# Additive Manufacturing Technologies

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# Lecture No 5

## Additive Manufacturing Technologies

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1. Vat Polymerization: a platform is dropped through or raised above a vat of liquid resin where light is used to selectively solidify it.
2. Material Extrusion: material is fed through a nozzle in a liquid state after which it solidifies;
3. Material Jetting: material is jetted in liquid droplet form after which it solidifies;
4. Sheet Lamination: sheets of material are bonded together either before or after the part outline is separated from the sheets;
5. Powder Bed Fusion: an energy beam (laser or electron beam) is focused onto the powder bed and rastered across the powder surface in a pattern to fill the area defined by one slice of the desired 3D model.
6. Binder Jetting: droplet printing of a liquid used to bind powder particles together;
7. Directed Energy Deposition: material is simultaneously fed into a moving focused energy region;

# Stereolithography Apparatus (SLA)

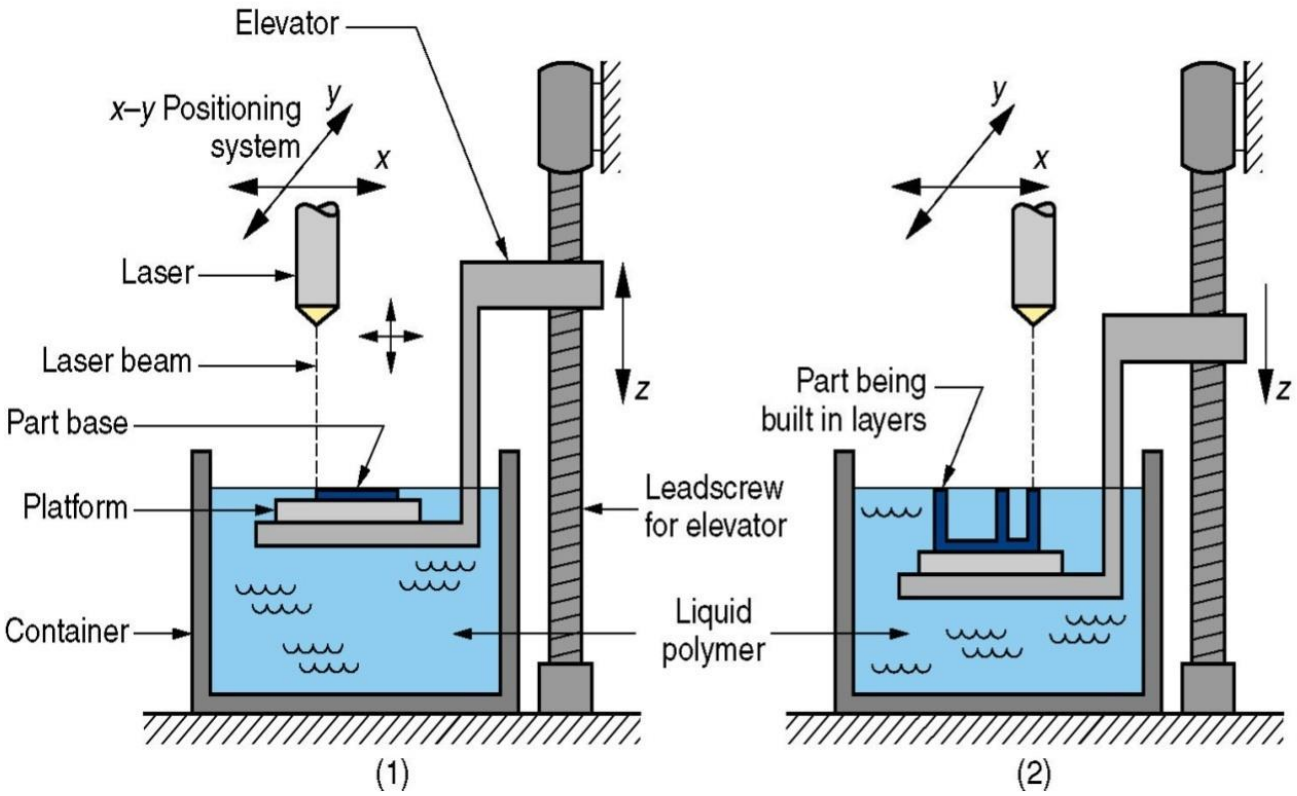
- Manufactured by 3D Systems
- Invented by Charles W. Hull
- The first commercial RP system
- Use photo-curable liquid resins
- Use UV laser

# Stereolithography (SLA)

- **Stereolithography (SLA)**. SLA is a process based on the principal of **hardening** (curing) a liquid photopolymer, using a directed **laser beam** to solidify polymer into a **specific shape**.
- Containing a mechanism whereby a **platform** can be **lowered** and **raised**, is filled with a photocurable liquid acrylate polymer.
- The liquid is a **mixture** of **acrylic monomers**, **oligomers** (polymer intermediates) and a **photoinitiator**.
- When the platform is at its **highest position**, the layer of liquid above it is **shallow**.
- A **laser** generating an ultraviolet beam, is now focused upon a **selected surface area** of the photopolymer and then moved in the x-y direction.

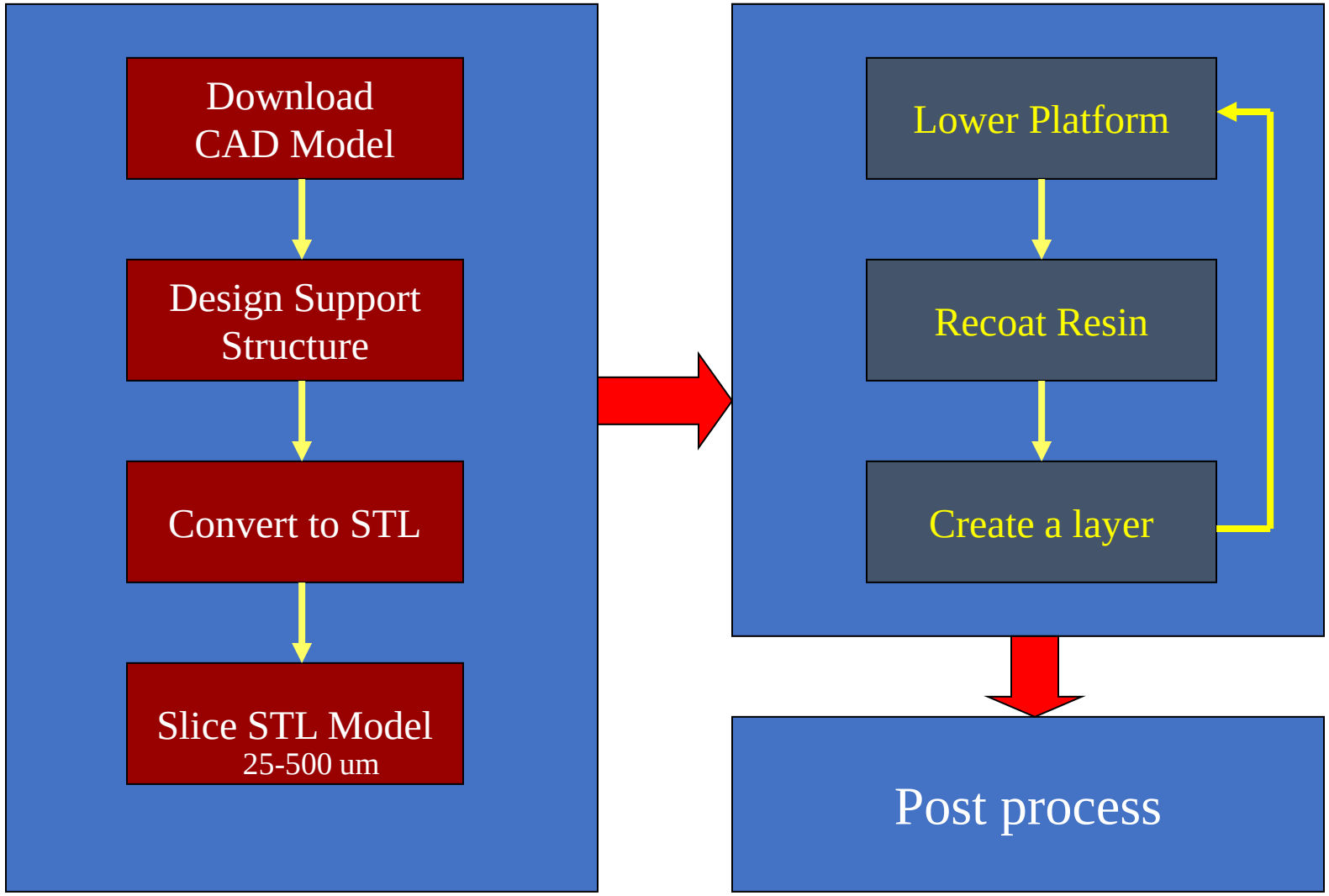
# Stereolithography (SLA)

- The **beam cures** that portion of the **photopolymer** and thereby produces a **solid body**.
- The **platform** is then **lowered** sufficiently to **cover** the **cured polymer**, and the sequence is repeated. The process is repeated until **level-b is reached**.
- **Generate a cylindrical part** with a constant wall thickness, the **platform** is now **lowered** by a **vertical distance-ab**.
- At **level-b**, the x-y movements of the beam are wider, a **flange-shaped** portion that is being **produced**.
- Process is repeated, **producing** another **cylindrical** section between **levels-b** and **c**.
- **Tolerance** depends on sharpness of the laser, typically 0.0125 mm.
- **Cycle times** range from a **few hours** to **a day**.
- Maximum **part size** is 0.5 m x 0.5 m x 0.6 m.



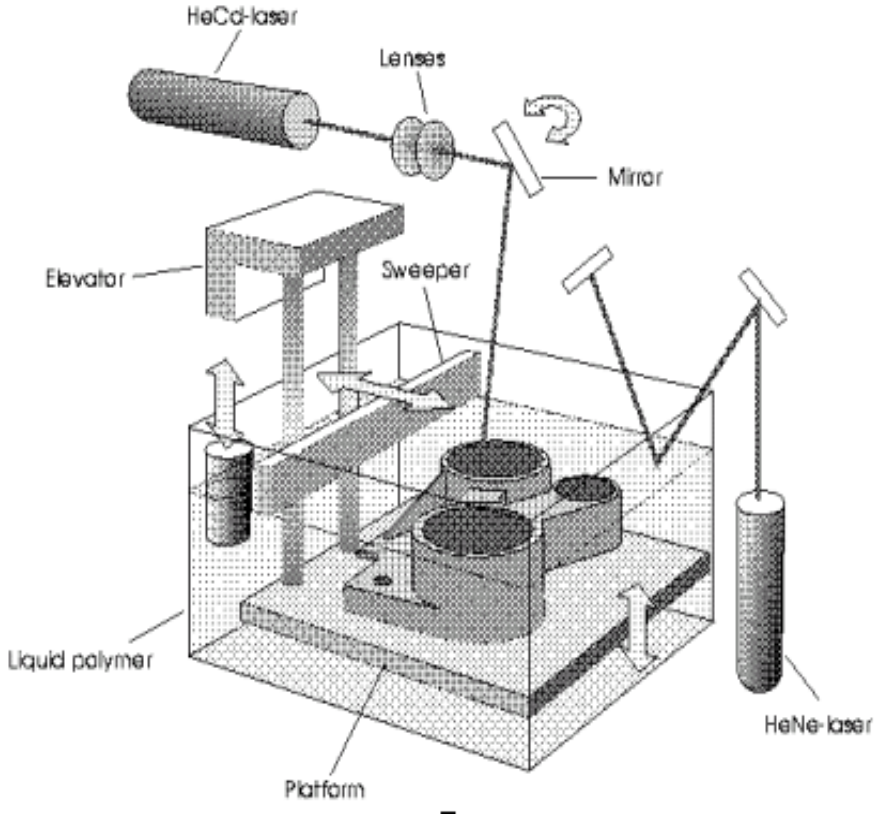

**Schematic illustration of the stereolithography process and part of SLA**

# SLA Process


Download CAD Model
Design Support Structure
Convert to STL
Slice STL Model
25-500 um
Lower Platform
Recoat Resin
Create a layer
Post process

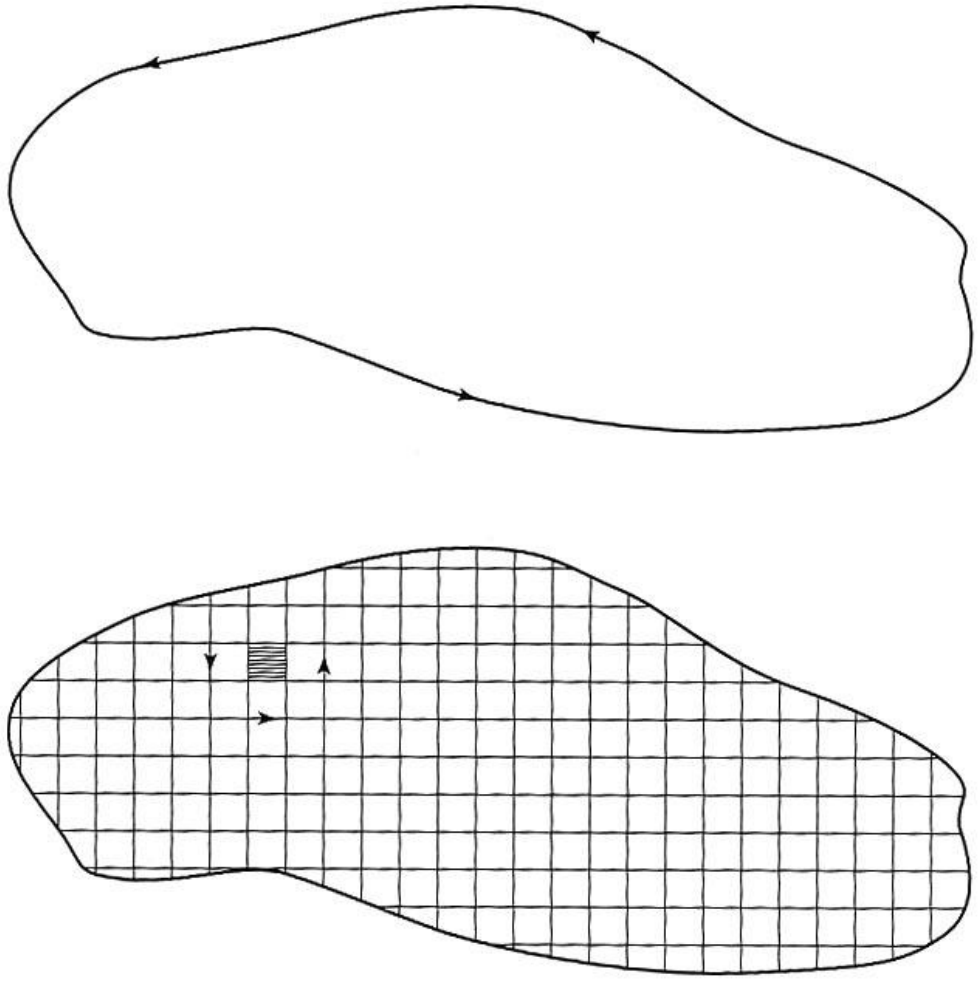
# Principle of SLA

Physical models are built from liquid photosensitive polymers.




Liquid polymer is solidified after exposed to UV light along the scan path.

# Layer Creation with SLA



# Stereolithography (SLA)

There are two primary configurations in this technology:

- an upright style
- inverse configurations