooth surface 3D prints

3) Transparent resins :-Used in strongest class and smoother to that rough and transparent in appearance.

In 3D-printers also used other materials like carbon fiber graphite and graphene nitinol paper

References

1. Dr.Muhammad Abu Khaizaran et-al, 'Team paper on 3-D printing technology', Birzeit university. Electrical and Computer system engineering department, 2014, Pp.1-9
2. Thabiso Peter Mpfou et-al, 'The impact and Application of 3-D Printing Technology', International Journal of Science and Research, Pp.2148-2152, ISSN2319-7064

5. Applications^[5]

There are many sectors where we can use this technology these are

1) Aerospace:-In this field many are directly made by using 3D-printer. The aerospace and defence industries contributed 16% of 3D-printing. SLA and material jetting are used to produce high details smooth scale models of aerospace design.

2) Food :-Additives manufacturing of food is being developed by using 3D-printing. NASA also worked on this technology which is making food on 3D-printer in the space. A larger no. of variety of foods are making on 3D-printers such as the chocolate candies pizza flat food. This technology helps to limit food waste.^[6]

3) Automobile industry:-In our automobile industries developed very fast new innovations are coming out from industry. Now a days industries adopted 3D-printing technology for making products.

4) Medical application :-This technology also used in medical application for printing skin bones drug organs medical equipment's tissues pharmaceutical research. 3D-printing also can be used to create human organs.^[7]

5) Art and jewellery :-By using this technology also used for printing jewellery. This used for printing many decorative parts.^[8]

5. Conclusion

3D printing have large scale industrial area where we can develop new things. New 3D printing technologies take less time for making products. These products making highly precise product in less time and less cost without any big equipment and machine, so it plays a very important role in our industrial areas. This research paper helpful for studies on future scope of 3D printing and also new technologies and their applications. In world wide, big market available for this type of technology.

3. N.Shahrubudin et-al, 'An overview of 3D Printing Technology: Technological, Materials, and Applications, published in second international conference on sustainable materials processing and manufacturing, proceeding manufacturing35(2019)Pp.1286-1296(Elsevier B.V.)
4. A.Ramya et-al, '3D Printing Technologies in Various Applications', International Journal of Mechanical Engineering and Technology', Volume7-issue3, may-June2016, Pp.396-409

5. Frank Thewissen et-l, 'If 3D printing has changed the industries of tomorrow ,how can you get ready today' www.ey.com/3D printing, EYG NO.02180-163GBL
6. Perez K.B. et-al, 'AM Principle cards on additive manufacturing' , based on the article 'Crowd sourced Design Principle FOR Leveraging the Capabilities of Additive Manufacturing' International Conference on Engineering Design, Milan, IT, July 2015
7. 2020n Types of 3D Printing Technology, <https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/>
8. 'Leading Uses of 3D Printing Technology', <https://www.statista.com/statistics/560271/worldwide-survey-3d-printing-uses/#:~:text=In%202020%2C%20the%20most%20popular,used%20the%20technology%20for%20production.>

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