3D Printing
(Industrial Applications)

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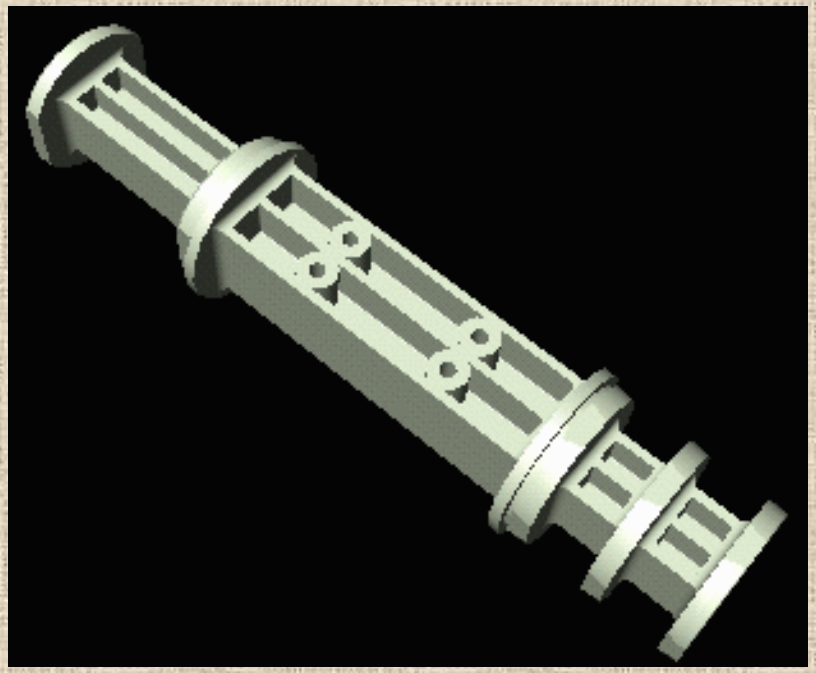
April 6, 2019

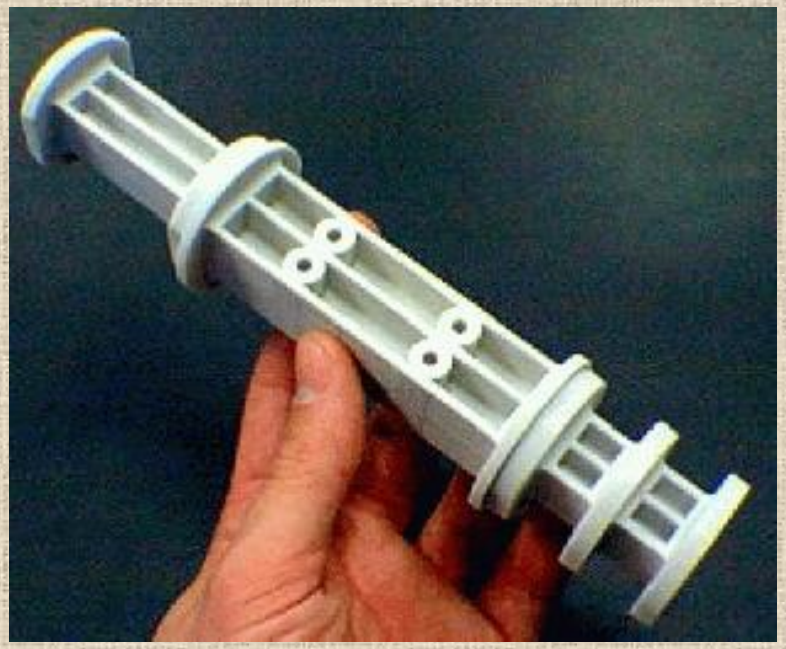
What is 3D Printing ?

3D Printing

3D Printing refers to a class of manufacturing methods which quickly produce physical artifacts/objects from 3D models



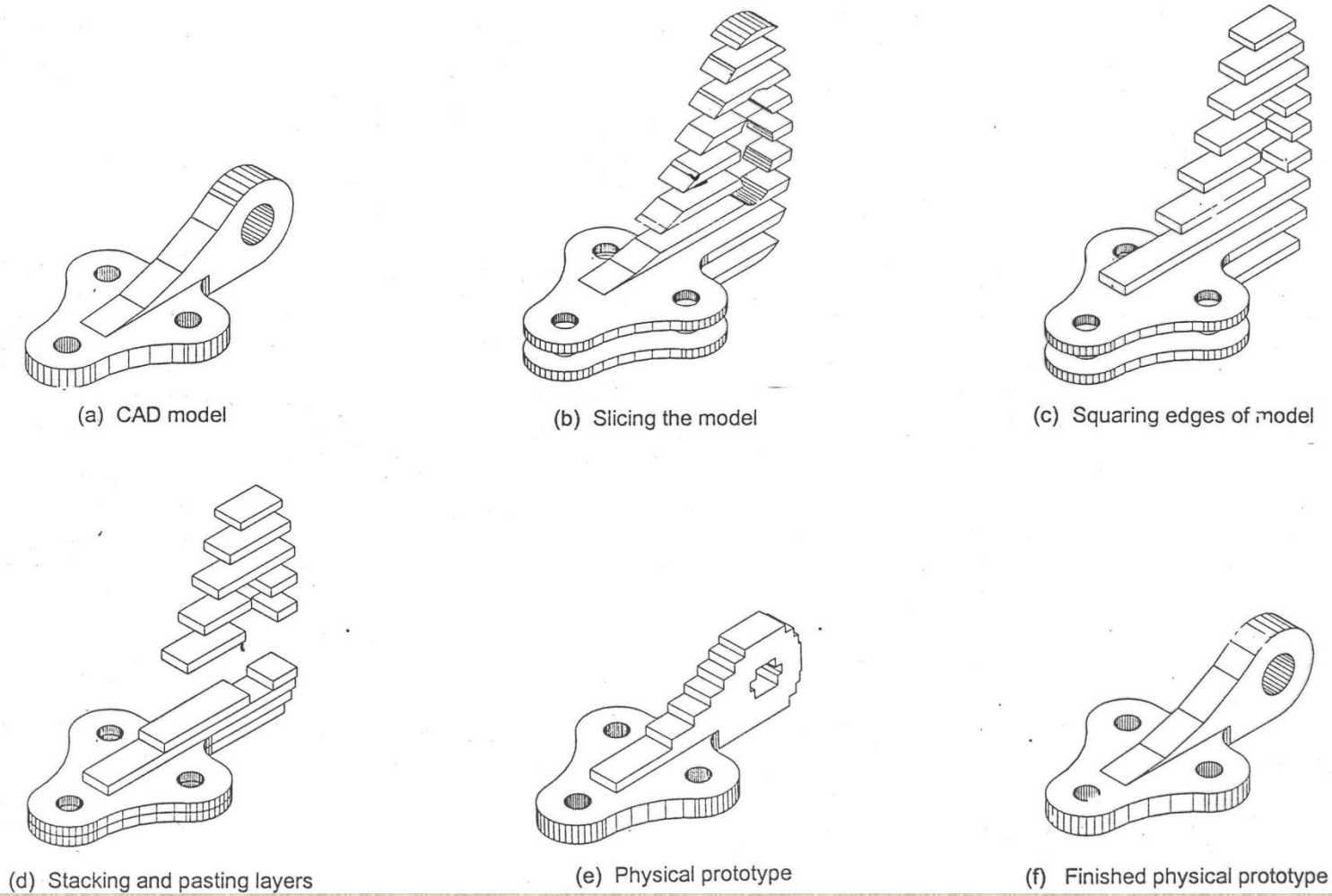
3D Model



Prototype

Also known as
(*rapid prototyping, additive manufacturing or layered manufacturing*)

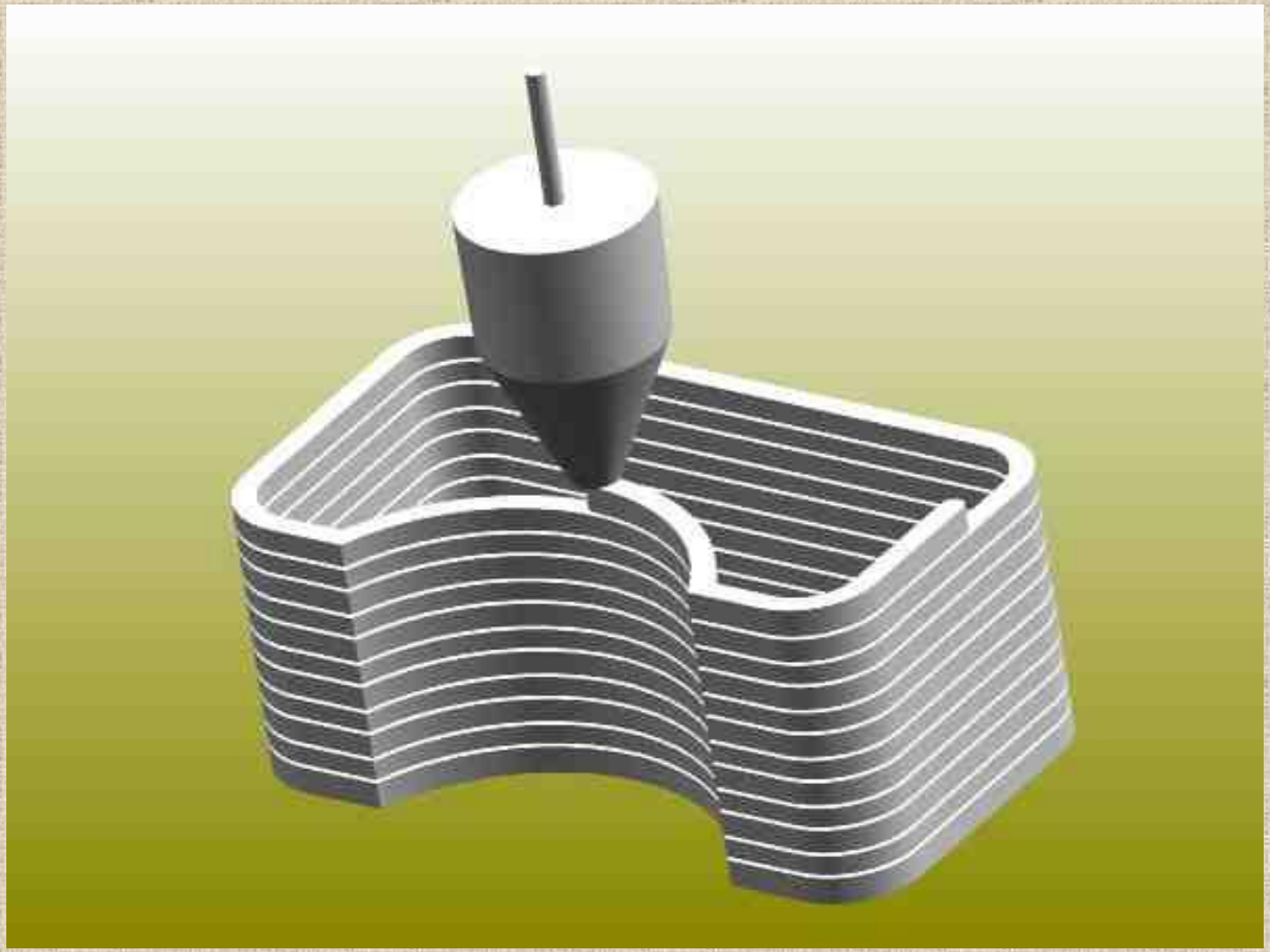
3D Printing



3D Printing processes use layer by layer addition to build an object

3D Printing Equipment

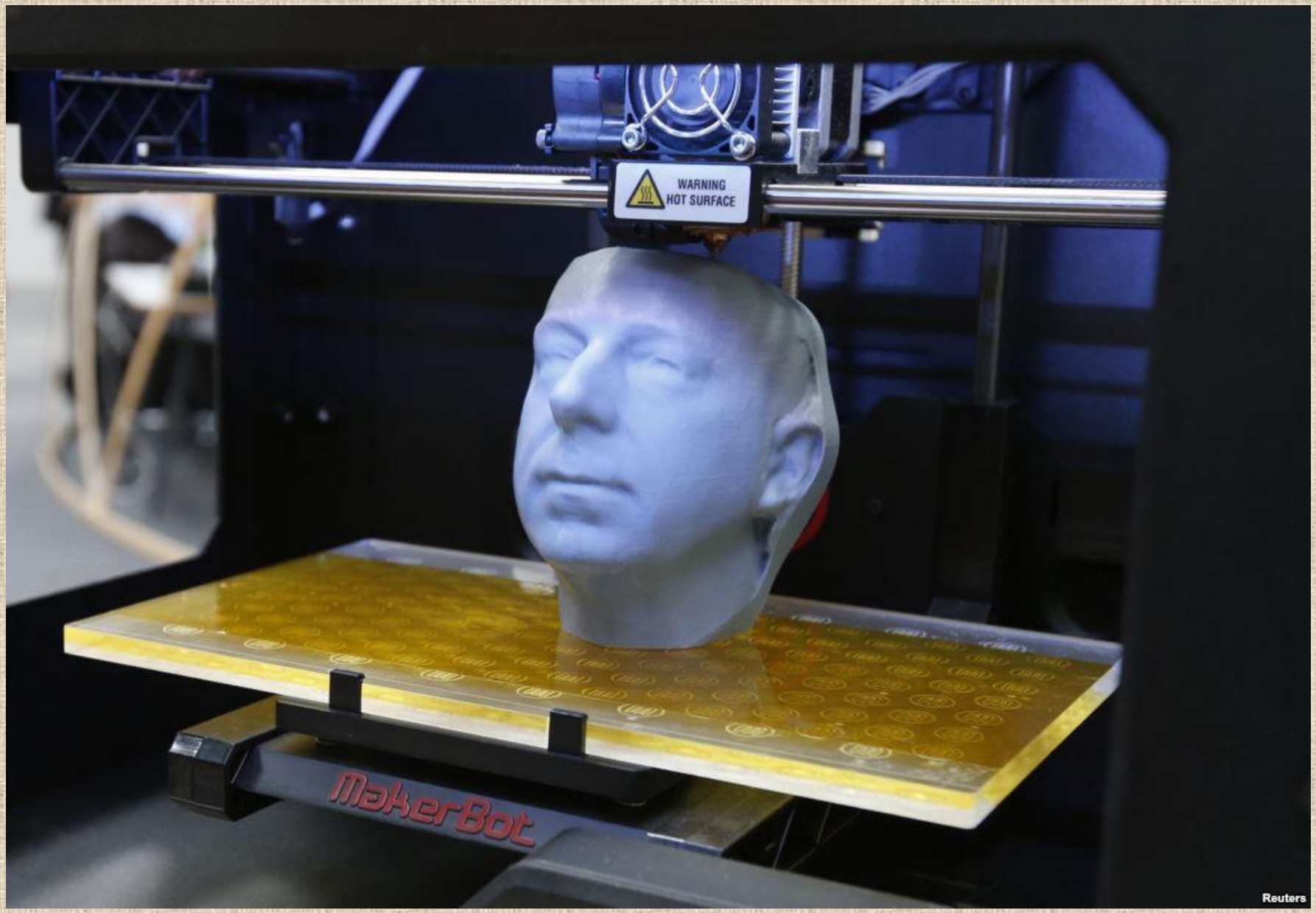
3D Printing



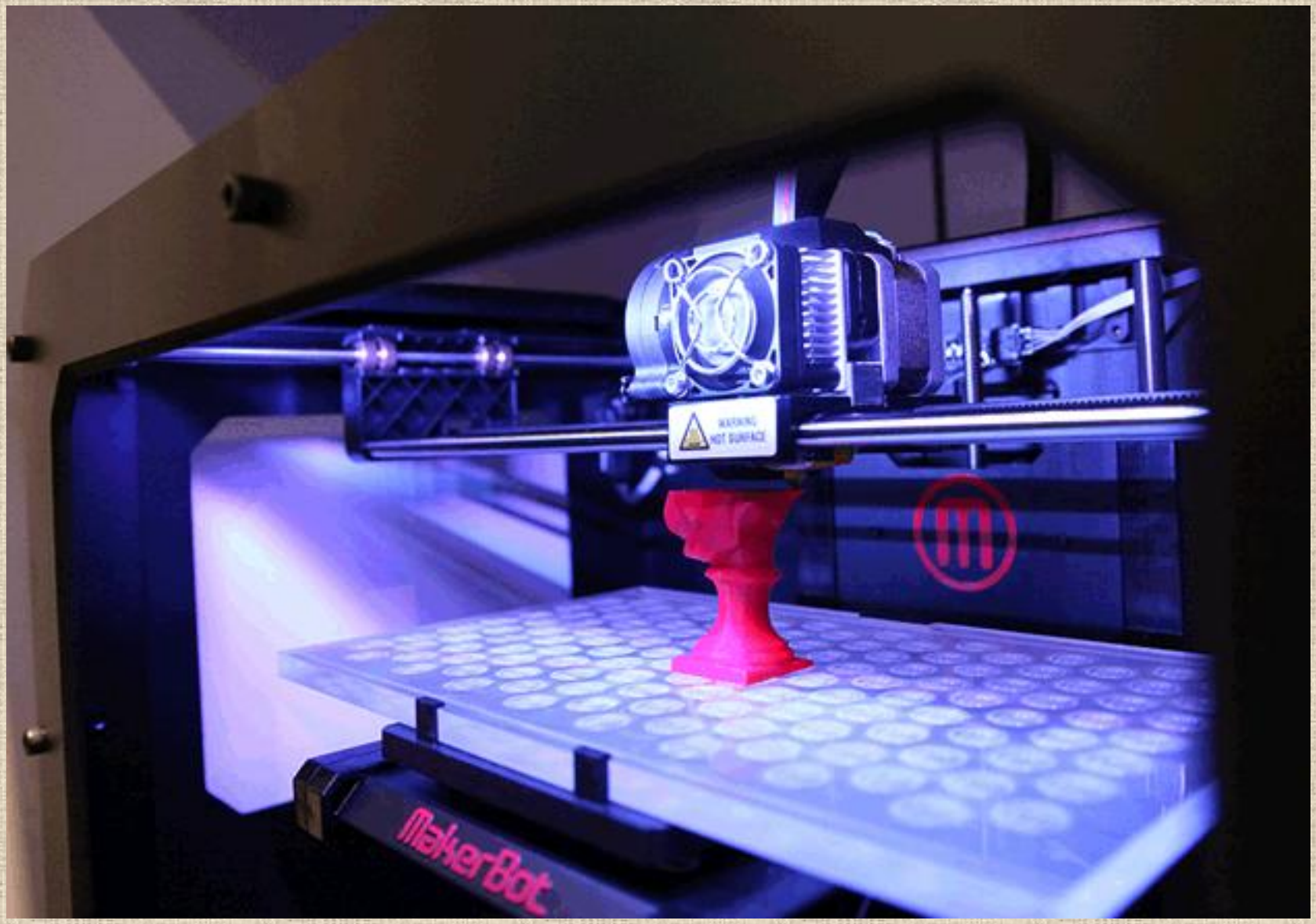
Material Deposition Layer by Layer

Courtesy: http://www.growit3d.com/wp-content/uploads/2012/09/FDM-Nozzle-GROWit-Good-Enough-for-NASA.jpg

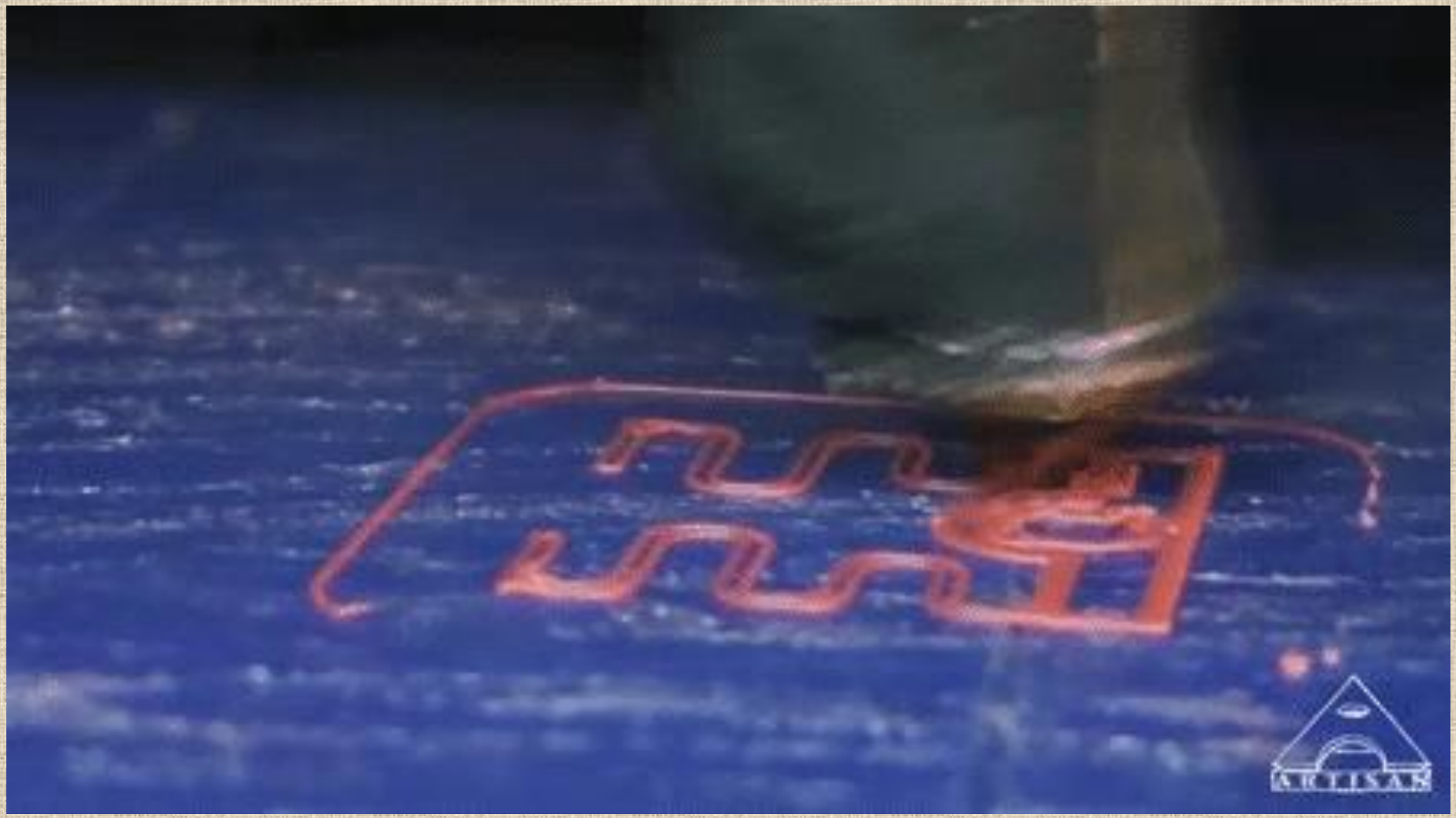
3D Printing



3D Printing

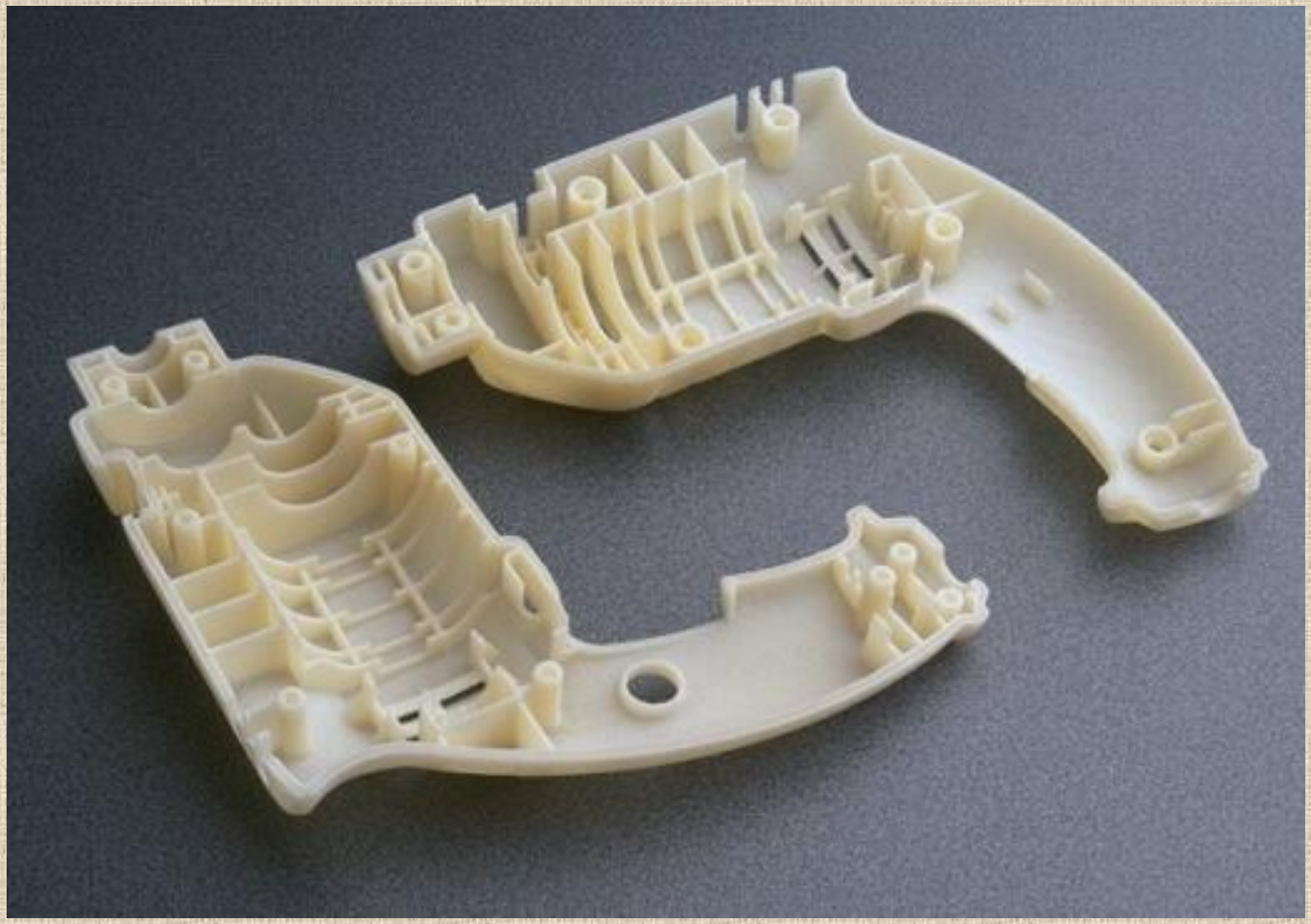


3D Printing



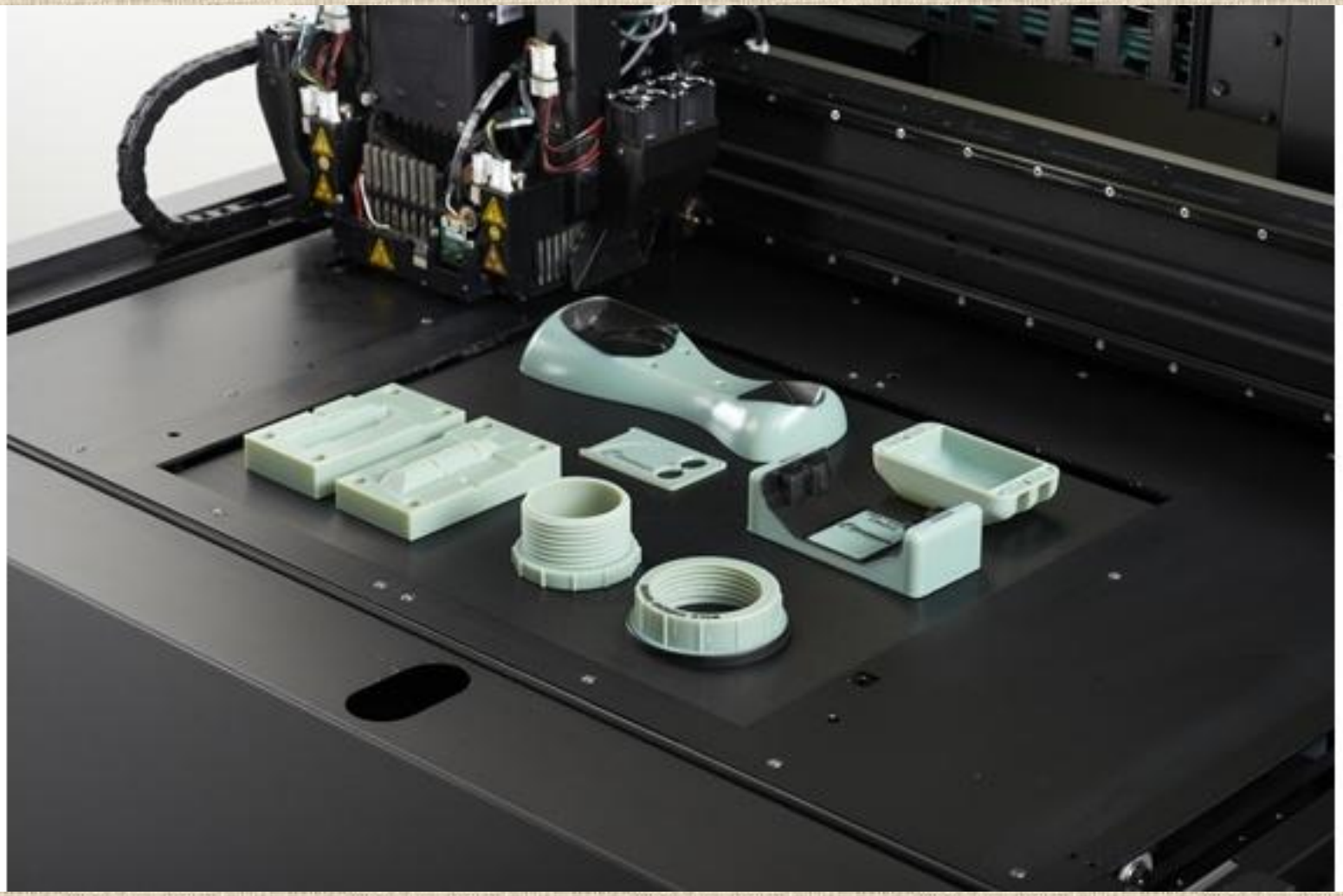
Why is 3D Printing Relevant?

3D Printing



3D Printing does not require any mold as a precursor to manufacture

3D Printing



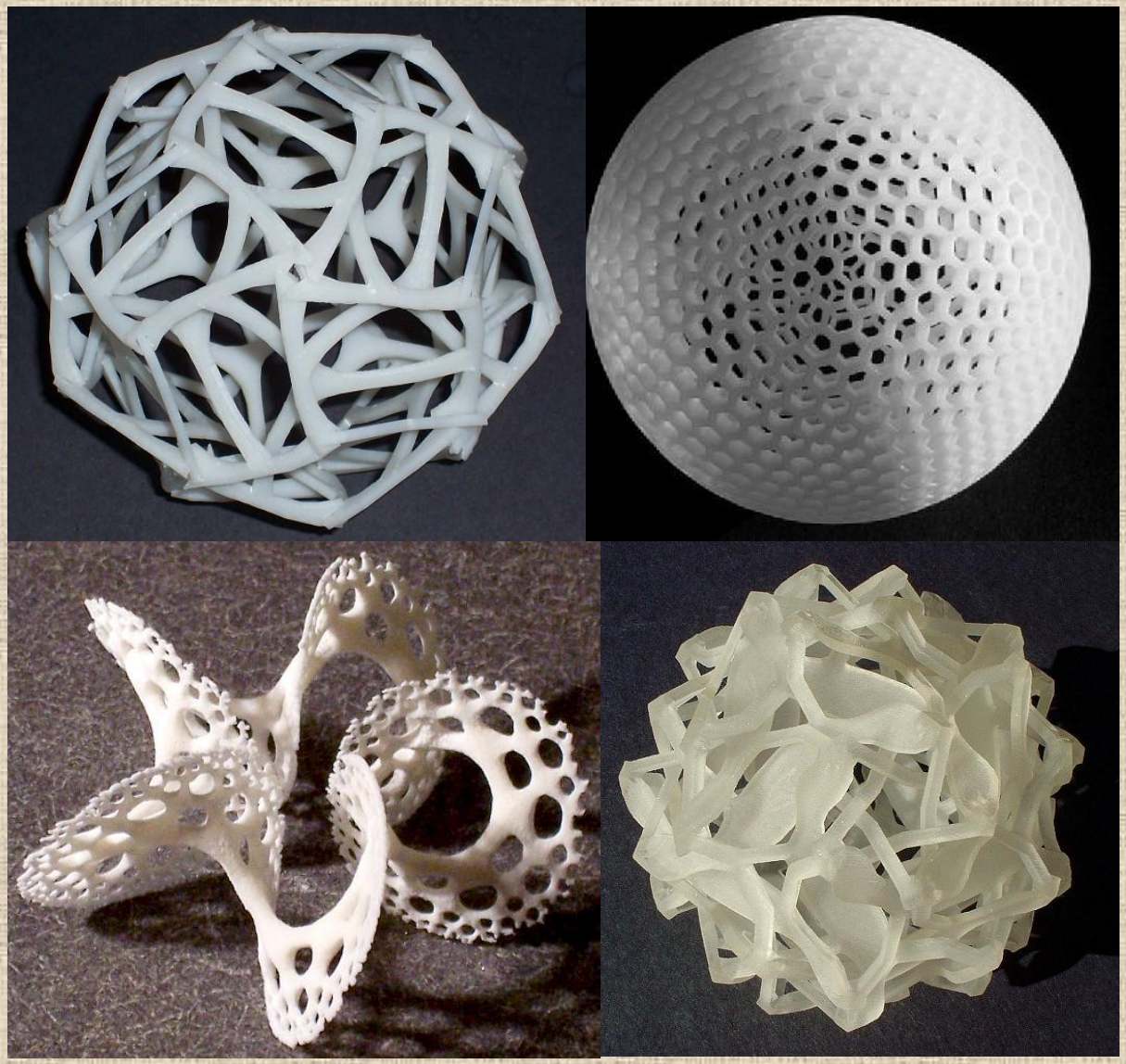
Multiple parts can be produced in one go

3D Printing

3D Printing has been used successfully to make parts of various sizes

Courtesy: FineLine Prototyping & NCMS, USA

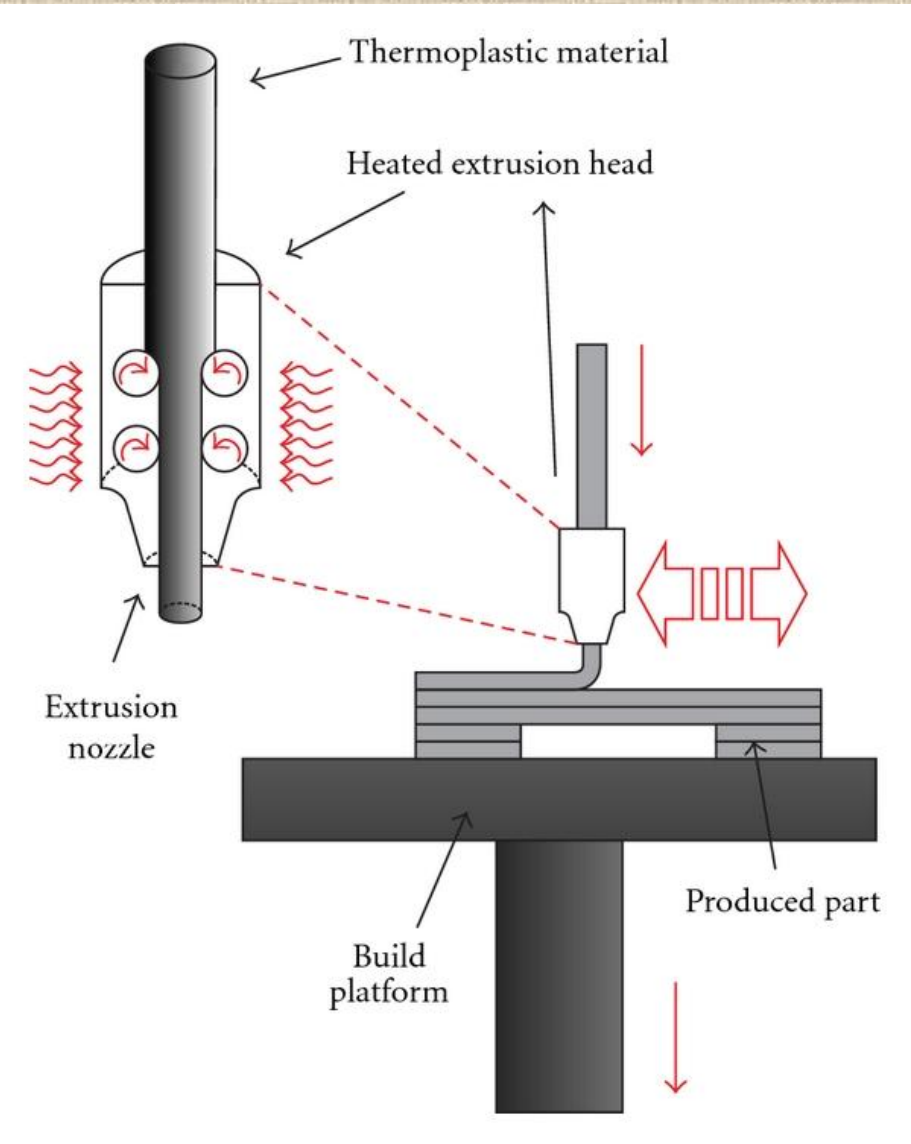
3D Printing



Geometric complexity is not a limitation in 3D Printing

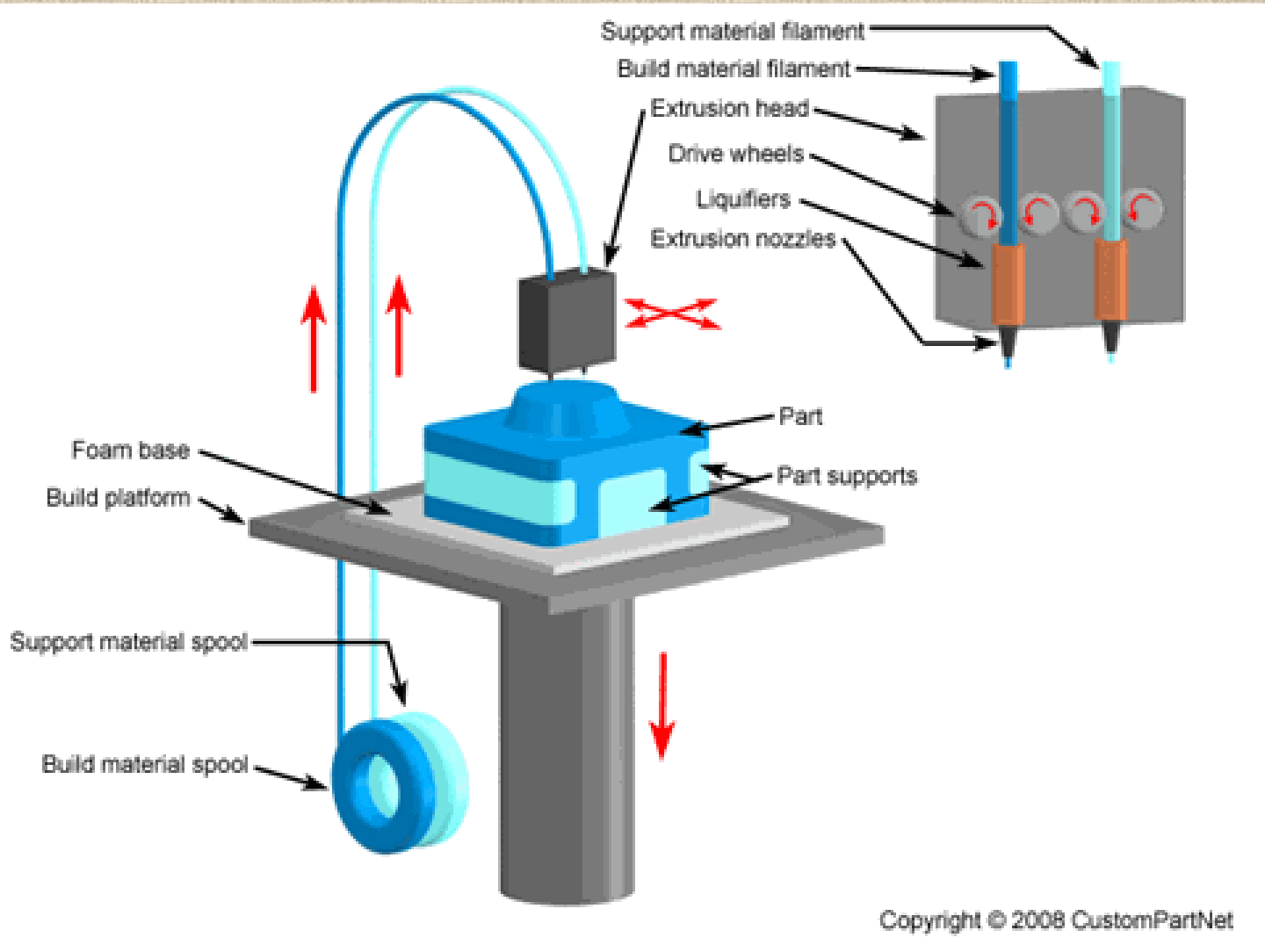
3D Printing Processes

3D Printing



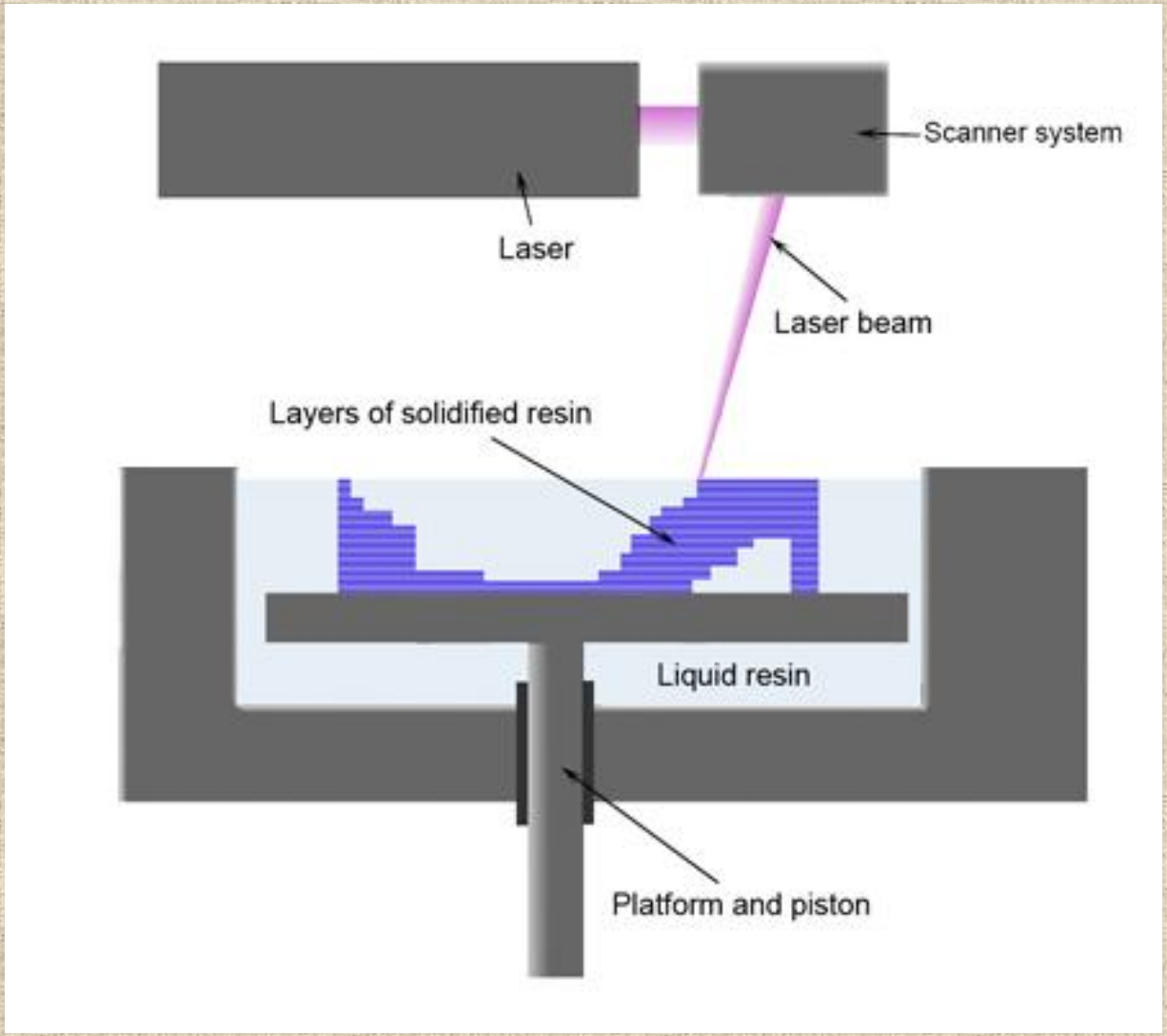
Fused Deposition Modeling (FDM)

Rapid Prototyping



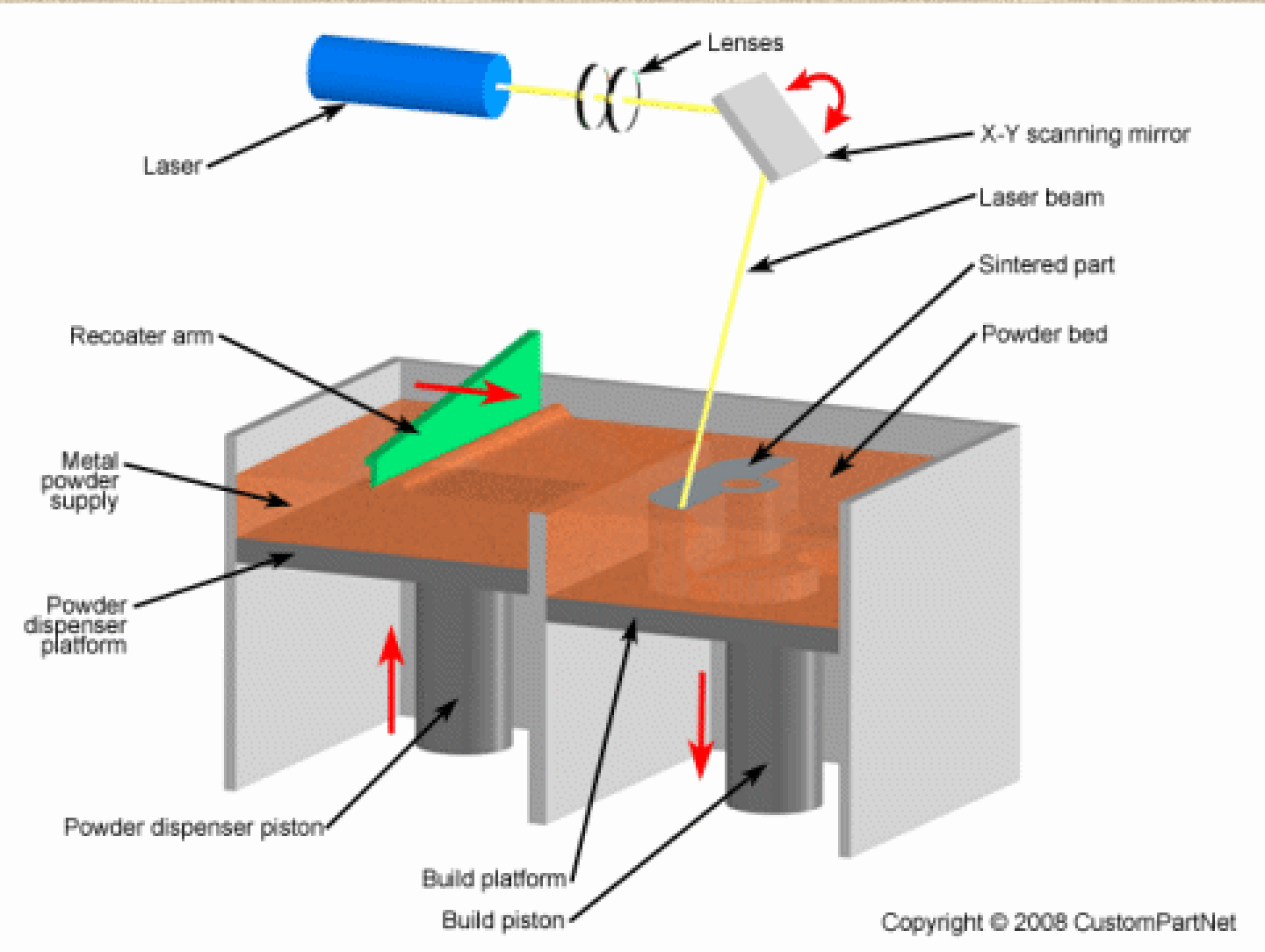
Fused Deposition Modeling (FDM)

Additive Manufacturing



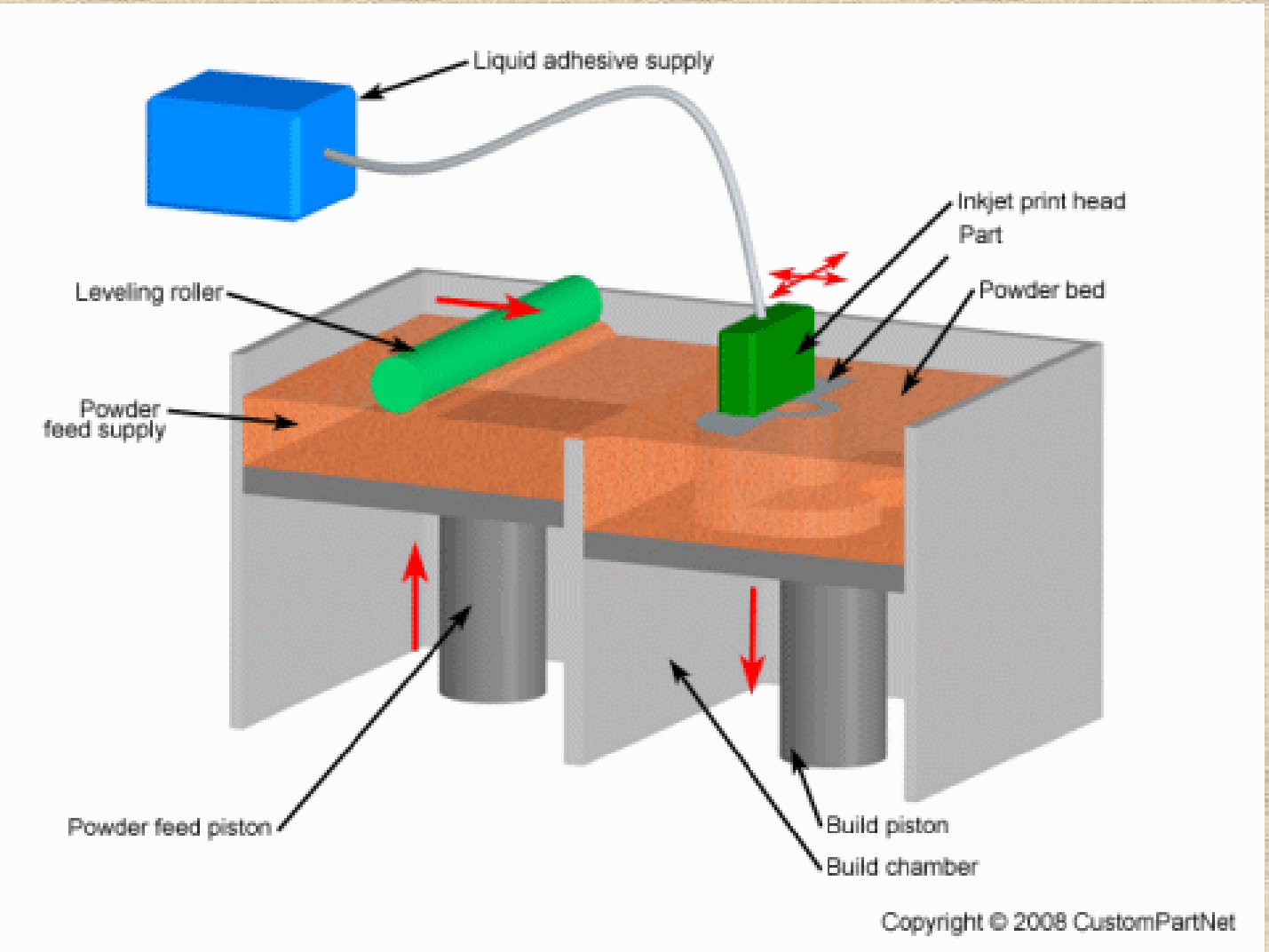
Stereolithography (SLA)

Rapid Prototyping



Selective Laser Sintering (SLS)

Rapid Prototyping



Powder Jetting

Other Technologies

Many Others…

- Laminated Object Manufacturing
- Direct Metal Laser Sintering
- Laser Engineered Net Shaping (LENS)
- Selective Laser Melting (SLM)
- Electron Beam Melting (EBM)

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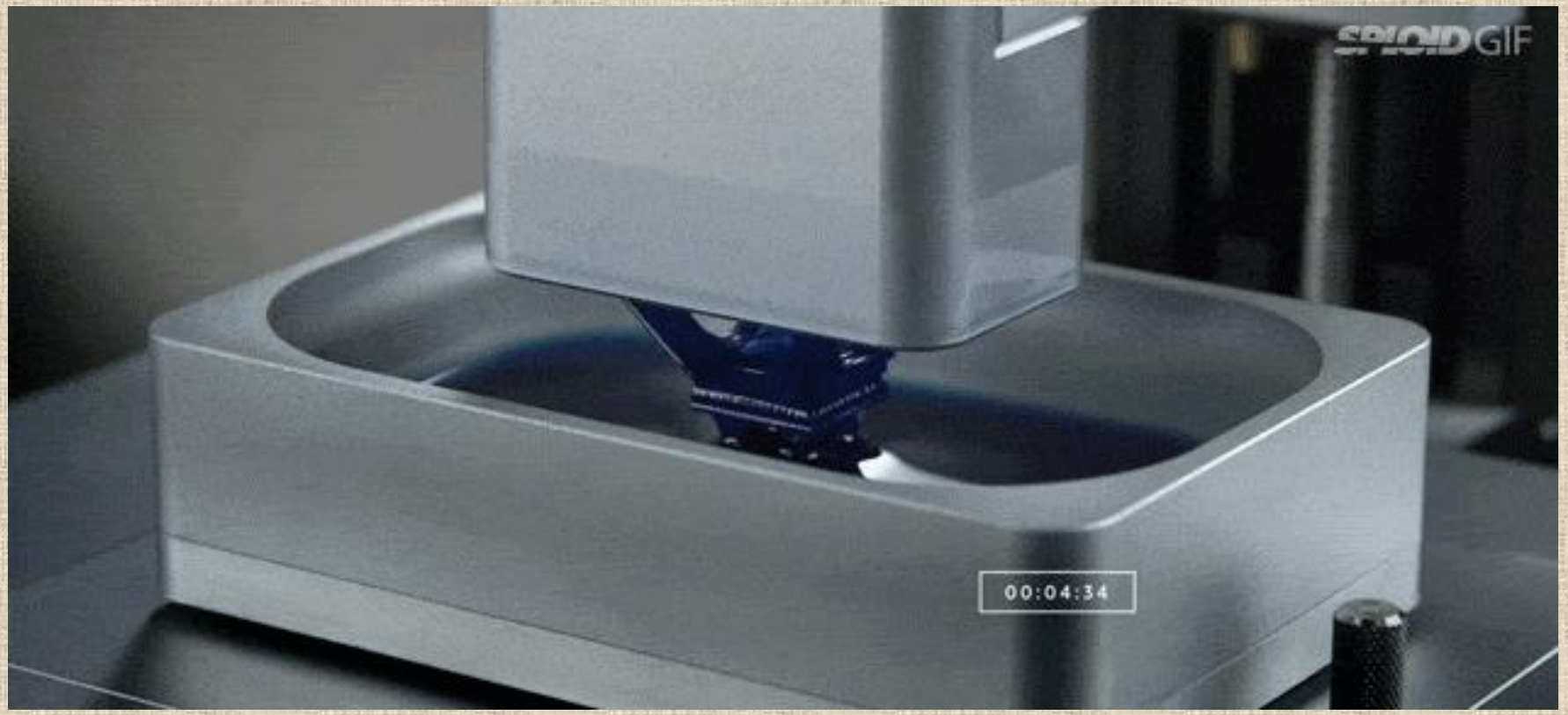
New 3D Printing Technologies



Continuous Liquid Interface Production (CLIP) invented by Dr Joseph DeSimone, Professor of Chemical Engineering UNC Chapel Hill and NCSU

Courtesy: SME

Applications

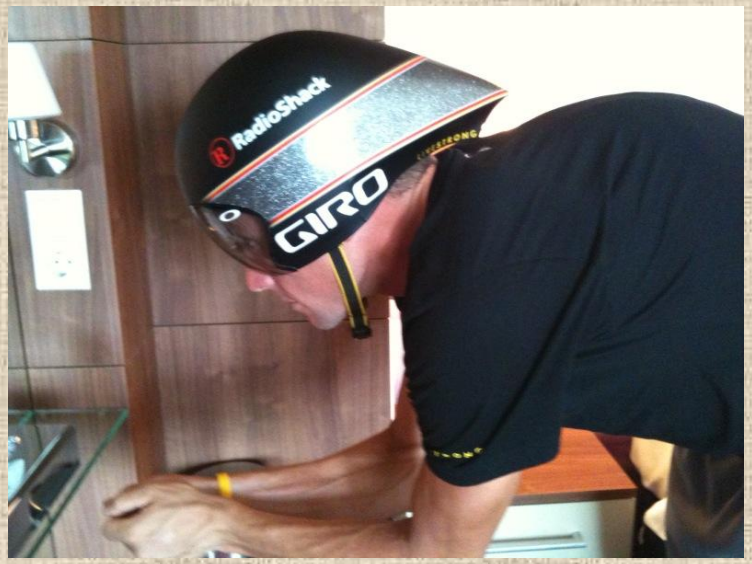
Applications of 3D Printing

Touch and Feel

Applications of 3D Printing

Form, Fit and Function

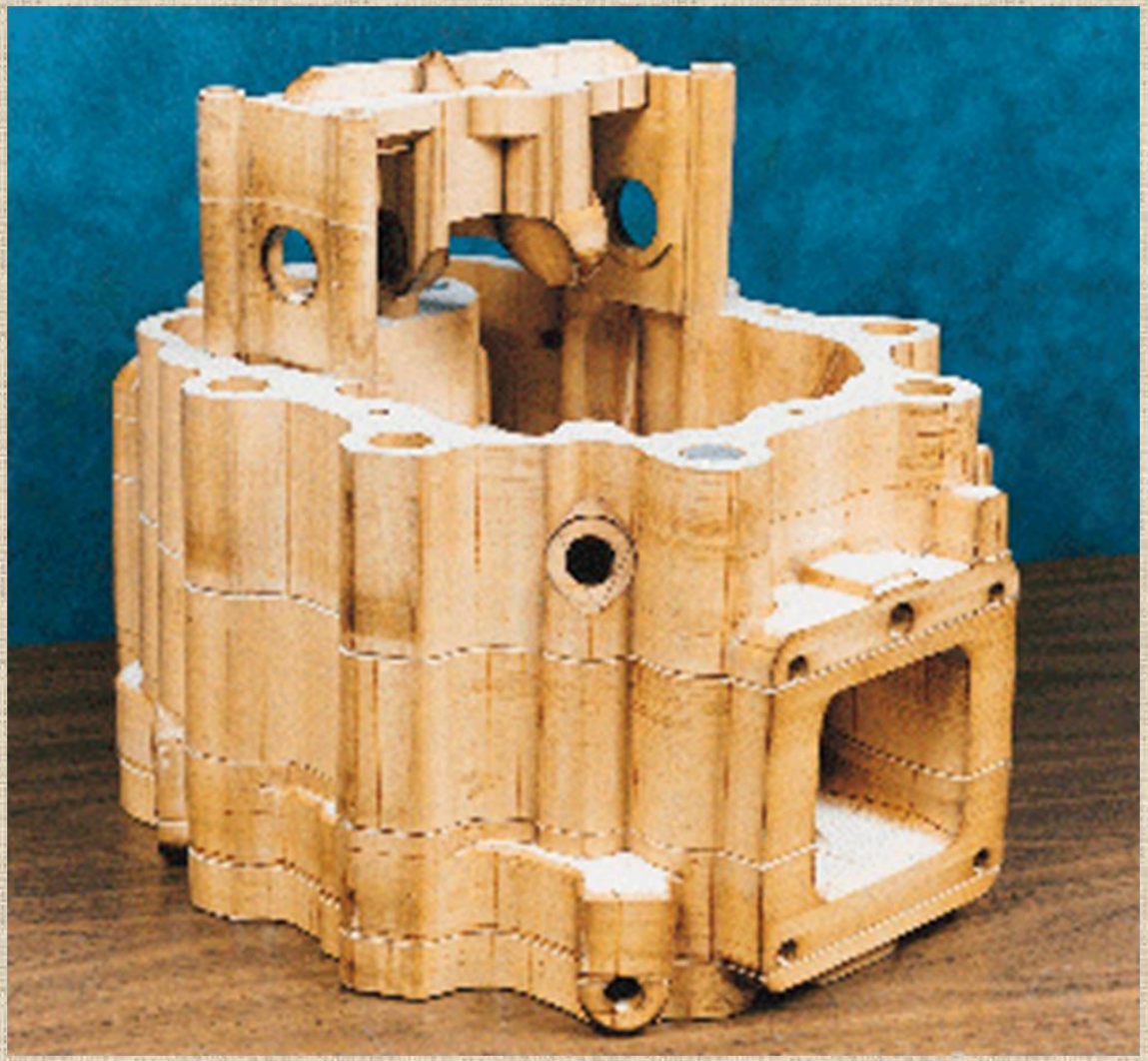
Applications of 3D Printing



Functional Testing

Courtesy: brandonsmarathon.com

Applications of 3D Printing



Patterns for Casting

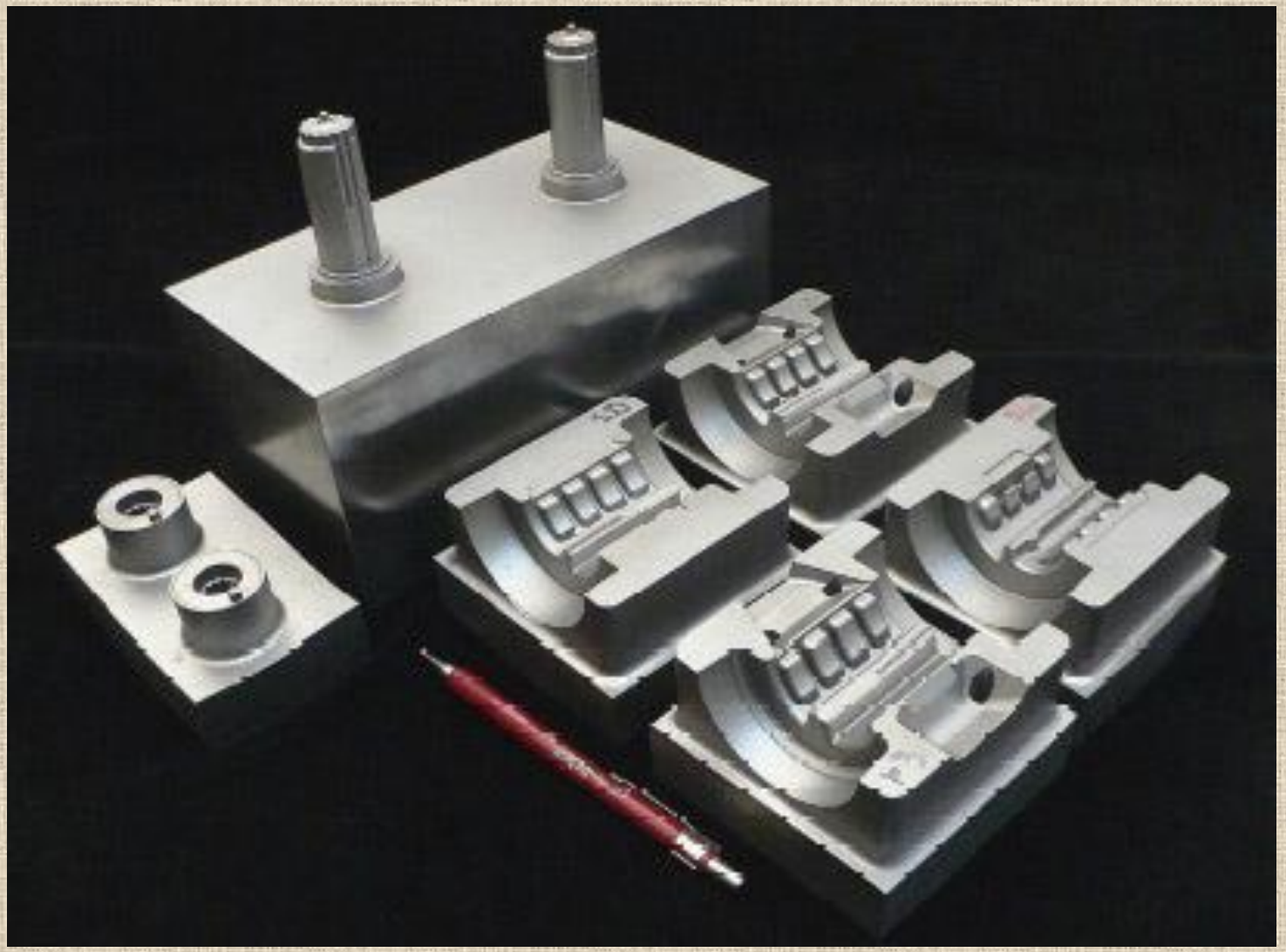
Applications of 3D Printing

Molds for Casting

Applications of 3D Printing

Patterns for Casting

Applications of 3D Printing



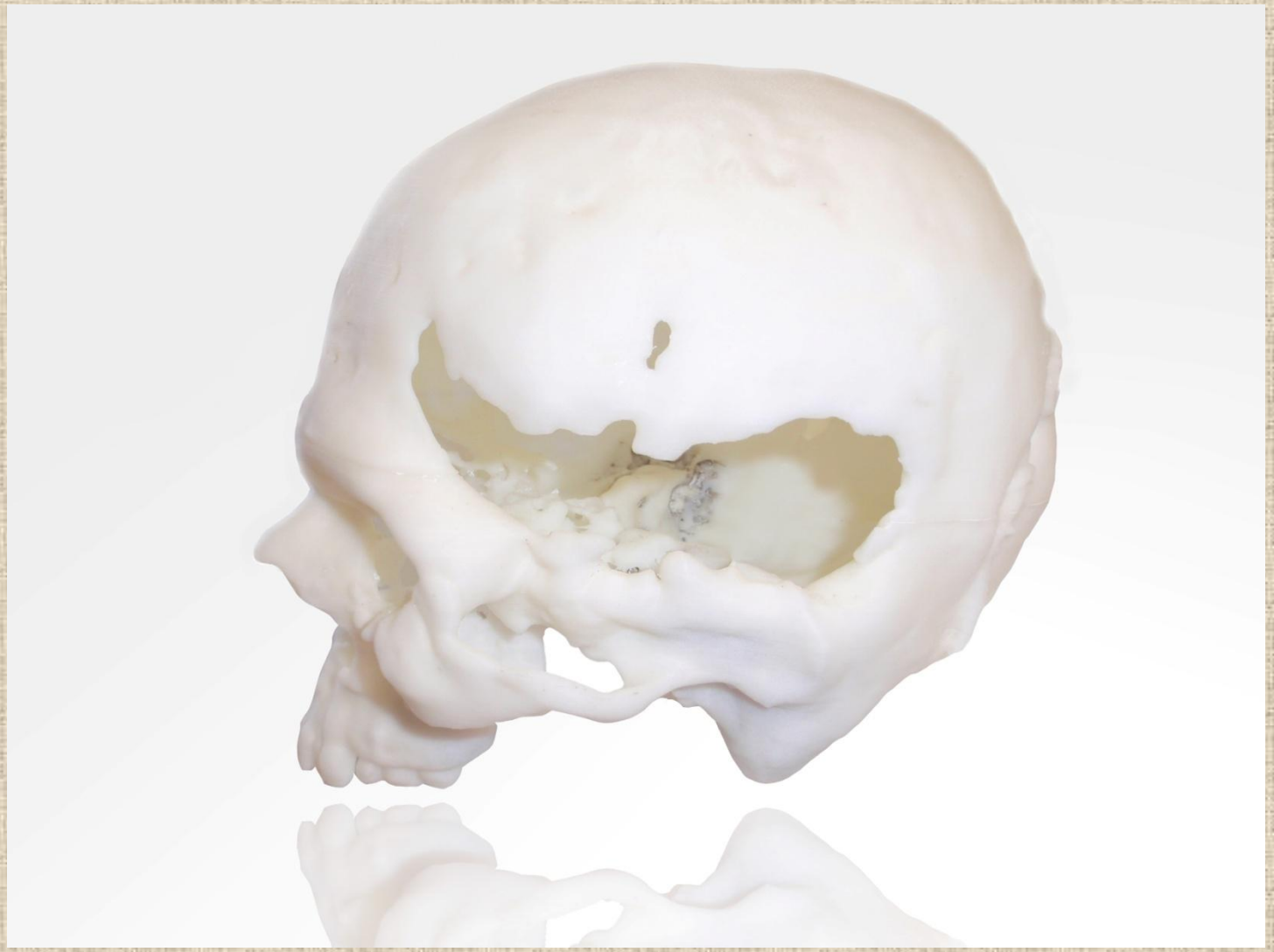
Direct Tooling

Courtesy: 3rtpd.co.uk

Applications of 3D Printing

Reverse Engineering

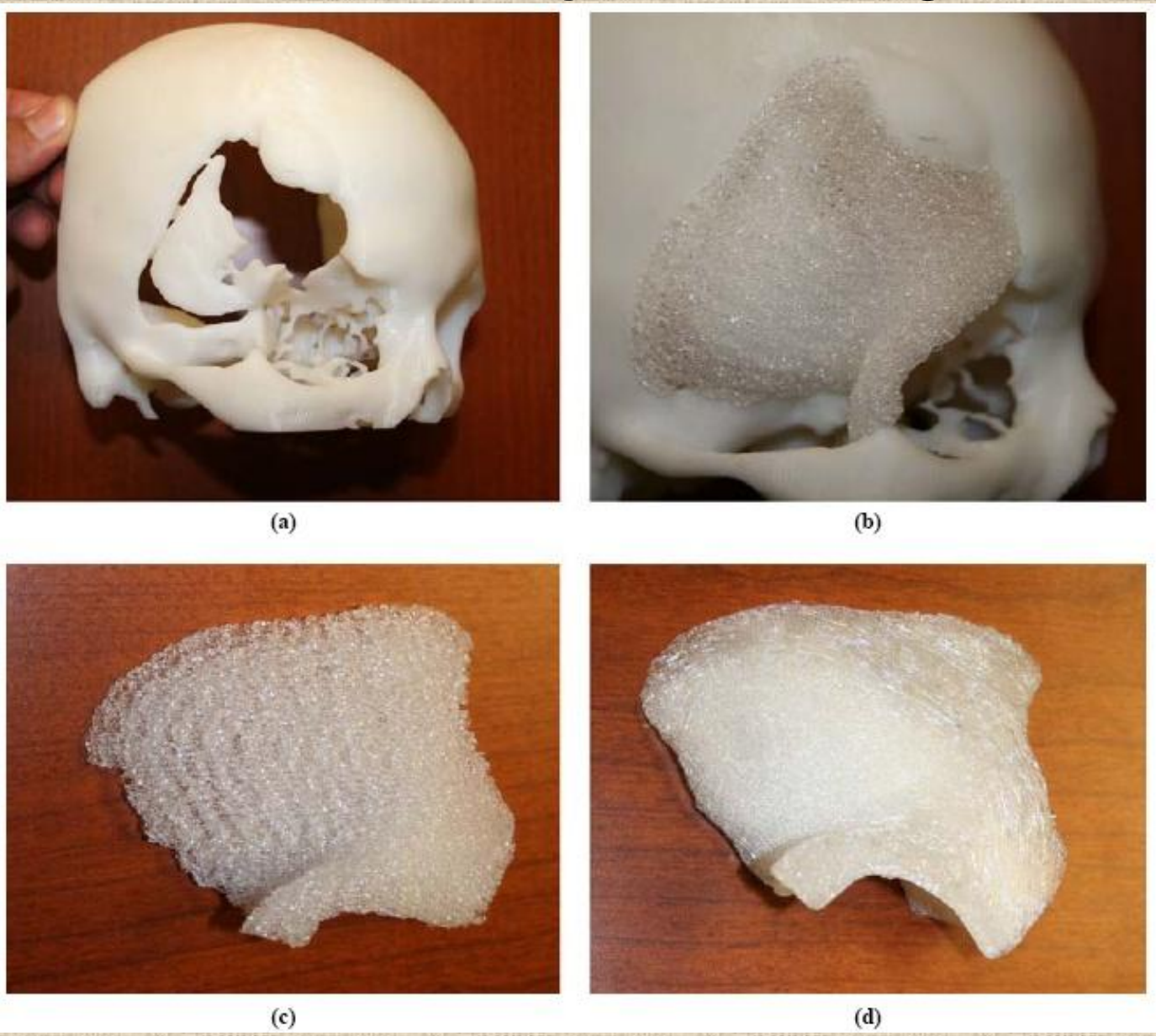
3D Printing



3D Printing can make parts in Biocompatible materials

Courtesy: FineLine Prototyping & NCMS, USA

Scaffolds by 3D Printing



Courtesy: Espalin et al. (Emerald),

Materials Options for 3D Printing

Metallic materials – Plain Carbon Steel, Tool Steel, Stainless steel, Aluminium, Copper, Titanium, Bronze, Nickel Alumides

Polymers and Polymeric Composites - ABS, Nylon (Polyamide), Polycarbonate, PP, Epoxies, Glass filled polyamide, Windform, Polystyrene, Polyester, Polyphenylesulfone

Others - Sand, Ceramics, Elastomers, Tungsten, Wax, Starch, Plaster

Bio Compatible Materials - Polycaprolactone (PCL), polypropylene-tricalcium phosphate, (PP-TCP), PCL-hydroxyapatite (HA), polyetheretherketone-hydroxyapatite, (PEEK-HA), tetracalcium phosphate (TTCP), beta – tricalcium phosphate (TCP), Polymethyl methacrylate (PMMA)

More Applications

Recent Applications

3D Printed Super Car

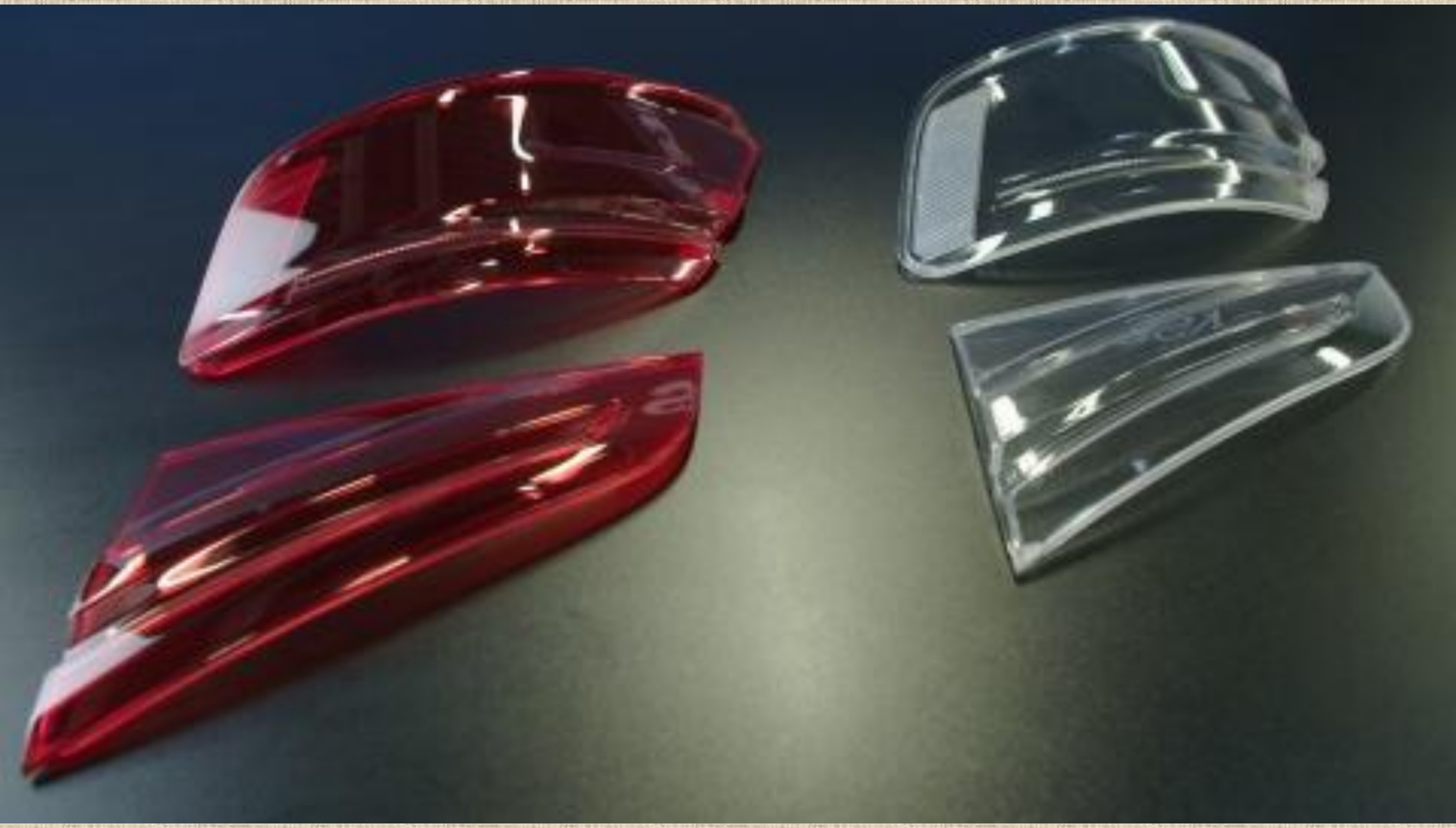
3D Printing

Recent Applications

Jet Engine (GE)

Courtesy: SME

3D printed tail light cover (Audi)

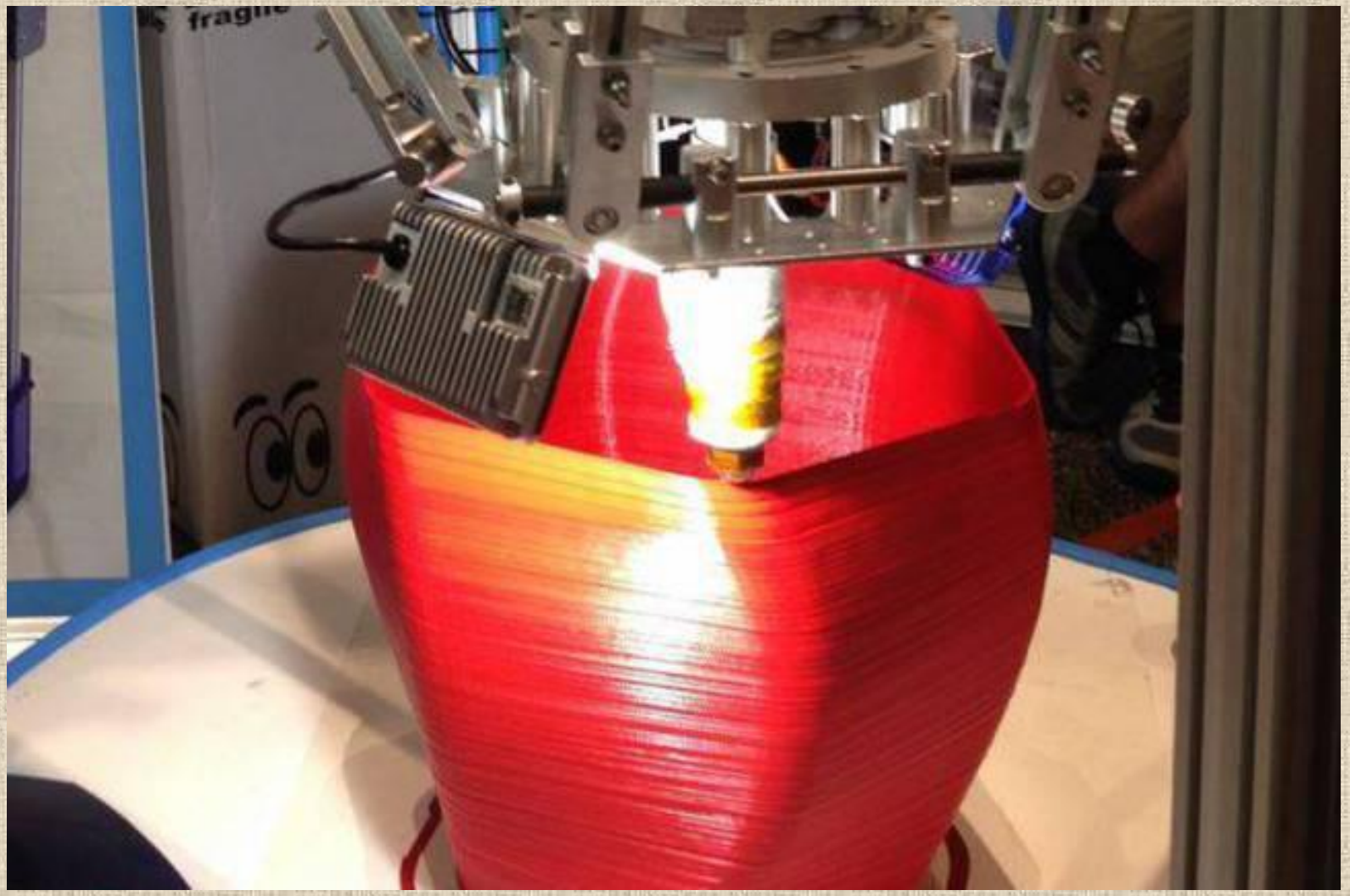


Courtesy: https://www.businesswire.com/news/home/20180607005410/en/

A forming die created with EBAM technology

Courtesy: Sciaky

Recent Applications



3D Printing on Truck (Amazon)

Courtesy: SME

Recent Applications

3D Printed Heart

Courtesy: SME

Recent Applications

3D Printed Bionic Eye

Courtesy: SME

Recent Applications

3D-Printed Braces for Disabaled Dog

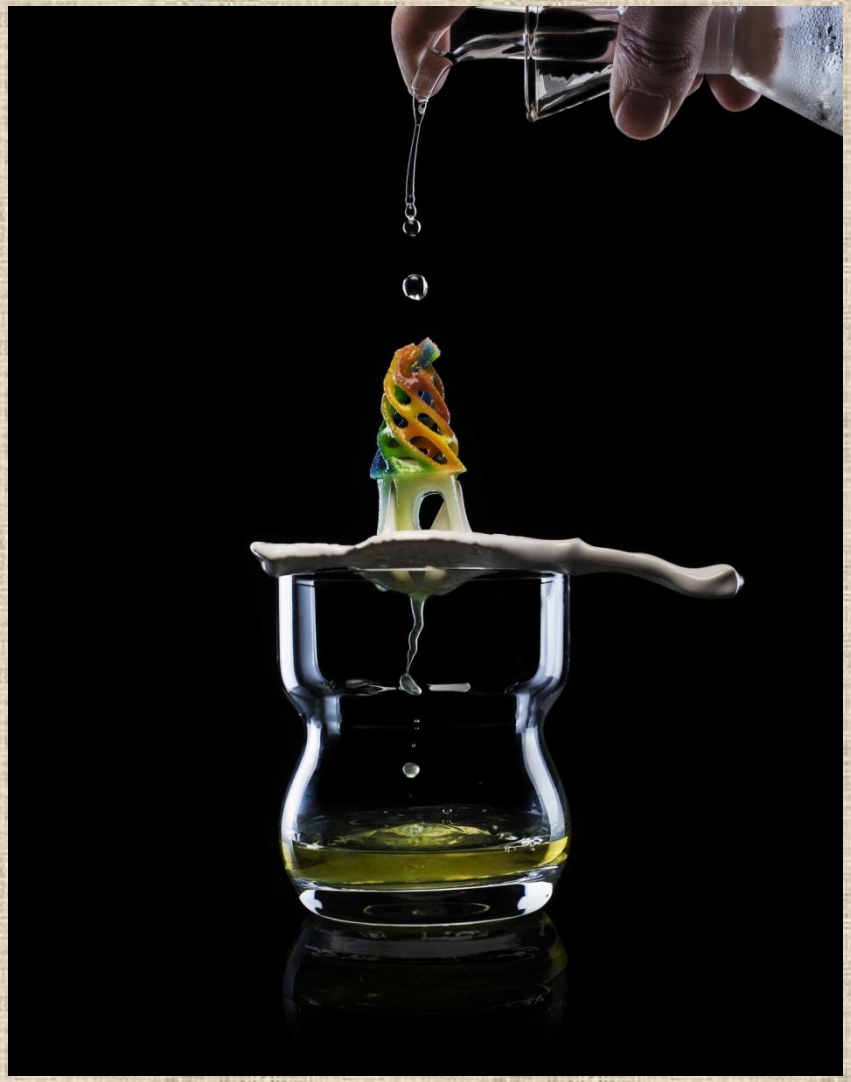
Courtesy: SME

Recent Applications

3D-Printed Braces for Disabaled Dog

Courtesy: SME

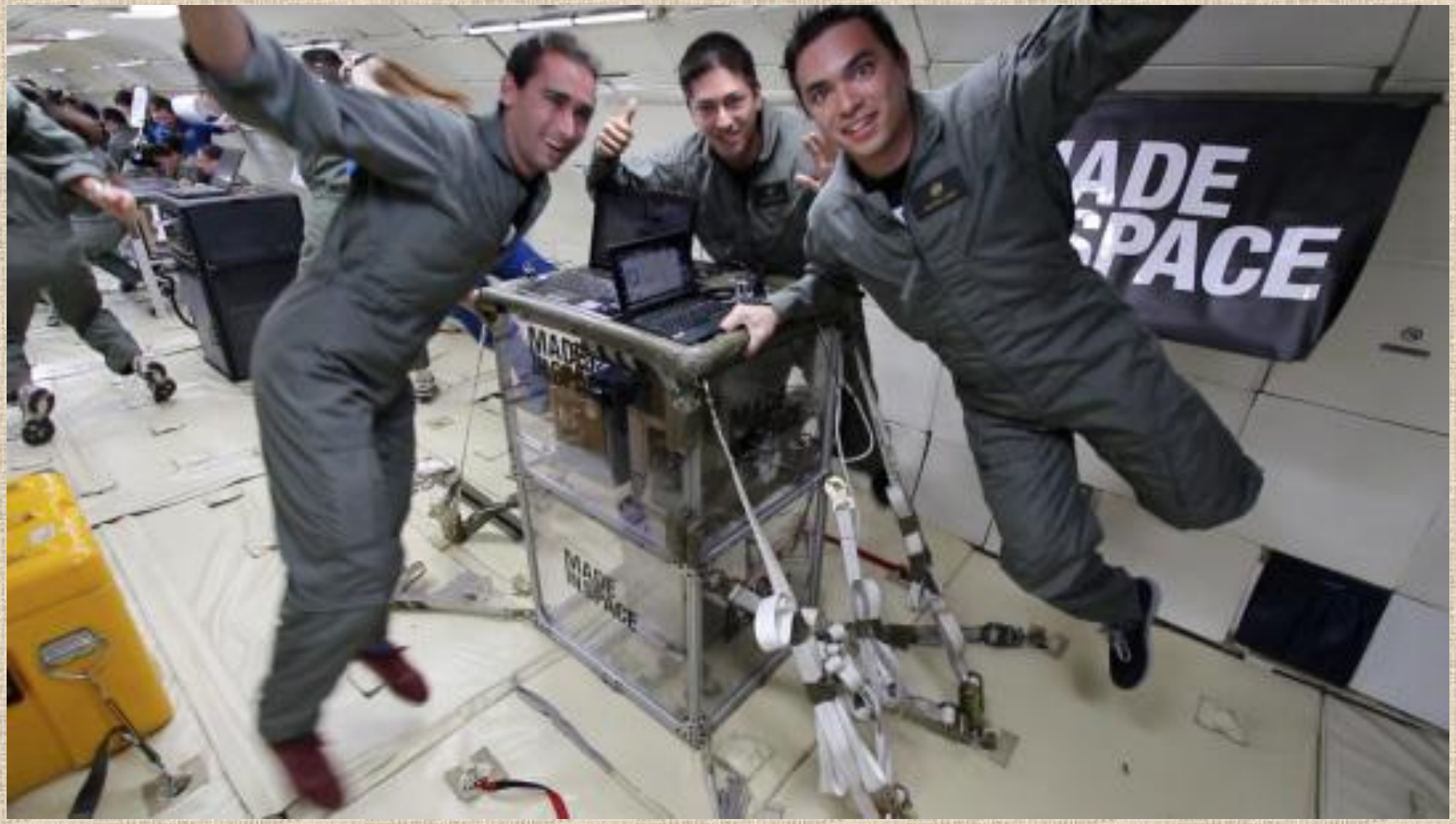
Recent Applications



3D Printed Food

Courtesy: SME

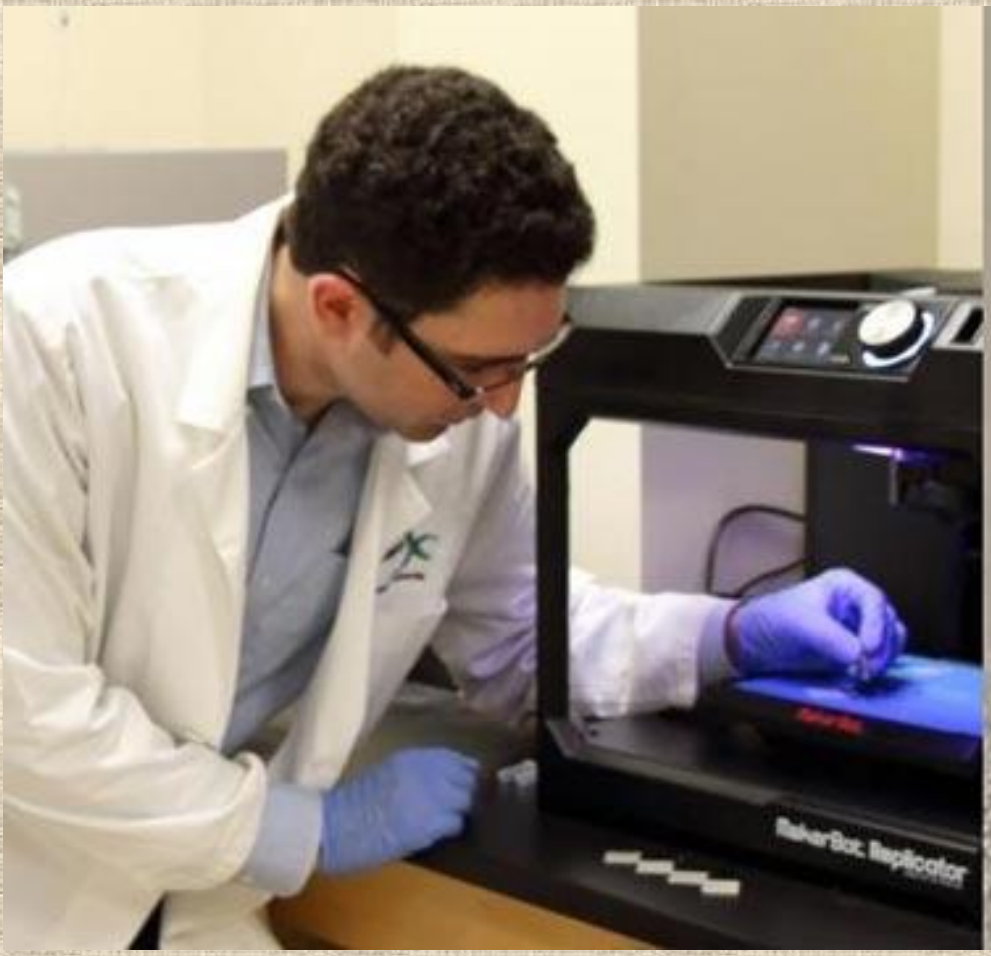
Recent Applications



3D-Printing on Space Station

Courtesy: SME

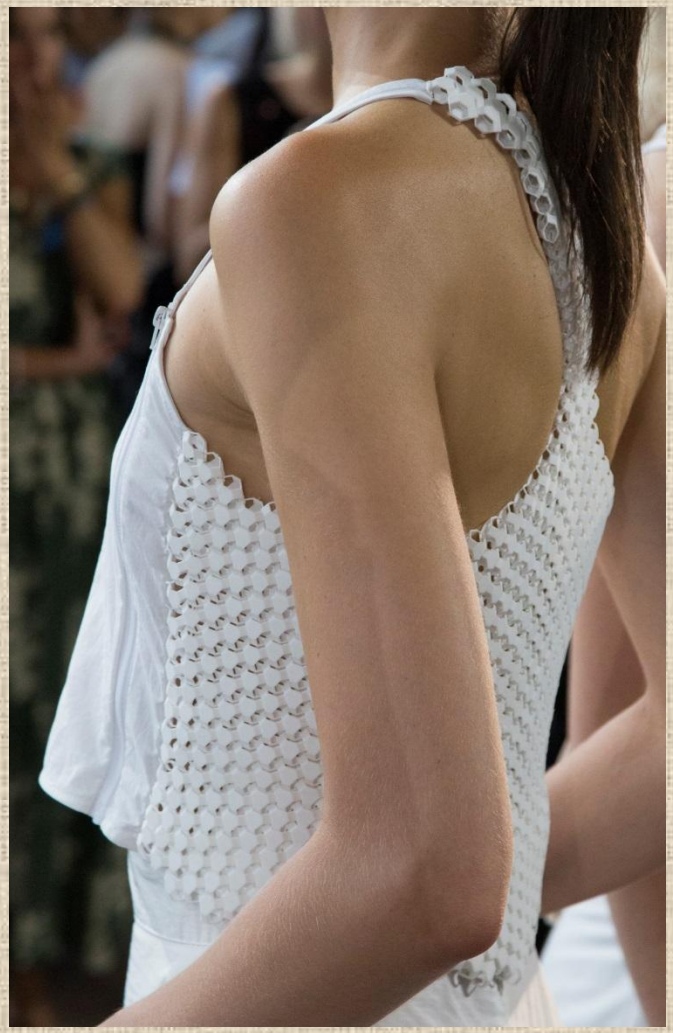
Recent Applications



Drug Delivery

Courtesy: SME

Recent Applications



3D Printed Garments

Courtesy: SME

Design of New Functionally Graded materials

Recent Applications

3D Printed Building (China)

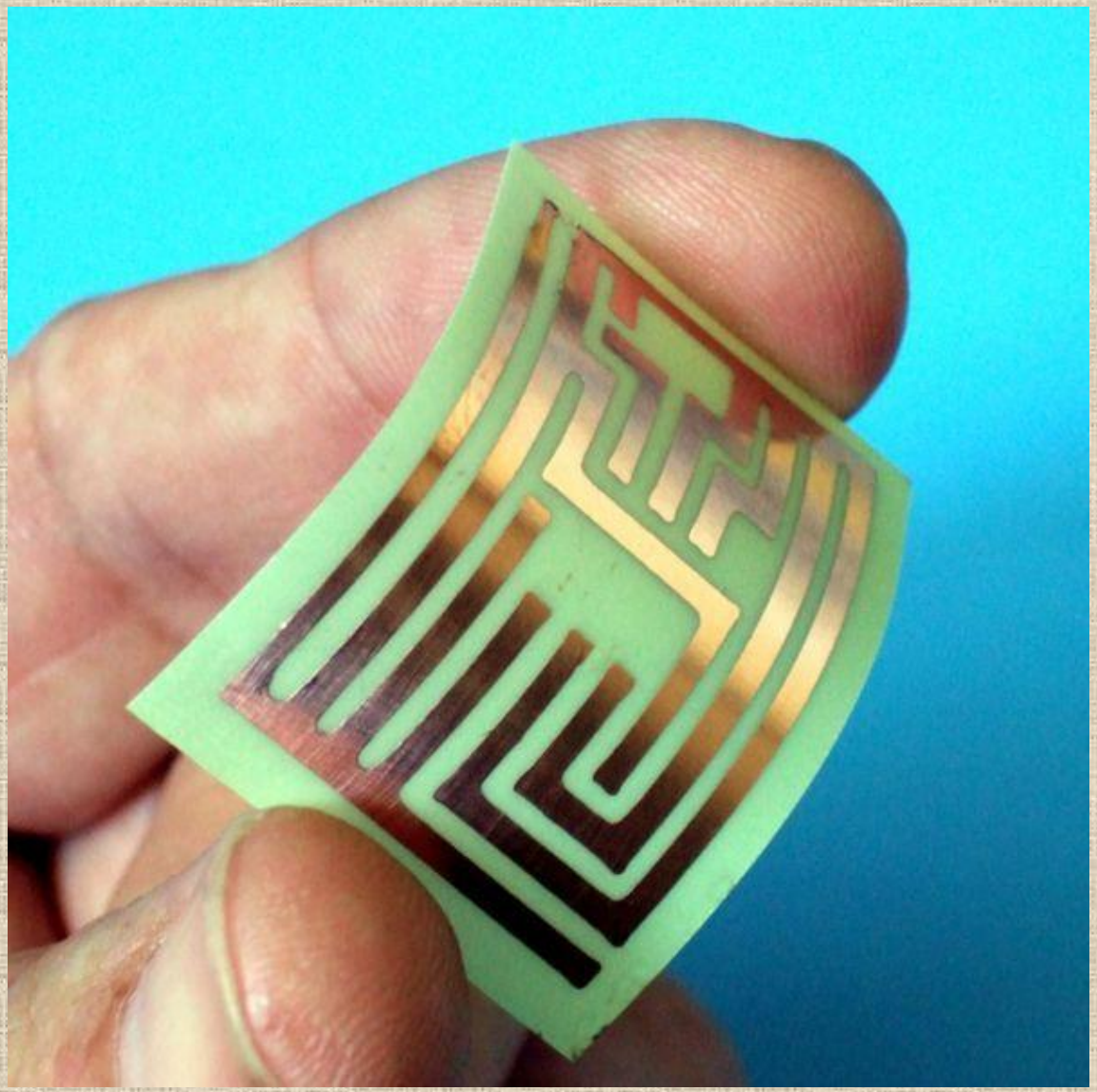
Courtesy: SME

Recent Applications

3D Printed Human Ear

Courtesy: SME

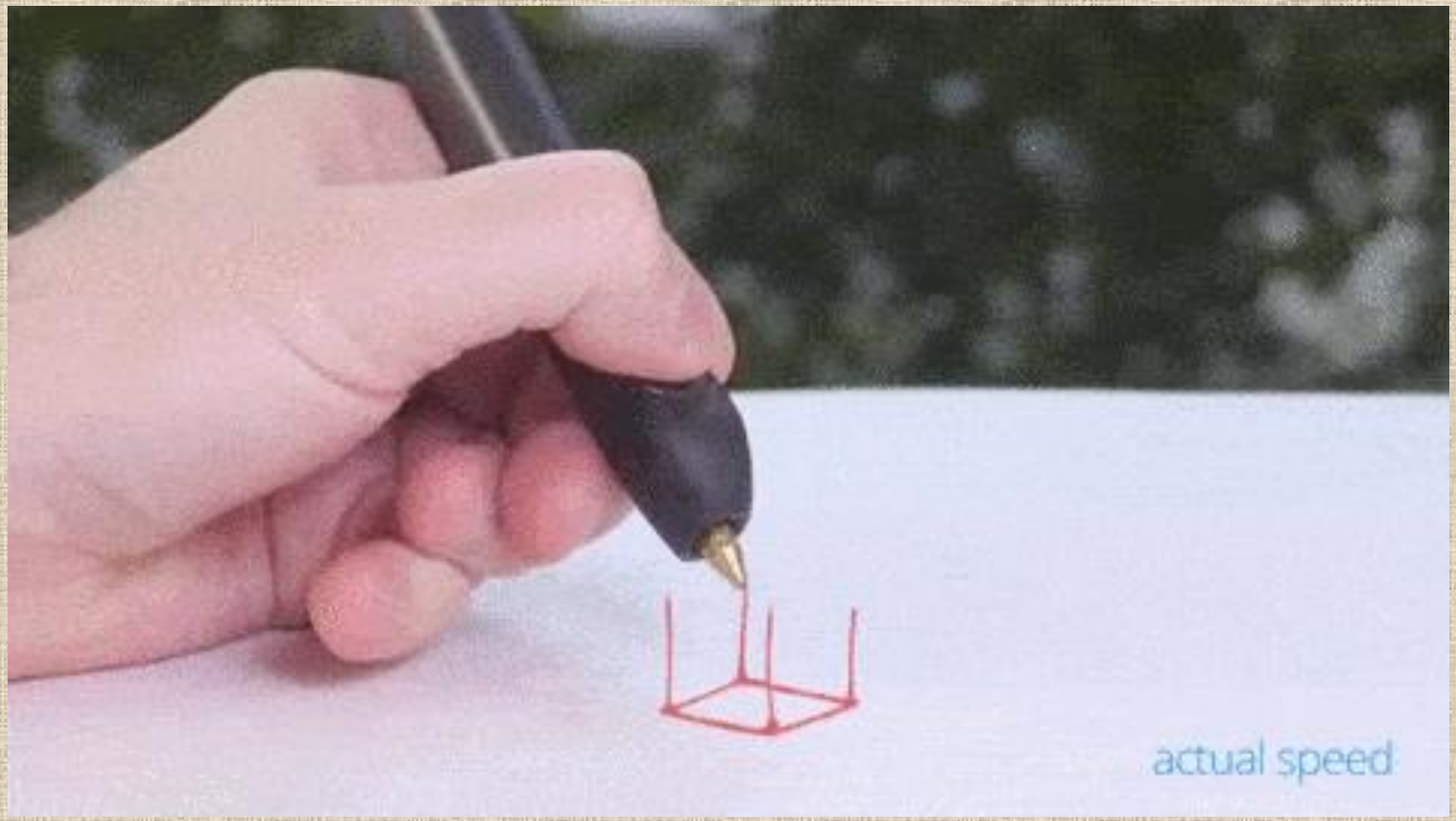
Recent Applications



3D Printing of Flexible Electronics

Courtesy: SME

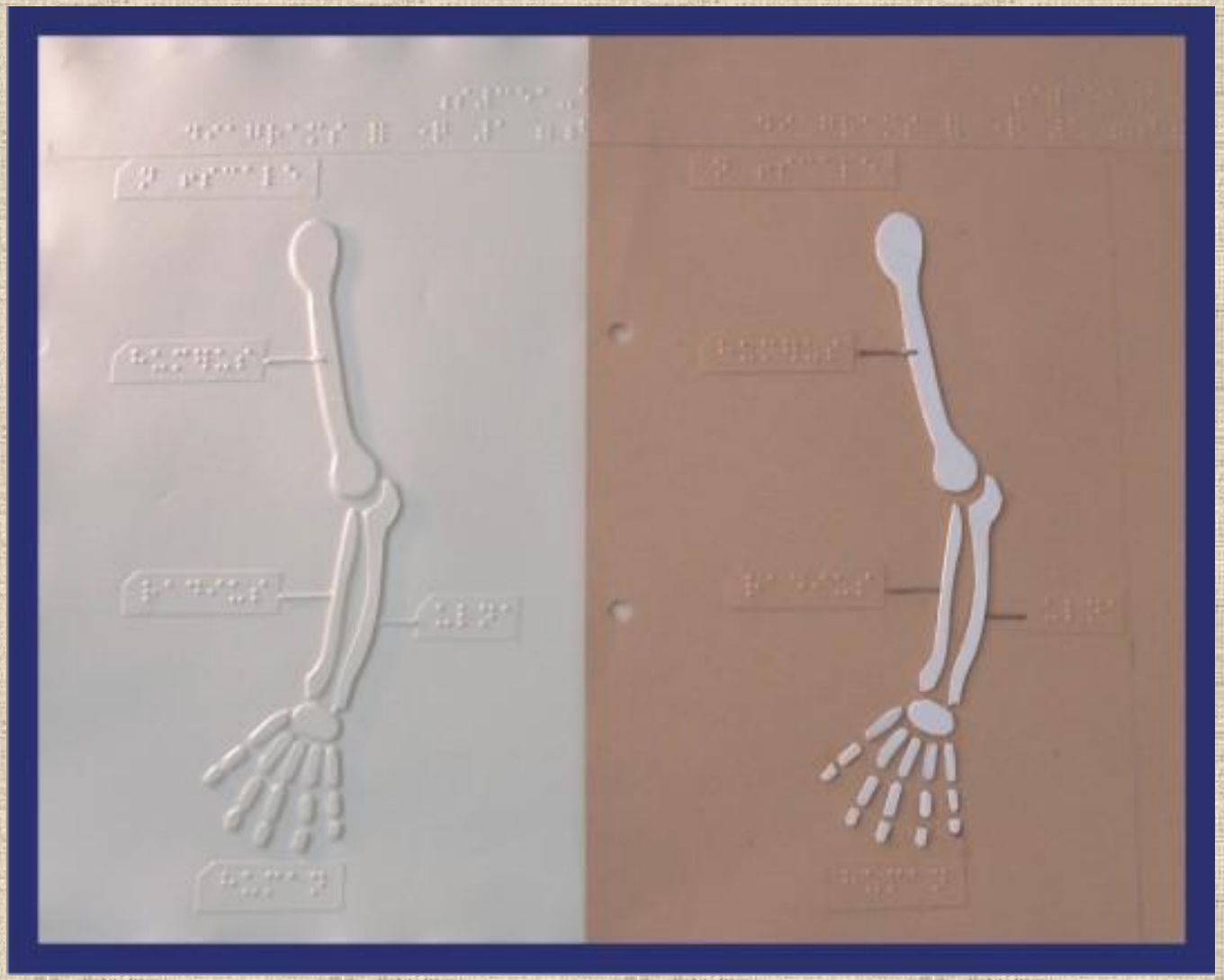
3Doodler



Design & Realization of Tactile Diagrams

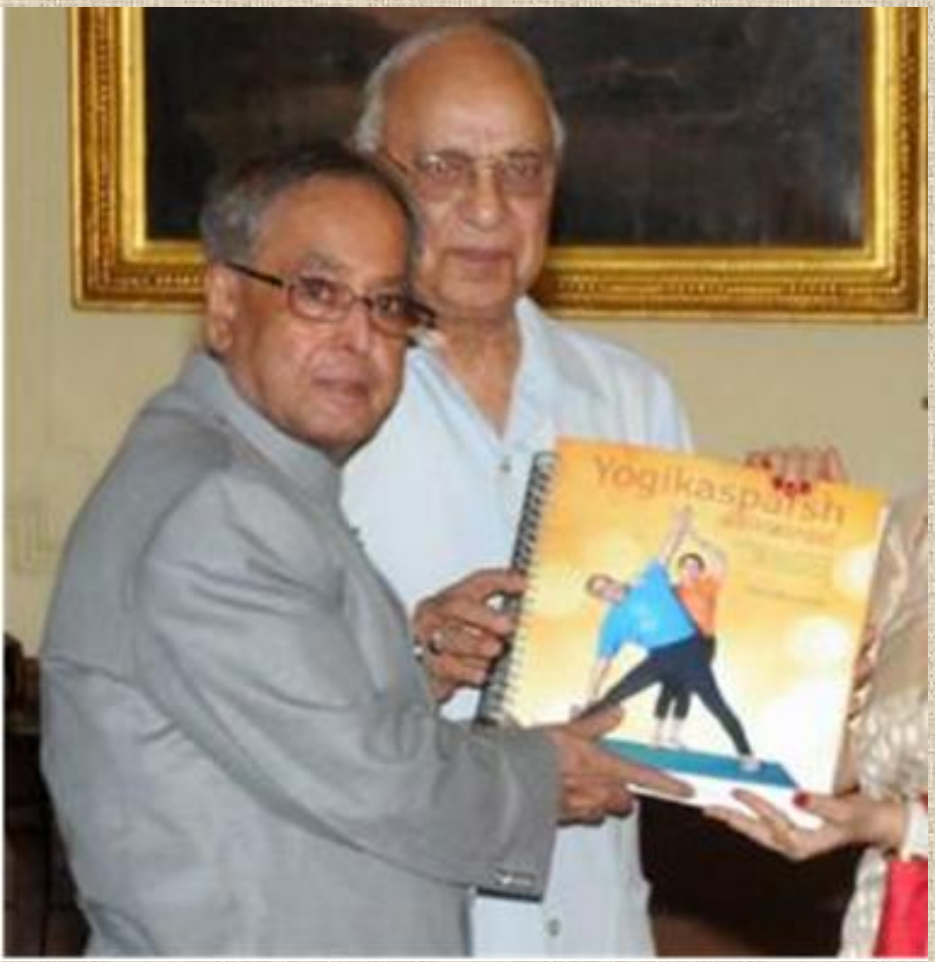
Tactile Diagrams (Thermoforming)

Tactile Diagrams

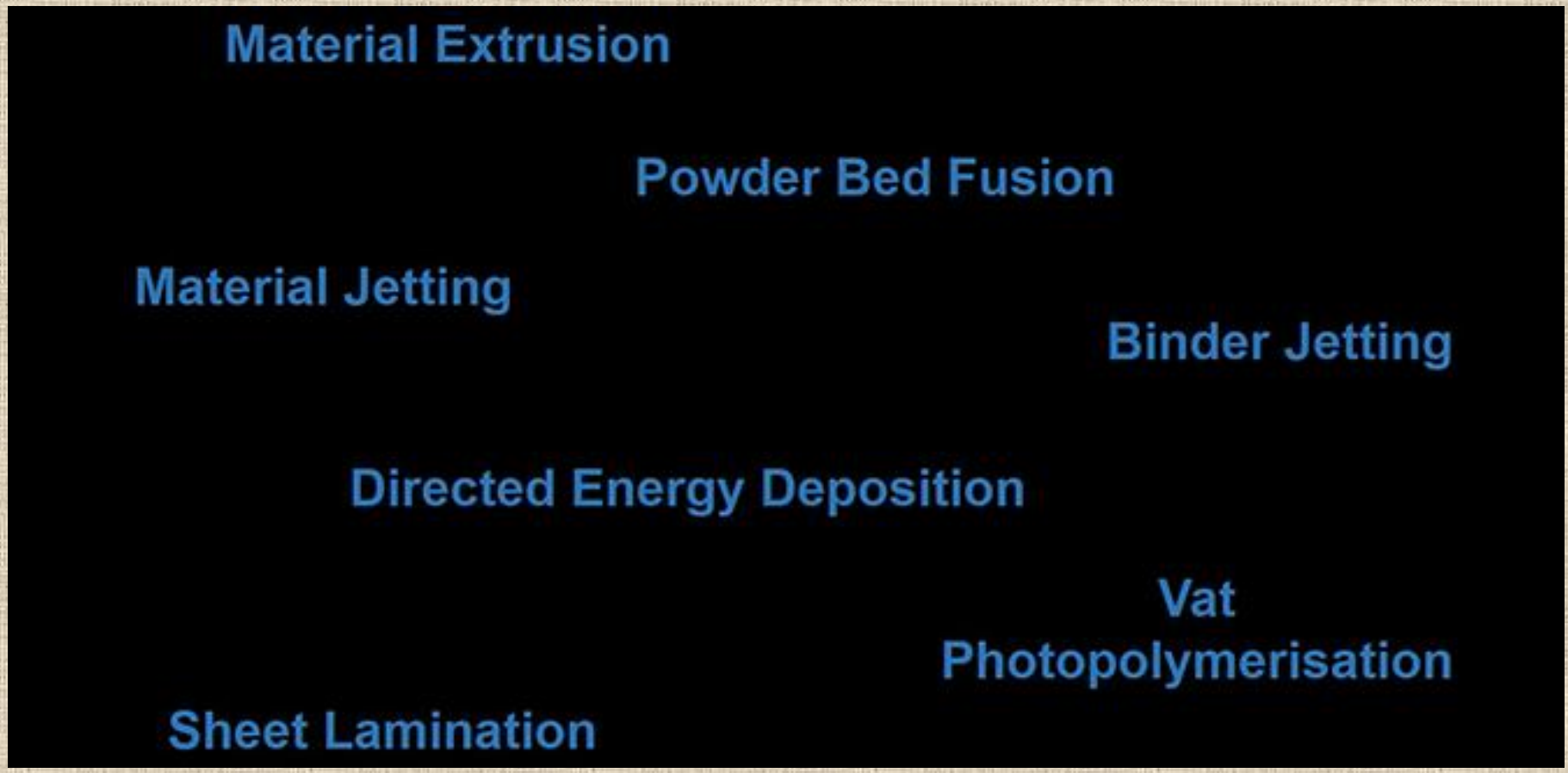


Thermoforming with 3D printed Molds

Tactile Diagrams



3D Printing Processes



Classification of 3D Printing Processes

Courtesy: http://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/