

Materials Assignment 2

by Joseph Omar

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Energy and environmental

Materials & Introduction to Manufacturing Technology

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Research two manufacturing methods

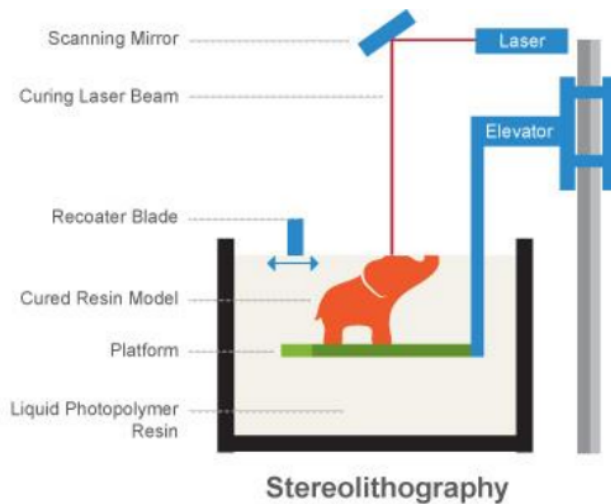
stereolithography

Stereolithography is a 3D printing process used to create concept model² cosmetics such as rapid prototypes and complex parts with intricate geometries in the span of a day. Stereolithography parts can be produced in a wide selection of materials such as extremely high feature resolutions and quality surface finishes are possible with Stereolithography.

² **How Does Stereolithography Work?**

The Stereolithography machine begins the process by making the layers of the supporting structures followed by the piece itself this is done with a ultraviolet laser aimed onto the surface of a liquid thermoset resin.

After a layer is made on the resin surface the build platform shifts down and a recoating bar moves across the platform to apply the next layer of resin. The process is repeated layer by layer until the work piece is complete.



Fresh built parts are taken out of Stereolithography machine and into a lab where solvents are used to remove any additional resins.

²hen the parts are fully cleaned, the support structures are physically removed. After that is done parts undergo a UV-curing cycle to fully solidify the outer surface of the work piece.

The last step in the Stereolithography process is the application of any custom or customer²⁰ specified finishing. It would be good to note that work pieces built in the Stereolithography process should be used with minimal UV and humidity exposure, so they don't degrade.

(reference)

<https://www.protolabs.co.uk/services/3d-printing/stereolithography/>

Author: Unknown

Date written: Unknown

15
“Stereolithography allows you to create Pretty much anything 3-D shaped that you could imagine. If you can make your design in a CAD program, you can probably bring that idea into fruition with this design process. The only condition is the need for structural integrity during the building process of your design. In some cases, you need to add internal bracing to a design so that it does not collapse during the printing or curing phases.”

(reference)

<https://computer.howstuffworks.com/stereolith3.htm>

Author: Marshall Brain

Date written: Unknown

What are the benefits of manufacturers using this method?

- 2
1. Competitively priced
2. Excellent surface finish
3. Easily duplicates complex geometries
4. One of the best surface finishes for an additive process

Are there any problems with using these methods for example personal protection equipment needed or special skills?

From what I have found from stereolithography it seems to be a very safe manufacturing process, but due to the amount of time a person would be working with resin and other potential toxic materials I would recommend very basic equipment like a dust mask and maybe some low level protective gloves, as I said previously its quite safe to use this process.

Some training in how 3-D printing works, solid works and other CAD packages would be very useful in this manufacturing process.

“Stereolithography is a highly expensive process. The machines as a whole cost in the region of around \$250,000. “

"They must be vented because of fumes created by the materials that would be used in this machine (polymers and solvents to name a few). The polymers and solvents associated with the machine are expensive."

"CibaTool SL5170 resin, a common type photopolymer is used in the stereolithography machine, it can cost in the range of \$800 a gallon."

"For these reasons, it is uncommon to find stereolithography machines anywhere but in large companies."

(reference)

<https://computer.howstuffworks.com/stereolith4.htm>

Author: Marshall Brain

Date written: Unknown

What materials will work with these methods?

Is there a material that they are excellent for? Which materials won't work?

The materials listed below are used for this manufacturing process

2
"ABS-like

- ABS-like black (accura black 7820)
- ABS-like translucent/clear (watershed)
- Microfine tm Green
- Microfine tm grey

PC-like

- PC-like advanc high temp (accura 5530)
- Ceramic-like (advanc Hightemp perForm)

PP-like / ABS-like

- ABS-like grey (accura Xtreme Grey)
- ABS-like white (accura Xtreme white 200)"

(reference)

12
https://www.protolabs.co.uk/services/3d-printing/stereolithography/#Design_Guidelines:_Stereolithography

Author: unknown

Date written: Unknown

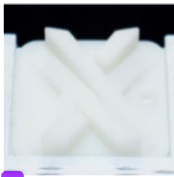
3
stereolithography (SLA) is known for its high accuracy, great surface finish and its long-life expectancy. Below are some more materials that I found that can work with this machine.

3 Impact Resistance

Certain SLA materials create long lasting parts, which are ideal for tough or hard-pressed environments (environments such as the CAD industry). These materials are especially known for their robustness which allows it to enter in field that require such materials.

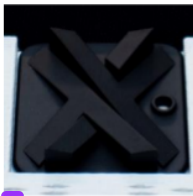
3 Accura Xtreme White

This is a very robust SLA material (polypropylene or ABS to name a few). It is widely used for snap enclosures and is available in the colour white. The material Xtreme Grey also has the same properties in the colour grey.



3 Opaque Black

SLA parts are known for their superior level of detail and high definition surface finishes. However, there are limited options out there for a dark coloured SLA material.



3 Accura ABS Black

A durable ABS-like SLA material with a smooth black finish useful for parts designed for injection moulding.

3 Highly translucent or clear

Transparent SLA materials are naturally clear, but there are certain limitations to what this material can done due to layering required with this process. You can easily see colours through the parts but may not be able to read text that clearly. Below are some examples.

3 Somos Watershed

Is a naturally transparent ABS-like material with an excellent resistance to moisture build up. The material exhibits high clearness with secondary finishing. 3

Accura 60

3
is a naturally transparent PC-like material that can give a good feature resolution. This material exhibits high clearness with secondary finishing.

(Reference)

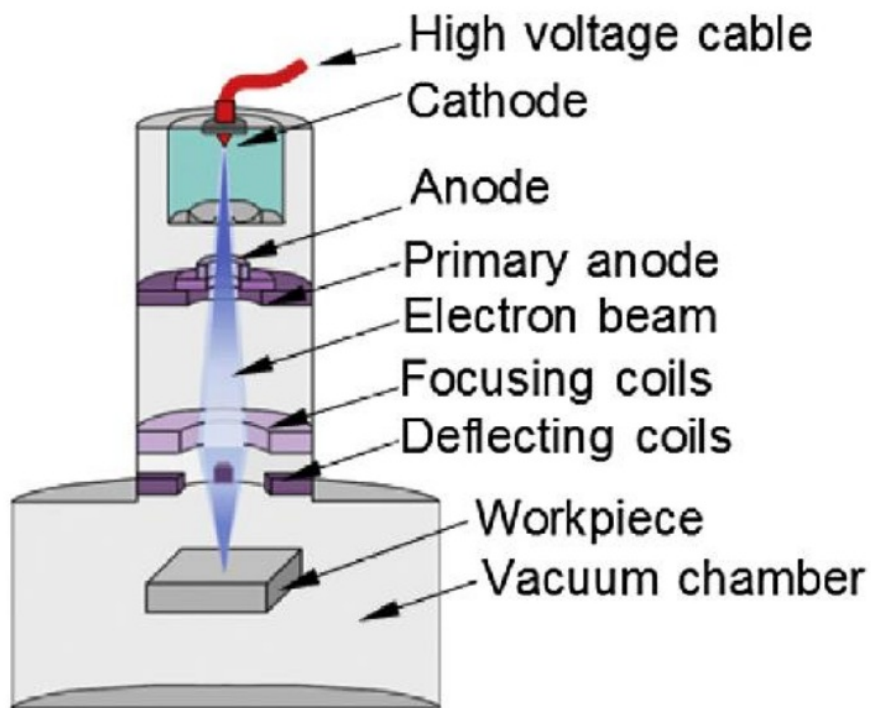
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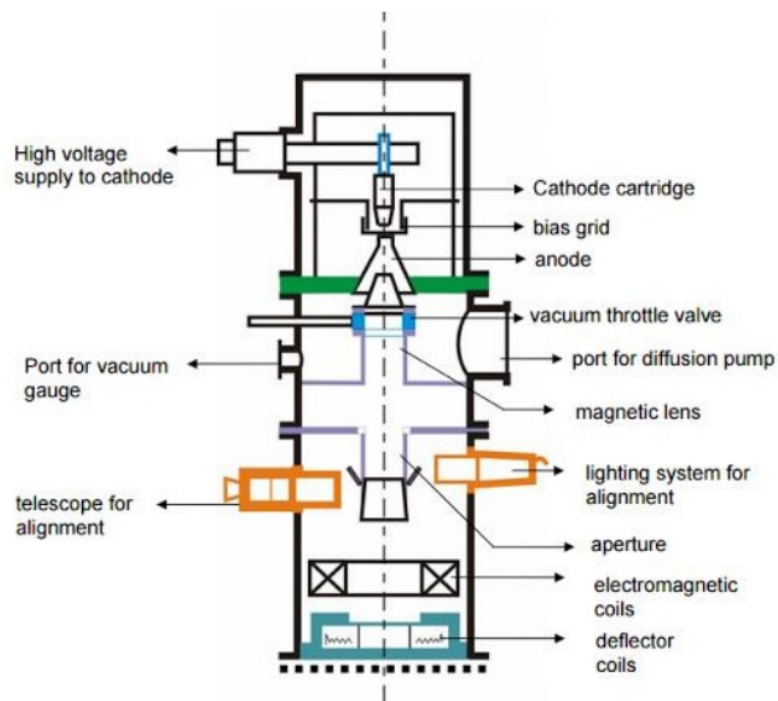
<https://www.xometry.com/blog/6-most-popular-sla-materials>

Author: unknown

Date written: Unknown

Electron beam machining





1. Electrons passing through the anode are pushed to $\frac{2}{3}$ of the speed of light by applying 50 to 150 kilo volts at the anode, and this speed stays the same till they reach the workpiece.
2. Due to the nature of the electrostatic field produced by the grid cup, the electrons are focussed and made to flow in the form of a converging beam through a gap in the anode.
3. A magnetic deflection coil is used to make the electron beam circular having a cross-sectional diameter of 0.01 to 0.02 mm and deflect it anywhere.
4. The built-in microscope with a magnification of 40 on the workpiece enables the operator to accurately locate the beam impact and observe the operation of the machining process.
5. As the beam impacts on the workpiece's surface. the kinetic energy of high velocity electrons is immediately converted into the thermal energy and it vaporizes the material at the spot of its impact.
6. Power density is very high (about 1.5 billion W/cm²) it takes a few microseconds to melt and vaporize the material upon impact.

7. The process is carried out in repeated pulses of small duration of time.
8. The pulse frequency may range from 1 to 16,000 Hertz and duration may range from 4 to 64,000 microseconds.

(Reference)

<https://www.theengineerspost.com/electron-beam-machining/>

Author: unknow

Date written: unknown

Advantages

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The advantages for Electron-Beam Machining are:

- "This process can be used to produce bolts of an extremely small size.
- The machine has high accuracy which allows the work piece to have a better surface finish.
- Due to the machine's compatibility almost all types of materials can be machined.
- The machine can also deal with highly reactive metals such as Aluminium and Magnesium.
- Due to the machine not having any mechanical cutting methods it does not apply any force on the work piece, so cost the of work holding and fixture tools is reduced."

Disadvantages

The disadvantages for Electron-Beam Machining are follows:

- "Due to the machines complex working methods there are some high equipment cost.
- The machine has a very low metal removal rate.
- Due to the machines complexity a high skilled operator is required to operate this machine.
- This machine has a high-power consumption to work.
- The machine cannot produce perfectly cylindrical deep holes."

(Reference)

10

<https://www.mechanicalbooster.com/2017/04/electron-beam-machining.html>

Author: Pankaj mishra

Date written: April 8th 2017

1

Applications of EBM

Some typical applications of the process are:

1

1. "It is while used for drill fine gas orifices, less than 0.002 mm, in space nuclear reactors, turbine blades for supersonic aeroengines.

2. This also used to produce wire drawing dies, light-ray orifices and spinnerets to produce synthetic fibres.
3. Produce metering holes in injector nozzles in diesel engines, etc.
4. Can be used to scribe thin films.
5. The machine can be used to remove small broken taps from holes.”

(Reference)

²¹
<https://www.theengineerspost.com/electron-beam-machining/>

Author: unknow

Date written unknown

6. ²¹ “Electron Beam Machining can also be used in these fields, such fields include automobile, aerospace, marine etc.”

(Reference)

¹⁰
<https://www.mechanicalbooster.com/2017/04/electron-beam-machining.html>

Author: Pankaj mishra

Date written: April 8th 2017

¹⁴ **Nanomaterials**

Nanomaterials are chemical substances/materials that are manufactured and used on a very small scale. Nanomaterials are developed to exhibit a wide range of characteristics compared to the same material without nanoscale features, such as enhanced strength, increased chemical reactivity and better conductivity.

(Reference)

<https://www.safenano.org/knowledgebase/resources/faqs/what-is-a-nanomaterial/>

Author: unknown

Date written unknown

⁴
 Nanomaterials can occur naturally in the nature (natural sources include soot from forest fires and volcanic ash). They can even be created in an unplanned manner as by-products of various combustions and chemical reactions like diesel engines and welding. The naturally occurring

nanomaterials and the by-products are dubbed as ultrafine particles since they are chemically diverse in nature and are physically different too.

The nanomaterials that are engineered and intentionally created are designed in such a fashion that they possess certain chemical/physical properties which can be utilised for physico-chemical properties for a specific purpose or function.

(reference)

11
<http://www.justscience.in/articles/what-is-nanomaterial/2018/01/02>

Author: Just Science

Date written June 2nd 2018

To put it in simply

The use of nanotechnology is increasing rapidly with each passing day with widespread applications in the field of. Such applications are not limited to electronics, textiles, cosmetics, environment protection, information technology and healthcare. Nanomaterials are the most important product of any and all nanotechnologies.

Since nanomaterials are different from their bulkier counterparts, they go through different risk assessment methods. There are three types of nanomaterials engineered they are: deliberate, this is for nanomaterials that are made by humans to have a certain characteristic that is required to perform a specific function, Then there is incidental nanomaterials these types are accidentally produced by a certain by-product of some industrial or mechanical process, Finally there is natural nanomaterials this is a type of nanomaterial that is exclusively found in nature.

(reference)

11
<http://www.justscience.in/articles/what-is-nanomaterial/2018/01/02>

Author: Just Science

Date written: June 2nd 2018

Where are nanomaterials found?

Some nanomaterials can appear in natural place, they can appear in blood borne proteins essential for life and lipids found in the blood and body fat. Scientists however are particularly interested in engineered nanomaterials (ENMs), which are used in a wide range of commercial materials, devices and structures. They are already in thousands of common products such products include sunscreens, cosmetics, sporting goods, stain-resistant clothing, tires, and electronics are all manufactured using ENMs. They are also in medical, imaging and drug delivery and in environmental remediation.

Types of nanomaterial

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There are many different types of nanomaterials such as:

- Dendrimers
- Composites
- Carbon based materials
- Metal based materials
- Natural Nanomaterials
- Artificial Nanomaterials

7

Dendrimers

These nanomaterials are smaller versions of nanosized polymers built from branched units. The surface of a dendrimer has numerous chain ends, which can be tailored to perform specific chemical functions. This property could also be useful for catalysis. Also, because three-dimensional dendrimers contain interior cavities into which other molecules could be placed, they may be useful for drug delivery.

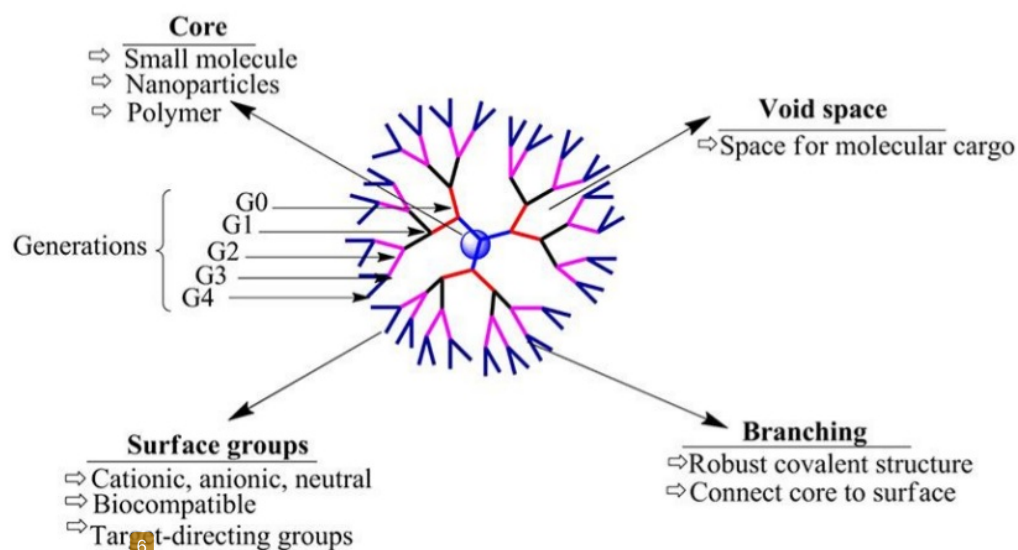
(Reference)

7

<https://www.azonano.com/article.aspx?ArticleID=1872>

Author unknown

Date written March 1st 2007



Dendrimers are highly branched polymers with tuneable surface topology. This polymer has

spherical core-shell nanoarchitecture with a high density of surface functional groups. It is available in several different generations and size making it a diverse nanocarrier for biomedical applications. Drugs can be loaded in multiple ways including complexation and/or conjugation to surface functional groups and/or encapsulation inside the core of the dendrimers. Dendrimers have been explored as drug delivery vehicles by various routes of drug administration and for other biomedical applications. The chapter provides an overview of physicochemical properties of dendrimers and its various biomedical applications.

19
(Reference)

<https://www.sciencedirect.com/science/article/pii/B9780123969835000168>

Authors: Umesh Gupta, Omathanu Perumal

Date written: January 24th 2014

5
The bioactive agents may be encapsulated into the interior of the dendrimers or chemically attached/physically adsorbed onto the dendrimer surface, with the option of tailoring the carrier to the specific needs of the active material and its therapeutic applications. In this regard, the high density of exo-presented surface groups allows attachment of targeting groups or functionality that may modify the solution behaviour or toxicity of dendrimers.

Modified dendrimers have been shown to act as Nano-drugs against tumours⁵, bacteria, and viruses. Recent successes in simplifying and optimizing the synthesis of dendrimers provide a large variety of structures while at the same time reducing the cost of their production.

(Reference)

19
<https://www.sciencedirect.com/science/article/abs/pii/S0169409X05001894>

Authors: Sönke Svenson, Donald A. Tomalia

Date written November 21st, 2005

There are some disadvantages to this nanomaterial some of those include:

- The unstable nature of the nanomaterials.
- Has not got a high corrosion resistance.
- Has a high solubility.
- Nanomaterials when in direct contact with oxygen have a chance to cause an explosion
- Nanomaterials are Impure
- The use of nanomaterials in the medical field is worrying due to it being biologically harmful due to its high toxicity
- Carcinogenic
- Hard to synthesize
- Cannot be safely disposed of

- Hard to recycle

(Reference)

<https://www.elprocus.com/nanomaterials-classifications-and-its-properties/>

Authors: unknown

Date written Unknown

word count (without references) =2069

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