

## The SLA 3D Printing Technology and Development

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### Abstract

In recent years, 3D printing technology as a kind of rapid prototyping technology rapid development, and is quickly changing people's production and life style. There are many kinds of 3D printing manufacturing technology, mainly in SLA, SLS and LOM, FDM technology mainly. There are mainly the SLA, SLS and LOM, FDM technology at present. And SLA 3D printing technology is currently the world's most in-depth research, the earliest, the most mature technology, the most widely used a method of rapid prototyping. In this paper, the SLA 3D printing technology principle and application are introduced, and the SLA technology development has made the outlook for the future.

### Keywords

3D printing technology, Manufacturing technology, SLA.

### 1. The SLA Technology Introduction

The SLA is Stereo Lithography Appearance, that is, three-dimensional molding in curing light, also often referred to as Stereo lithography or stereoscopic printing molding [1]. In 1984, the United States, Charles. Hull used the technology to print out the first three-dimensional objects, and established the world's largest 3D printing company, Opened the prelude of the 3D printing technology. SLA 3D printing technology as the earliest development of rapid prototyping technology, also often used as a high quality printing methods [2]. It with photosensitive resin as raw material, the computer control of ultraviolet laser based on the information of parts of each layer section, the photosensitive resin surface of point by point scanning, if the thin layer of the resin area is scanned, then the area light occurs polymerization and curing resin, parts of a thin layer is formed. After completion of a layer of photosensitive resin curing, The workbench will move down a thick layer of distance, so that in the original good curing resin on the surface and then apply a layer of new liquid resin, repeat steps until the three-dimensional entity printing is completed [3].

The SLA technology molding characteristics: Molding speed, high degree of automation, can forming arbitrarily complex shape, the material utilization rate of close to 100%, high resolution, high strength, but the parts easy to deformation, can use the types of materials, liquid resin have less brittle odor and toxicity and production of goods. Because of the above characteristics, the SLA technology is mainly used in complex, high-precision, with the purpose of the art of fine pieces of rapid prototyping. In recent years, in the field of micro-electro-mechanical appeared Micro Stereo lithography. It is in the traditional method of SLA technology, on the basis of rapid prototyping technology for micro mechanical structure production.

### 2. The SLA Tecgnology Principle

The SLA technology principle is shown in figure 1. Print stereoscopic object, the first liquid tank filled with liquid photosensitive resin, in helium - cadmium laser or argon ion laser emit ultraviolet laser beams in the control system under the control of parts of the layered cross section information in photosensitive resin surface point by point scanning, the scanned area of the thin layer of resin to produce light of polymerization and curing, a thin layer of formed parts. A layer after curing, the workbench down a thick layer of distance, so that in the original good curing resin on the surface and then apply a layer of new liquid resin, scraping board will be larger resin viscosity liquid surface flat,

and then on to the next layer scanning and processing. New solidification layer of the bonded firmly in the previous layer, repeat until the whole parts manufacturing, get a three-dimensional entity prototype. When the entity prototype is completed, first remove the entity, and excess resin net. After removing, cleaning, and then the entity prototype under uv laser overall after curing. Because of the high viscosity of resin material, after each layer curing, surface hard to flow quickly in a short time, it will affect the precision of the entity. After using scraper scraping, the required number of resin will be very evenly with polish apply on a laminated, so after laser curing can get a better precision, make the product surface more smooth and flat; And it can solve the problem of residual volume [4].

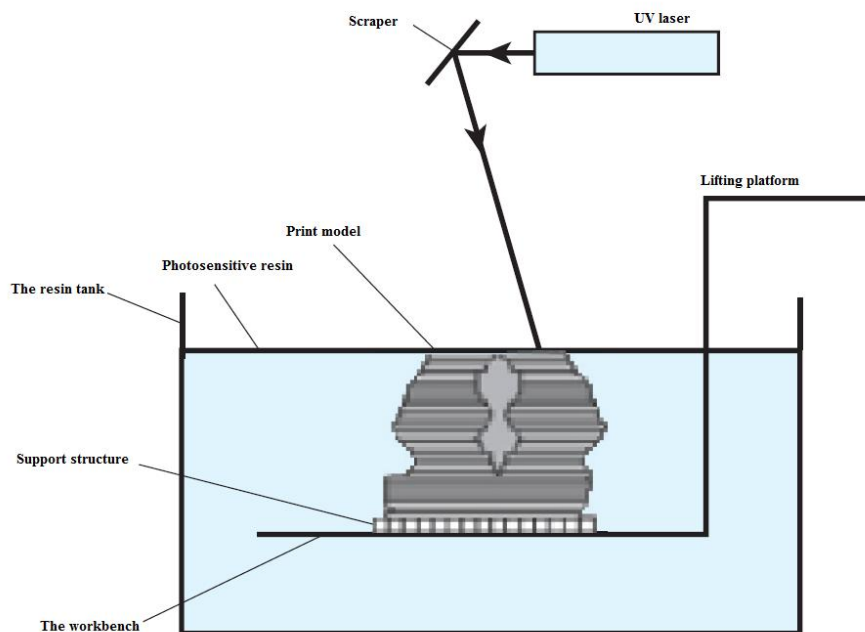


Fig. 1 Principle schematic diagram of the stereo lithography technology

### 3. The application of Stereo Lithography Appearance

Several methods for rapid prototyping technology in the current application more, The SLA technology with molding process automation degree is high, the surface of the prototype of good quality, high dimensional accuracy and can achieve more detailed sizes forming characteristics and the most widely used. In the conceptual design of exchange, the single small batch precision casting, the product model, rapid mould and directly facing the product mould and so on many aspects of directly facing the product is widely used in aerospace, automotive, electronics, consumer goods and medical industries [5,7].

### 4. The SLA research progress of technology

Since the emergence of the SLA technology, it has played an important role in the field of rapid manufacturing rapidly, and has become the focus of engineering. The light curing prototype manufacture precision and molding performance of the material, has been the hotspot in research of the technology. At present, many researchers through the molding parameters, forming method, material curing analyzing various factors that influence the forming accuracy of proposed many methods for increasing accuracy of uv-curable prototype production, such as scanning line overlap area curing process, improved secondary exposure method, research and development with the original CAD data directly sectioning, optimize the process parameters such as before parts processing, the process method can reduce the deformation of the parts, to reduce the residual stress, improve the prototype manufacture precision. In addition, the materials used in the SLA for liquid photosensitive resin and its performance is good or bad will directly affect the forming part of the important indexes such as strength and toughness, which affect the technical application prospect of

SLA. So improve the performance of molding materials to reduce costs in recent years has also done a lot of research, the proposed many effective technique, such as the modification of nano SiO<sub>2</sub> dispersion in the photosensitive resin of free radical-cationic hybrid, can make the critical exposure of photosensitive resin increases and projection depth decreases, its von berg systeme heat resistance, hardness and bending strength significantly improved; And as to join SiC whisker in the resin matrix, can improve the toughness and reliability; Development of new type of visible light cured resin, this new type of resin using visible light can be curing and curing speed, less harmful to human body, improve the production efficiency greatly reduced the cost at the same time.

Because of the MEMS (Micro company - Mechanical Systems) and the rapid development of microelectronics field, on the basis of traditional method of SLA technology, this paper proposes a new demand for Micro Mechanical manufacturing rapid prototyping technology - light curing rapid prototyping technology (Micro Stereo Lithography), using the technology to the traditional SLA to sub-micron technology molding precision, develop the rapid prototyping technology in Micro machinery manufacturing applications[8]. Hardcotton start-up company, Australia in 2014 launched a so-called pressure control of the world's first 3D printers, Elemental SLA 3D printer, the printer USES a pressure control system to control the printing of the resin level height, can increase or reduce the resin level accurately with building area or any interaction in photosensitive resin. In 2016, the university of Vienna, Austria (TU Wien) researchers combined with DLP 3D printers, develop a new 3D printers, effectively solve the need to constantly in the process of 3D printing to try and match the surface quality of the injection molded parts structure and the performance of the problem. This printer adopts the technology of the SLA laser precision optical processing technology to the optimization model of the surface of the resolution, compared with the traditional SLA printing technology, its product print resolution of 20 um, impact strength can reach 40 kj/m<sup>2</sup>, elongation at break of up to 40%.

## 5. The prospect of SLA technology

The SLA technology development has made considerable progress, towards industrialization, industrialization continues, the combination of it and other advanced design and manufacturing technology is more and more closely. In the development of light curing rapid prototyping technology in the future, should be pay attention to the development trend of the following aspects: first, the further development of economic, efficient and precise light curing technology and equipment, and strive to improve shaping precision and dimension stability, reduce the equipment operation cost; Second, continue to study the mechanism of forming material and performance, to further develop high performance and low cost of light curing special material; Third, continue to expand new areas of application. Fourth, improve the forming speed, the cycle of 3D printer is usually a few hours or longer, or by increasing the laser nozzle as well as improve the scanning speed can effectively shorten the printing cycle.

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