

24ME306 MANUFACTURING PROCESSES

UNIT-5

Advanced Manufacturing Techniques

Stereo- Lithography (SLA)

Stereolithography (SLA) is a 3D printing and additive manufacturing process that builds objects layer by layer using a UV light source to solidify liquid photopolymer resin

Modern stereolithography (Emerged in 1970s)



Laser scanning stereolithography
(The first generation, from 1984)

Others: Color stereolithography,
Thermal stereolithography,
et al.



Projection stereolithography
(The second generation, from 1988)

Scanning-
projection

Multi-
material



Continuous stereolithography
(The third generation, from 2015)

Hybrid

Magnetically
assisted

Electrically
assisted

... ..



Volumetric stereolithography
(The fourth generation, from 2016)

Stereolithography Process

Stereolithography process (SLA) is a rapid prototyping process that involves building 3D parts layer by layer using a liquid polymer material, which is solidified with the assistance of a laser. In the Stereolithography process, a computer-controlled laser selectively solidifies the liquid resin, tracing the shape of each layer as dictated by a digital 3D model.

This layer-by-layer approach allows for the precise creation of highly detailed prototypes, making SLA a popular choice in industries like product design, engineering, and medicine.

Construction of Stereolithography Machine

1) Laser Source

The Laser Source emits a precise laser beam, which is directed onto the liquid resin in the container. This laser is a critical component in the solidification process, as it selectively cures and hardens the liquid resin layer by layer, ultimately forming the desired 3D object.

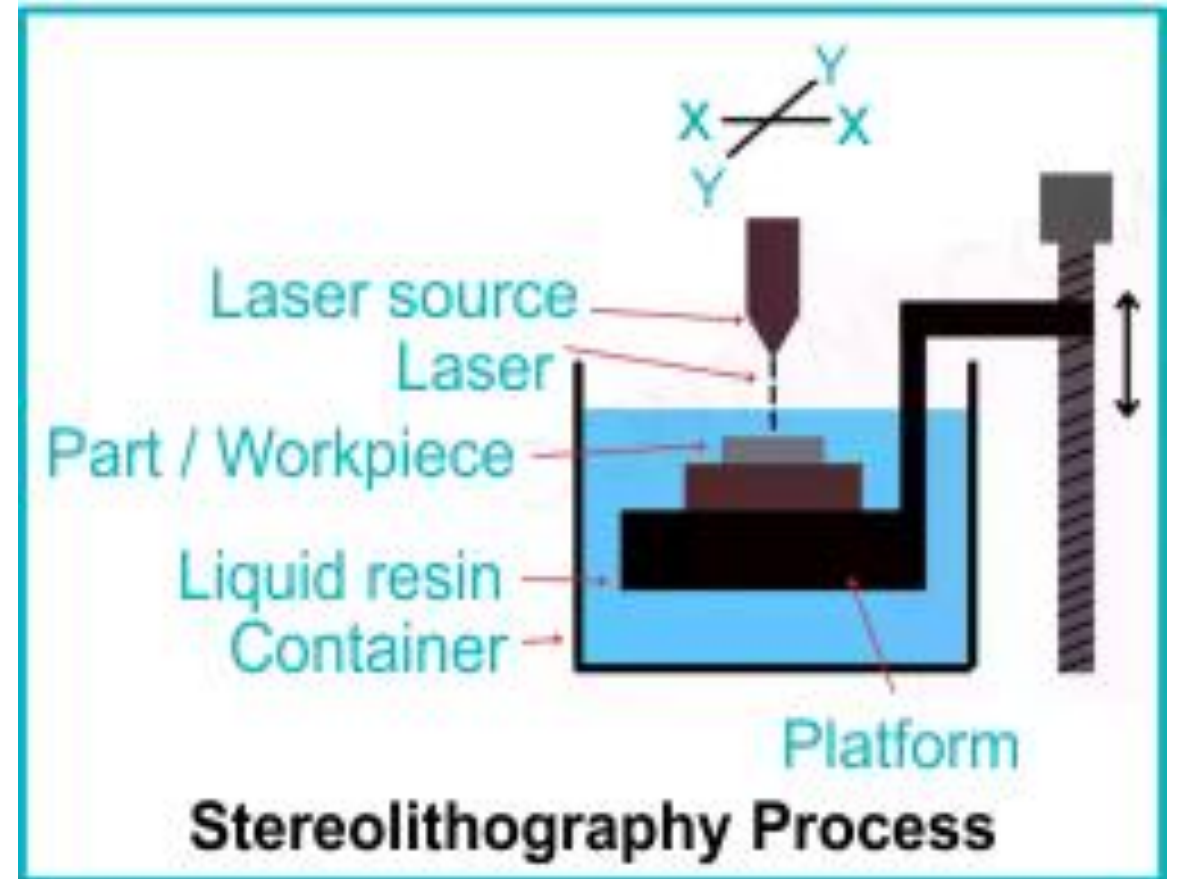
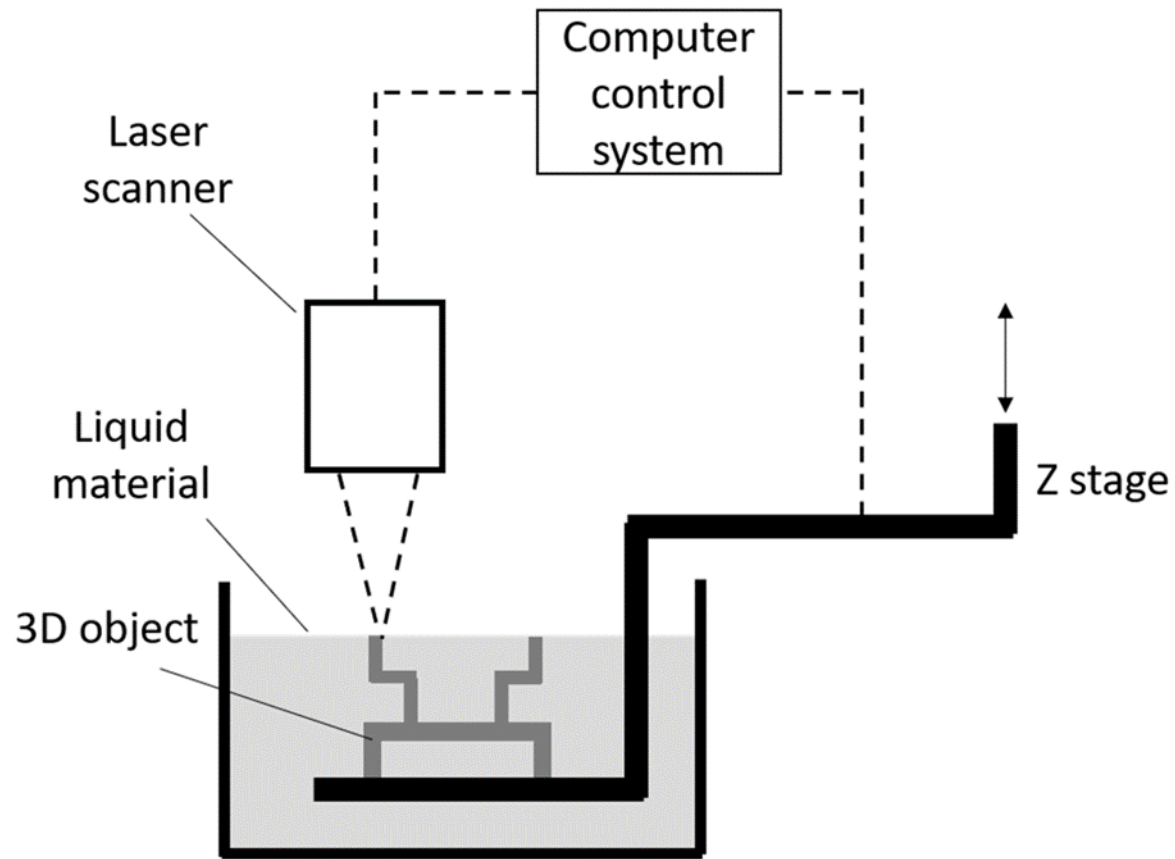
2) Container

The Container is filled with liquid resin, serving as the raw material for creating the part. When the focused laser beam interacts with the liquid resin, it initiates the solidification process. This precise interaction between laser and resin is the foundation of Stereolithography's layer-by-layer construction.

3) Platform

The Platform in the Stereolithography Machine is an integral part of the part-building process. It possesses the capability to move both upward and downward. During the construction of a part, the Platform descends incrementally after the laser solidifies each layer. This controlled movement allows new layers of liquid resin to be added and solidified on top of the previously formed solid layer. The precision and accuracy of the Platform's movement are essential for producing detailed and dimensionally accurate 3D objects in the Stereolithography process.

Working of Stereolithography Process



Stereo- Lithography

During the Stereolithography process, the action of a precision-controlled laser beam solidifies a layer of liquid resin on the build platform. This controlled solidification is crucial for layer-by-layer construction of the desired part. This additive manufacturing technique allows for the creation of highly detailed prototypes with intricate geometries and smooth surface finishes, making it indispensable in various industries such as product design, engineering, and healthcare.

Advantages of Stereolithography Process

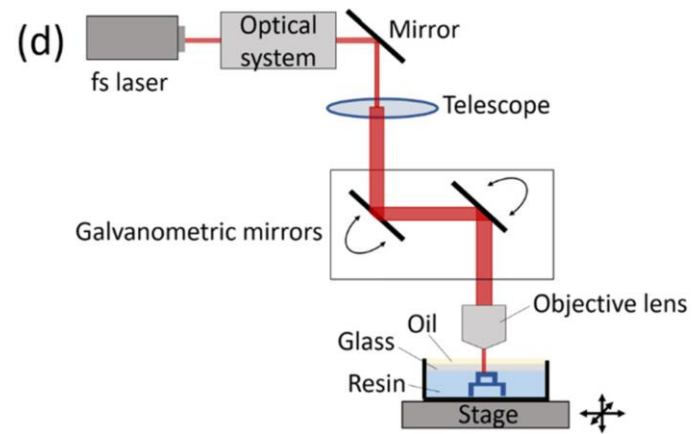
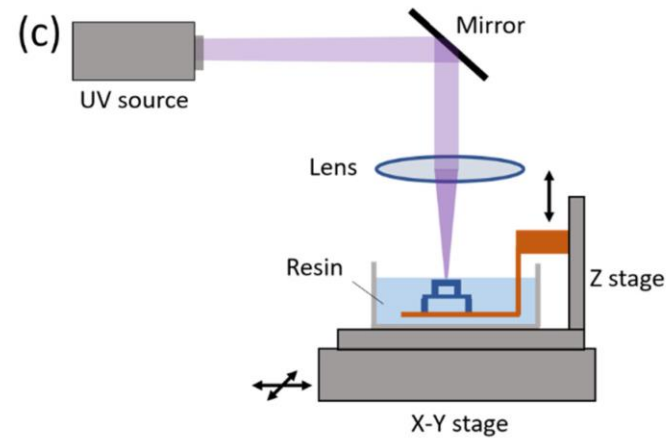
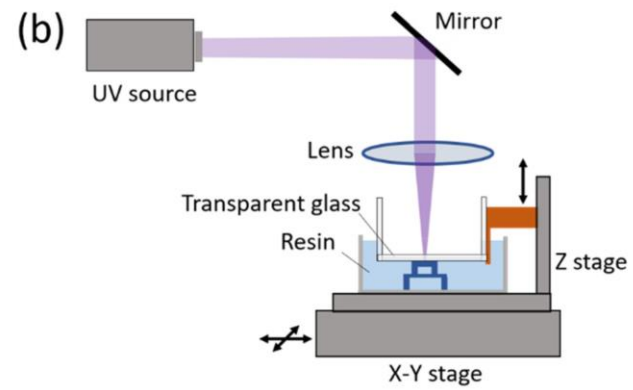
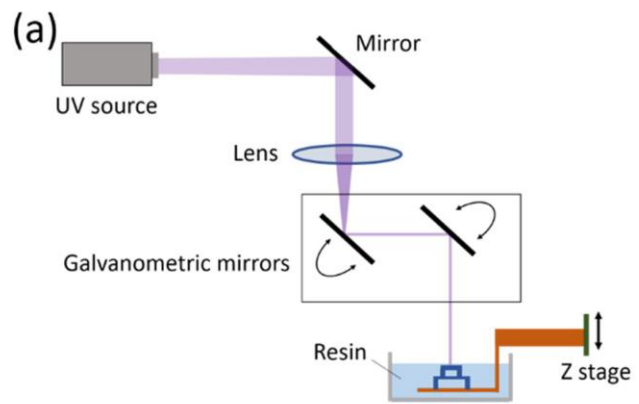
- High precision and fine detail in the final product.
- Smooth surface finish, reducing the need for post-processing.
- Versatility in creating intricate and complex geometries.
- Supports a wide range of materials for different applications.
- Rapid prototyping enables quick design iteration.

Disadvantages of Stereolithography Process

- Limited in building large-sized objects.
- Stereolithography machines tend to be relatively expensive.
- Material choices are often limited compared to other 3D printing methods.

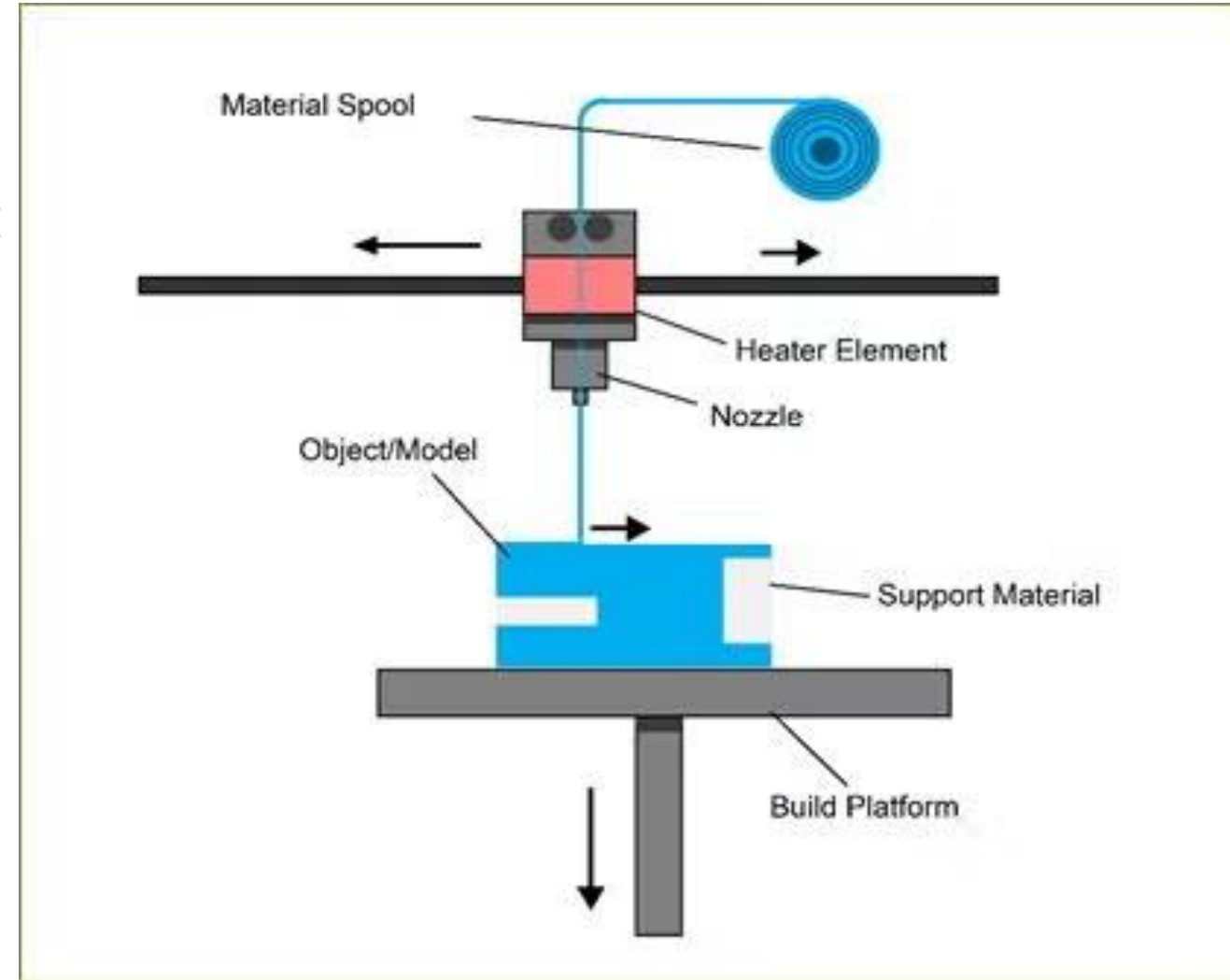
Applications of Stereolithography Process

- Prototyping and product development
- Medical and dental models
- Custom jewelry and fashion accessories
- Architectural models
- Art and sculptures
- Rapid tooling and manufacturing aids
- Educational models
- Engineering and aerospace components
- Consumer electronics components



Fused Deposition Modelling (FDM)

Fused Deposition Modeling (FDM), also known as Fused Filament Fabrication (FFF), is an additive manufacturing process that builds 3D objects by selectively depositing layers of melted thermoplastic filament



The FDM Process

1. File Preparation:

A 3D Computer-Aided Design (CAD) file, typically in STL format, is processed by software that slices it into thin layers and generates tool paths.

2. Material Loading:

A thermoplastic filament is fed from a coil into a heated extrusion head.

3. Melting and Extrusion:

The nozzle melts the filament and extrudes the molten plastic, depositing it onto a build platform in layers.

4. Layer-by-Layer Building:

The nozzle moves according to the generated tool path, creating each layer from the bottom up, and the plastic hardens immediately after extrusion.

5. Support Structures:

If the design includes overhangs or complex features, disposable support structures are automatically generated and deposited.

6. Part Cooling:

As each layer is deposited, it cools and solidifies, bonding with the previous layer to form a complete 3D object.

