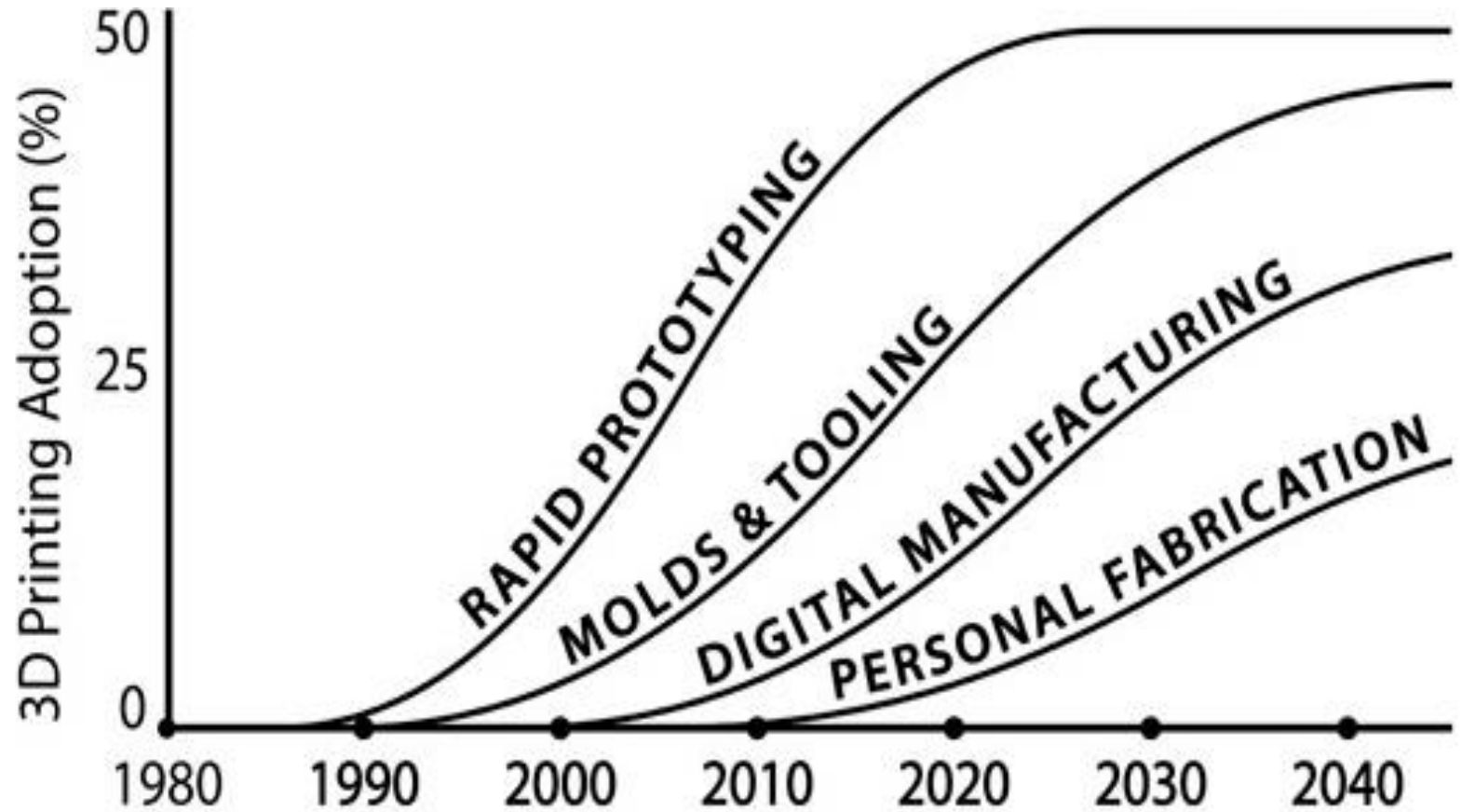


# 3D PRINTING ADDITIVE MANUFACTURING

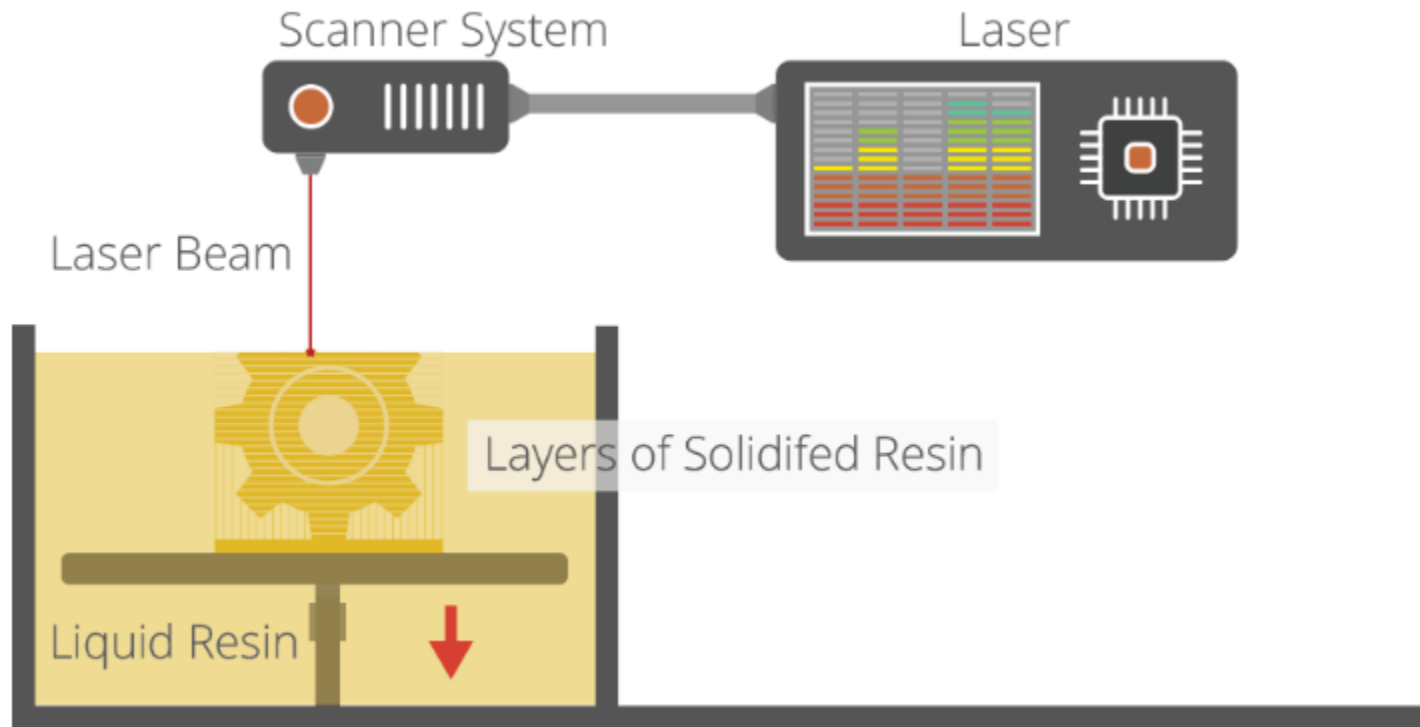
# APPLI CATIONS



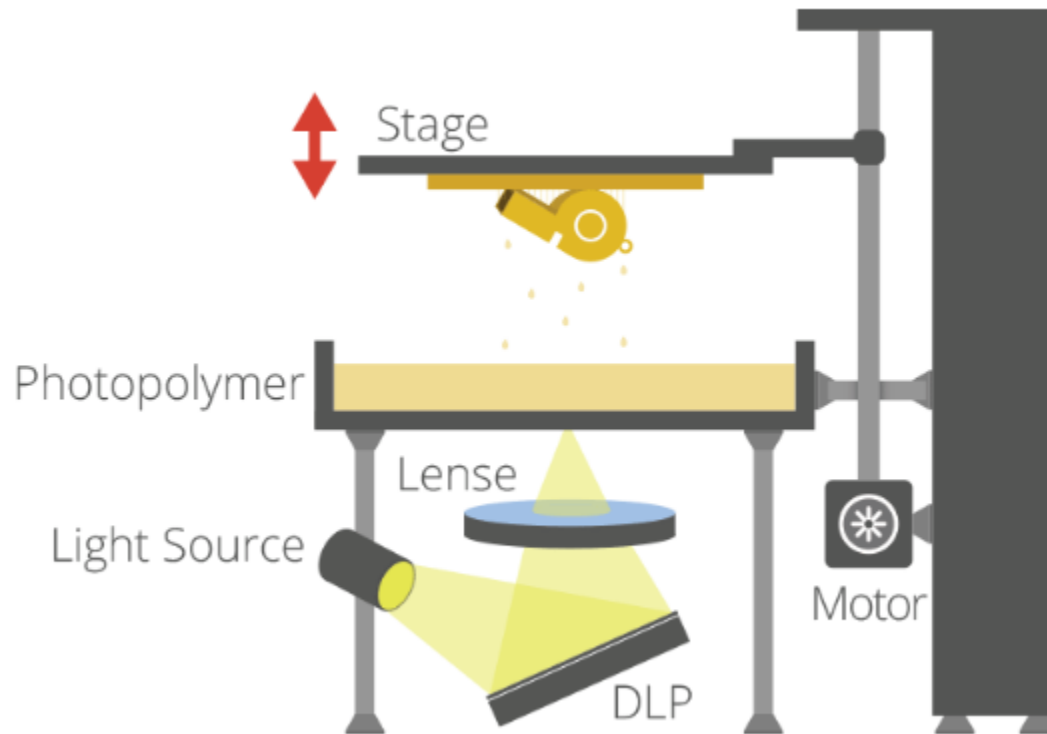
# PROCESSES

- STEREOLITHOGRAPHY
- DIGITAL LIGHT PROCESSING
- LASER SINTERING/LASER MELTING
- EXTRUSION/FDM/FFF
- INKJET: BINDER JETTING
- INKJET: MATERIAL JETTING
- SELECTIVE DEPOSITION LAMINATION
- ELECTRON BEAM MELTING

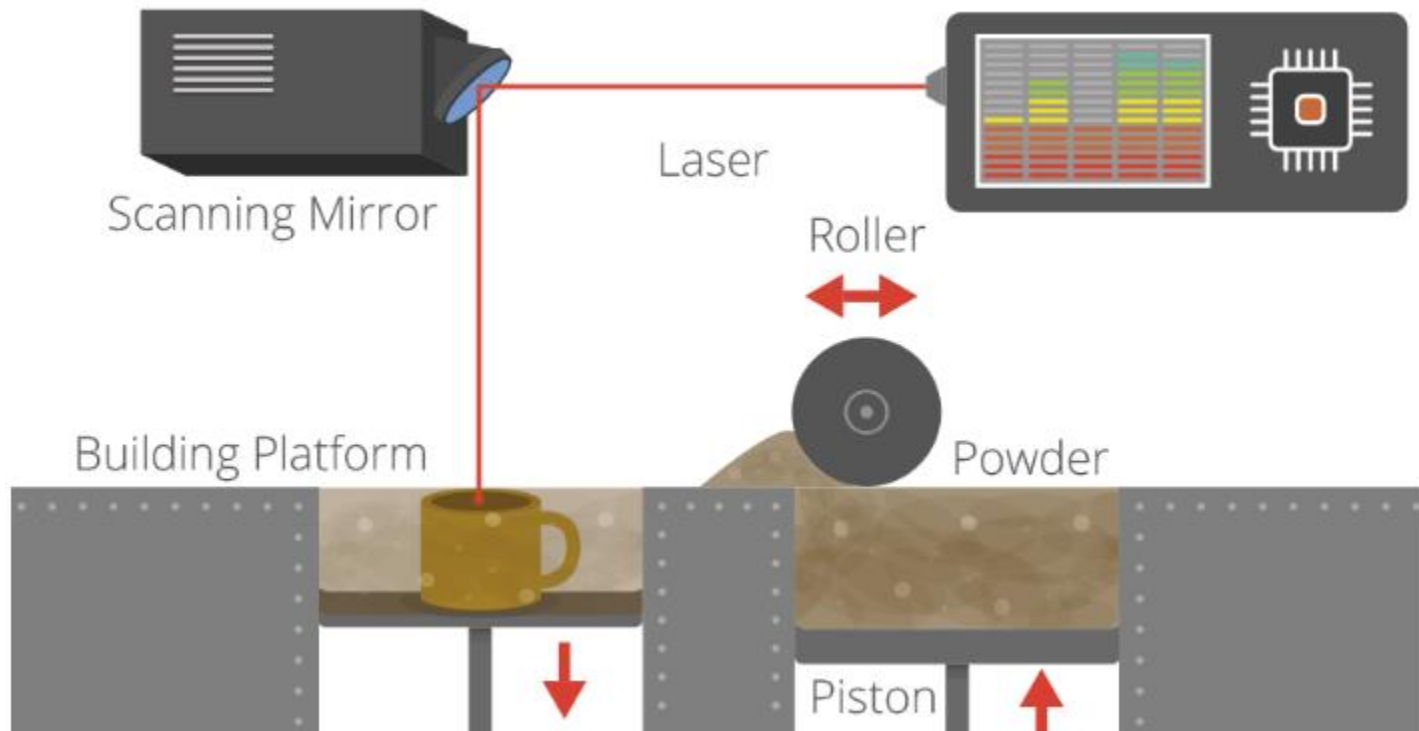
# STEREOLITHOGRAPHY



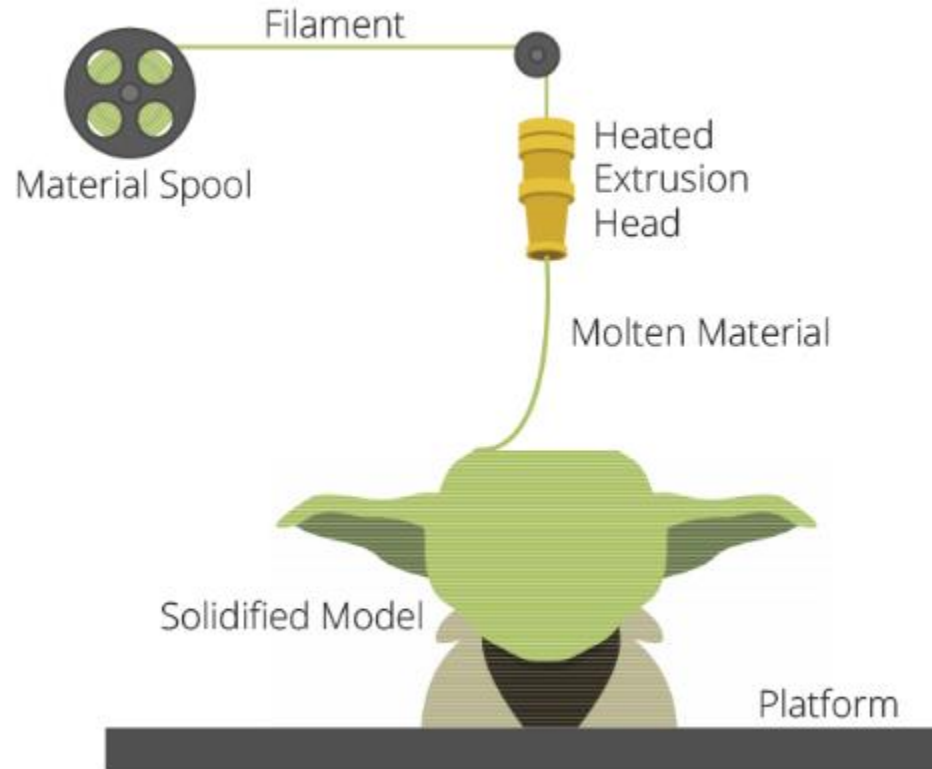
# DLP--DIGITAL LIGHT PROCESSING



# LASER SINTERING/LASER MELTING

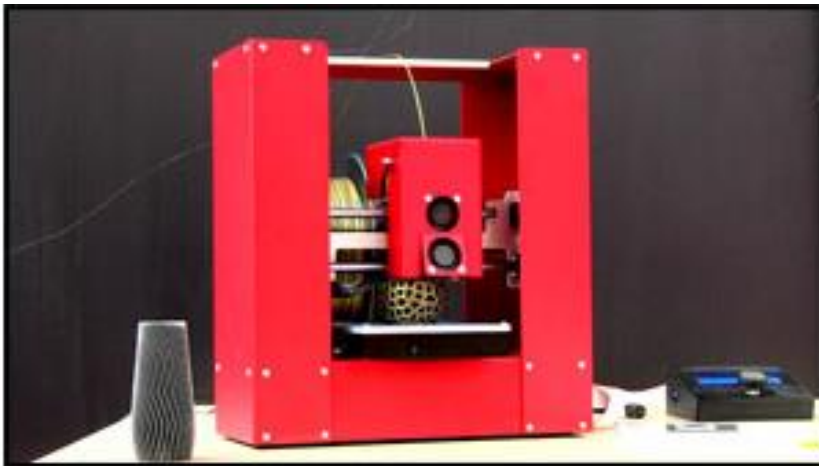


# Extrusion/FDM/FFF



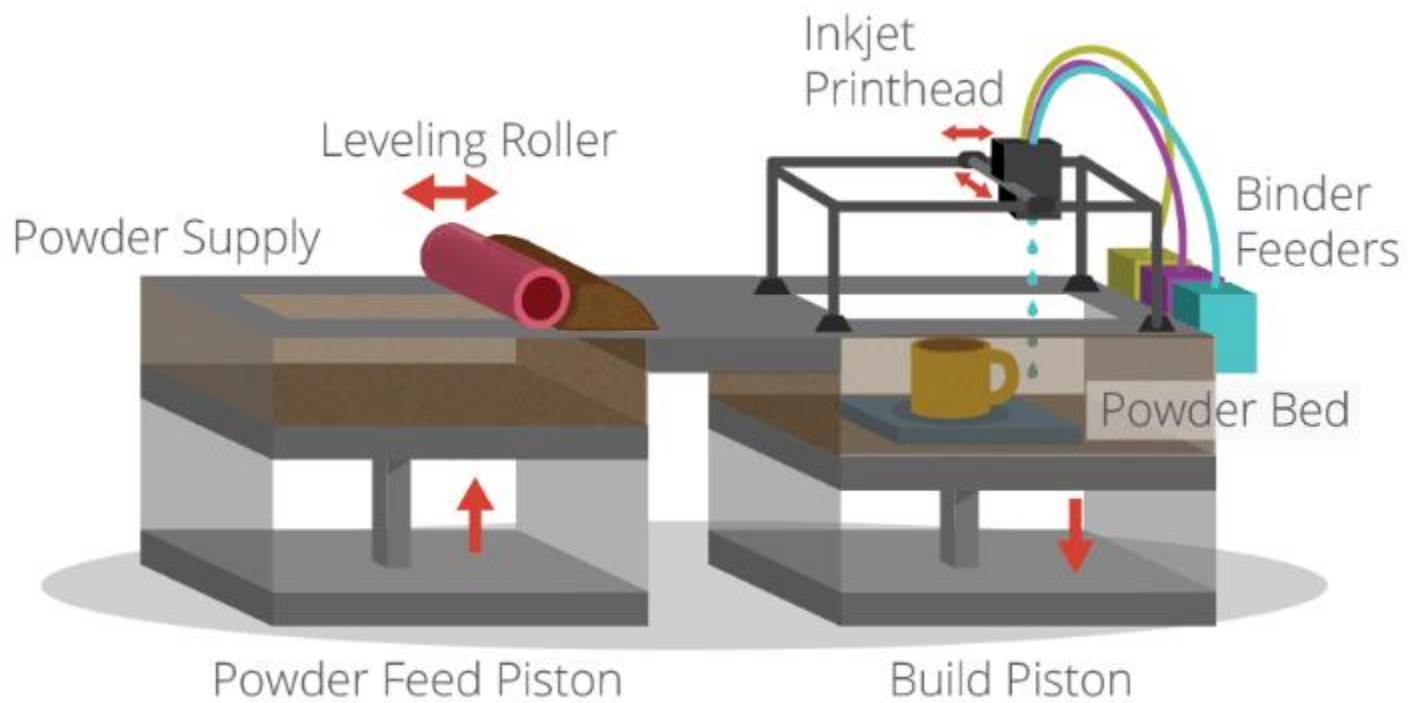
# PERSONAL FABRICATING

- Very, very early stage
- Thermoplastics or composites
- Free models
- Parts, accessories

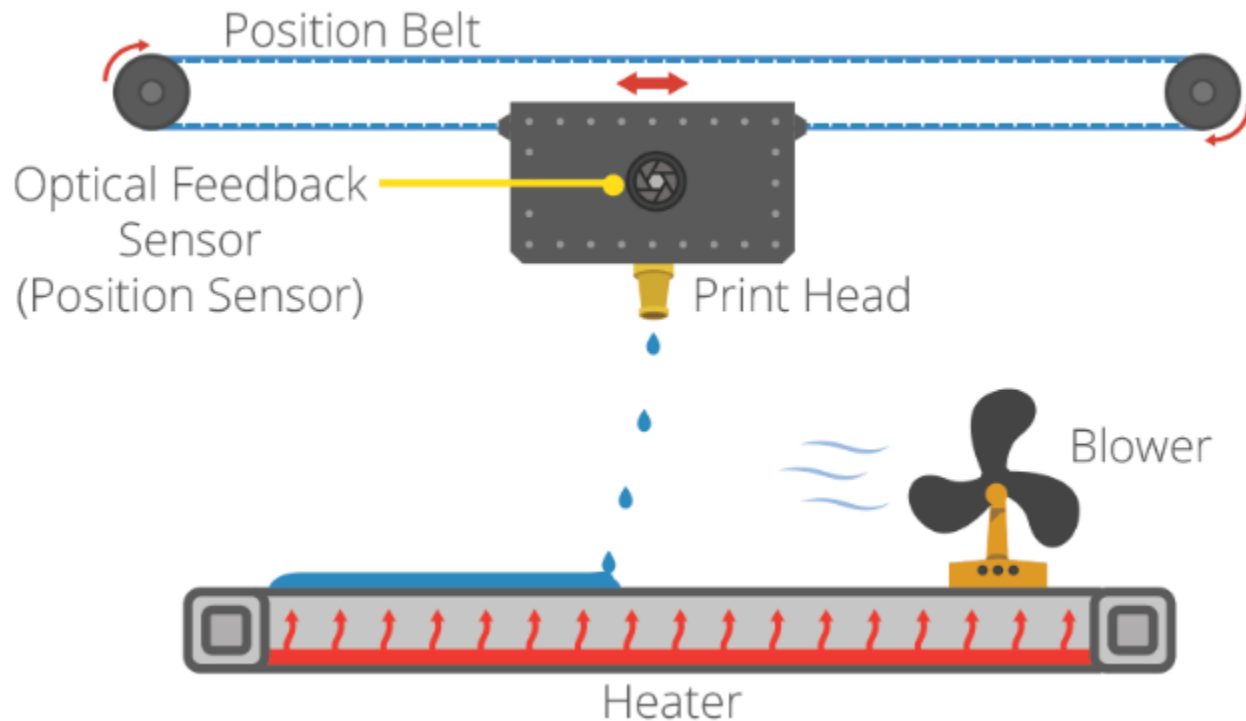




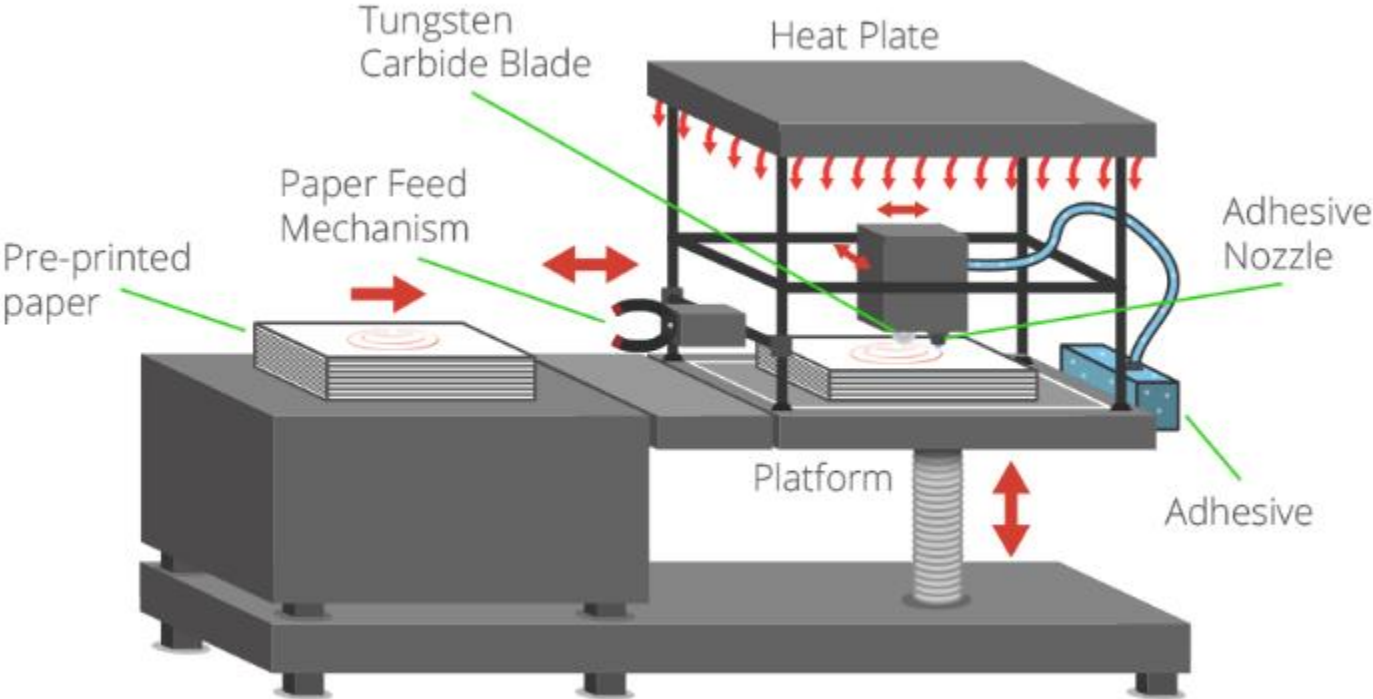
# INKJET: BINDER JETTING



# INKJET: MATERIAL JETTING



# SELECTIVE DEPOSITION LAMINATION SDL



# SDL: a closer look



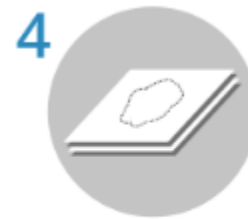
First sheet of paper is added to the platform



The adhesive is added to the select areas of the paper



Heat & pressure is applied to help bond the paper

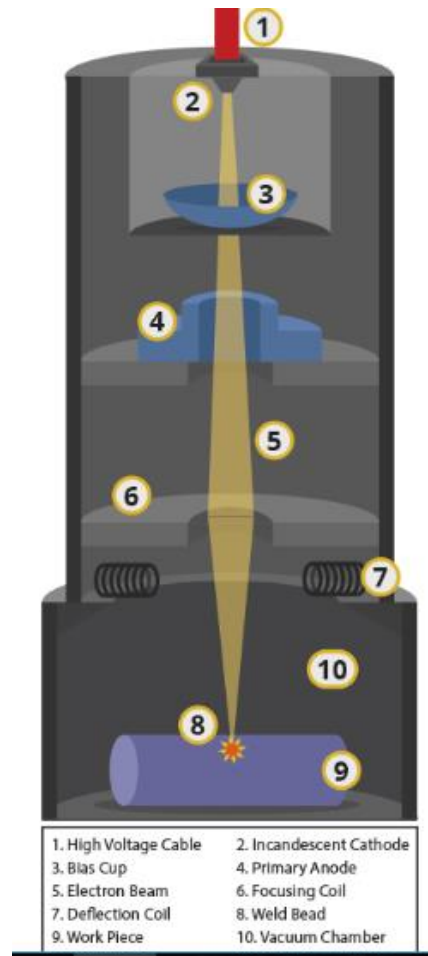


A tungsten carbide blade cuts the paper one sheet at a time along the cut line



This process continues until the model is finished

# ELECTRON BEAM MELTING: EBM



# KEY COMPONENTS

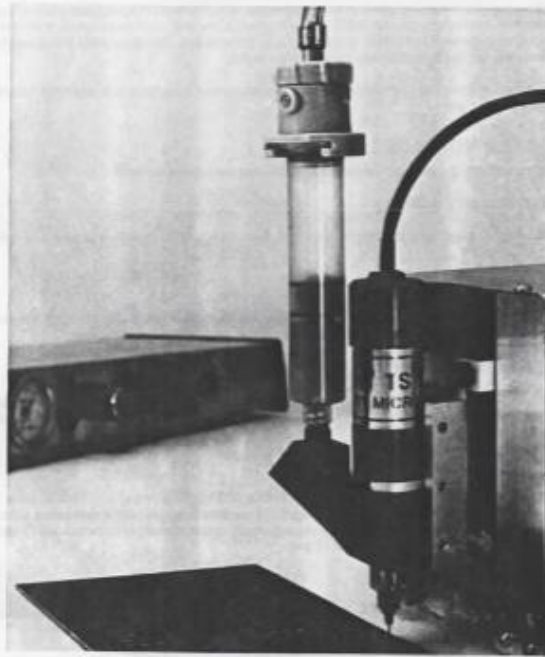
- Fast & accurate Cartesian robots
  - X,Y,Z
  - Overhead deposition with dropping table
- Sophisticated software
  - Slicing
  - CAD/CAM
- X-ray/CT Scan
- Materials that could be deposited and cured in process
  - Polymers, metals, human cells
  - Method of dispensing them
    - Liquids, filament, powder
- Method of curing them in process
  - Air, UV, hot iron, laser

# ICON



# SOLDER PASTE

## TS5000 ROTARY MICROVALVE POSITIVE DISPLACEMENT PUMP



**AUTOMATION  
UNLIMITED™**

26 Conn Street, Woburn, Massachusetts 01801 - 5662  
(617) 933-7288 / Telex: 5106005830 / Fax: (617) 933-2042



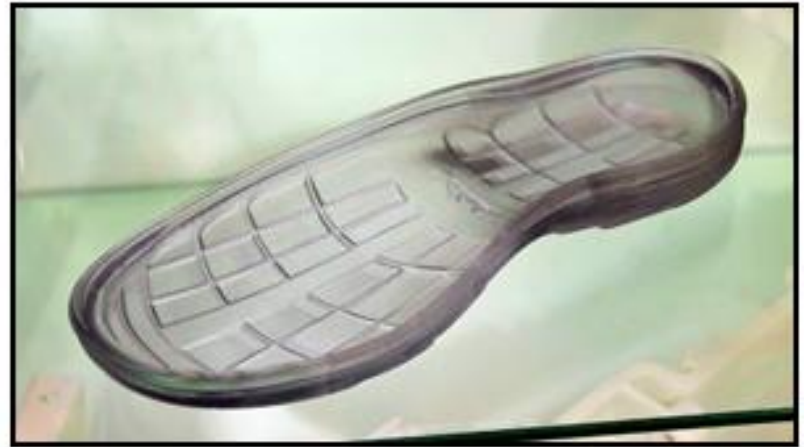
# APPLICATIONS



# MICRO FLAME



# PROTOTYPING



**3D printing is now widely used to create product prototypes and prototype parts**

# MOLDS & TOOLING



**3D printed injection molds and patterns**

# DIRECT DIGITAL MANUFACTURING

- Space/Aerospace: optimize geometries
- Automotive: save materials, low-run
- Healthcare: individual
- Toy making: geometries, color
- Arts & Crafts: geometries, colors
- Designer/Fashion: individual



# MATERIAL SCIENCE

- Material/heads: steady progress in heating/curing material; lasers; sintered metals
- Polyjet: UV curable materials
- Fused Deposition: Strands of Nylon, PC-ISO, PPSF-Polyphenylsulfone, PC-AB, PC-Polycarbonate, ASA, Ultem 1010.
- Laser Sintered: Nylon, FR-106, Duraform HST
- Direct Metal Laser Sintering: Stainless Steel, Cobalt Chrome, Inconel, Titanium, Aluminum
- Wax: Create cavities

# SOFTWARE

- big progress;
- CAD/CAM software
- CT/X-ray
- Slicing machine

# MANUFACTURING

- JET ENGINES



# DENTAL



# BIOPRINTING

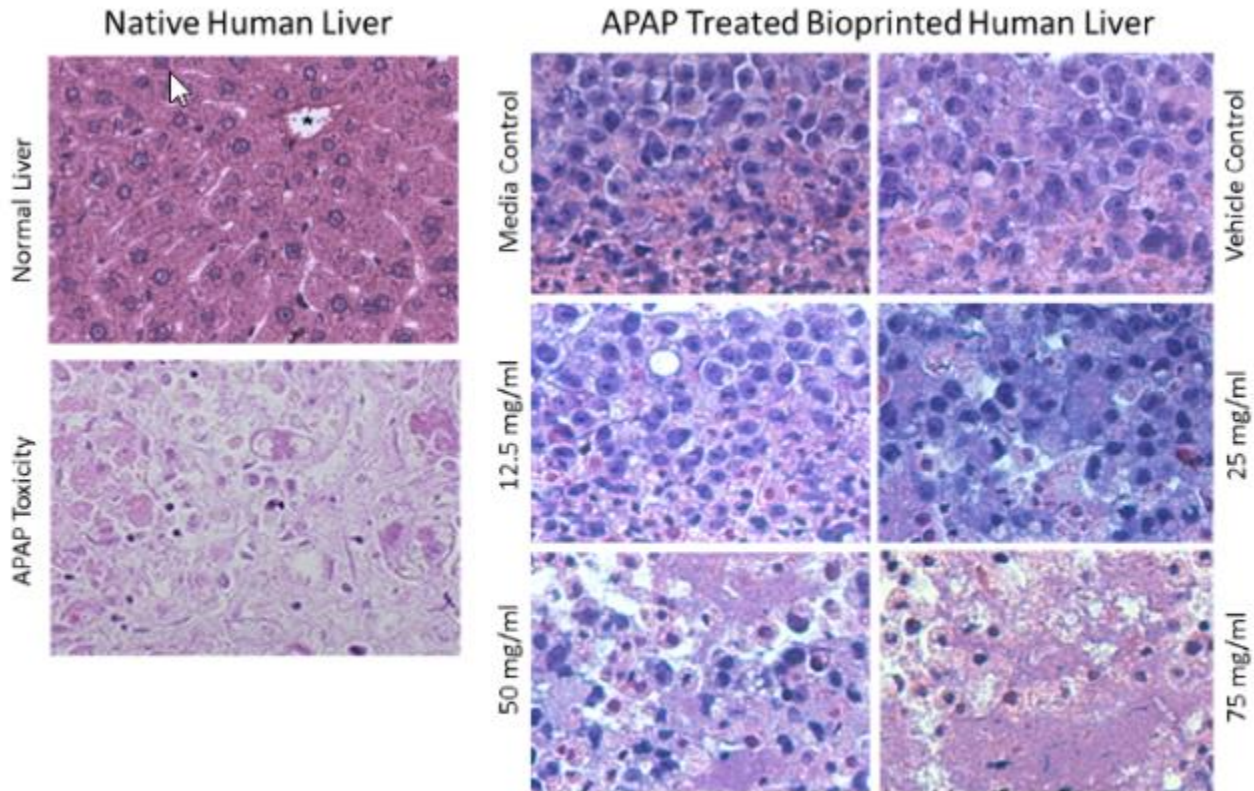
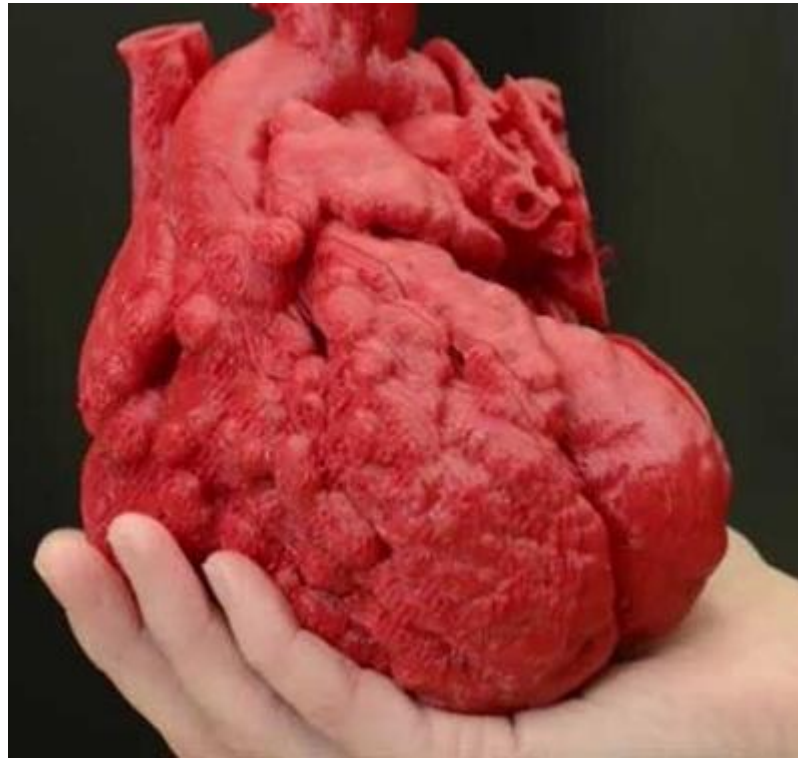


Figure 6: H&E stained native human liver tissue exhibiting APAP toxicity (left); ExVive 3D Bioprinted Human Liver Tissue treated with increasing doses of APAP (right)

# MEDICAL



# GLOBAL IMPACT

- Produce closer to end user
- Spare parts on site
- Local or household production
- Piracy
- Medical/Professional services
- BFGoodrich