

The Development of SLA (Stereolithography) and DLP (Digital Light Processing) Technology in China

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Abstract

The overall market for 3D printing industry reached 2.7 billion dollars in China, in 2017. The 3D printing market is growing rapidly in China, in which SLA and DLP print account for a large proportion. Although some high-end technology fields are still occupied by well-known foreign enterprises, with the government's policies support for 3D printing, the influx of venture capital funds, the attention to intellectual property rights, SLA and DLP technology are increasing a high level in some areas. The application of SLA and DLP technology extends from traditional manufacturing industry to new fields with higher added value, such as health care.

Keywords: 3D Printing Technology, SLA and DLP, Industry and Market, Intellectual Property, China

Introduction

3D printing technology, also known as additive manufacturing technology, is an advanced manufacturing process which combines the application of new materials with digital technology. It is a research hot spot in recent years over the world. 3D printing is highly integrated computer, laser, material, machinery and other fields of technology. Its industrial chain is based on precision machinery, supported by information technology, material science, and connected with other industries through application service. According to Wohler's Associate's statistics for 61 industrial manufacturers, 19 special material manufacturers, 100 service providers and a batch of manufacturers of additive manufacturing equipment around the world, the output of the industry reached 6 billion 63 million US dollars in 2016, 17.4% increase over the past year. In the last three years, the compound growth rate is as high as 26.0%. The research on 3D printing technology in China began as early as the 1990s. On the whole, additive manufacturing industry in China has a good development trend and has a certain technical basis. It has technical advantages in some fields. The industrialization process of 3D printing is accelerated obviously, especially the technology and application of SLA (Stereolithography) and DLP (digital light processing) have been expanded and deepened, and its industry has occupied a great proportion of the 3D printing market [1-3].

Industry and Market Market

It is estimated that the overall market for 3D printing industry reached RMB 17.3 billion yuan (about 2.7 billion dollars, global: about 6.0 billion dollars) in China, in 2017, and the industry is expect

to reach RMB 35.0 billion (about 5.4 billion dollars, global 21.2 billion dollars). Investigation show that incomes (include machine, material and service) of the top three companies in China, which are engaged in 3D printing (SLA/DLP/SLS/SLM), is about 1.0 billion dollars. They contributed more than 1/3 of the market value, of which SLA and DLP account for half of their business. This market includes machines, materials and application services [4].

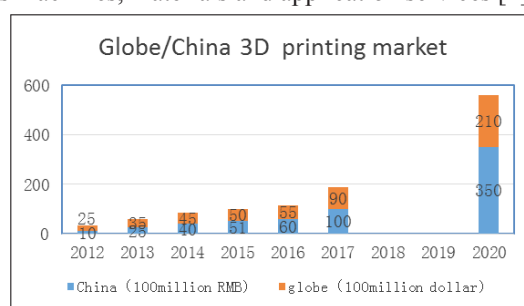


Figure 1: Globe/China 3Dprinting market size

Since 2015, the number of institutions working in UV curing 3D printing in China has grown rapidly, which has led to the outbreak of demand for SLA machines and photosensitive materials. In the next ten years, the market space of materials is estimated to be 16 billion dollars over the next decade. From the view of equipment of SLA and DLP, the early equipment was mainly imported from abroad in China, but at present the domestic machinery occupies the main market. Judging from the photosensitive materials used in SLA and DLP technology, the price of domestic resin is only less than 1 / 2 of imported materials. But at the top-end of the market, Chinese 3D printing companies still prefer to use US or German devices and materials. For example, the 3D printing machine of

lost-wax -casting and photosensitive material used in the dental and jewelry industry mainly come from Envision TEC, seldom seen the domestic products.

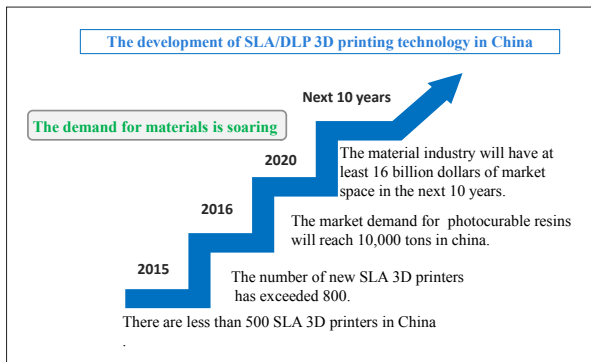


Figure 2: The market of SLA and DLP in China

In addition, in the early days of 3D printing, the manufacture of equipment and its technological research received a lot of money, but now, from the trend of investment, material companies are more likely to get funds from venture capital than machinery and equipment enterprises.

Government Policies

As a new technology, 3D printing is widely used in China. It is difficult to reach or surpass the international level in a relatively short time only based on individual strength. The booming development of technology and industry is closely related to the vigorous support of the government forces. This support comes specifically from the government’s financial, technological and educational sectors. Of course, other high-tech industries also have similar situation.

In 2015, the government issued “Chinese Manufacturing 2025”. This plan is regarded as a programmatic document guiding the development of China’s manufacturing industry in the next ten years or even longer. The plan of “Chinese Manufacturing 2025” is aimed at the new environment and a new problem facing the long-term development of China’s manufacturing industry. The aim is to improve the international competitiveness of China’s manufacturing industry in the future under the new technology environment, the international competitive environment and the domestic factor environment, and not just to solve the short-term difficulties in the development of the industry, or to provide investment power to solve the problem of short-term growth. In this plan, 3D printing is listed as a pillar industry for future development [5-6].

Industrial and technological projects that conform to national policies are easy to get money from national finance or venture capital, which is also a reason for the rapid development of 3D printing market in China.

Industrial chain structure

The upstream industry chain is composed of universities, national research institutes and 3D printing enterprises. These include Huazhong University of Science and Technology, Tsinghua University and Xi’an Jiao tong University. Universities and scientific research institutions realize the improvement of the precision and stability of 3D printing materials and equipment in the industrial chain, and break through the technical problems of less kinds and lower quality of 3D printing materials. The 3D printing enterprise

realizes the commercialization of the technological achievements. By 2017, China’s largest local SLA manufacturer was Union Tec in Shanghai and ZRapid Tech in Suzhou. However, DLP equipment and material providers are widely distributed, and no large enterprises monopolize the market.

The midstream industry chain is the service system networks and the third party platforms. These networks and platforms connect upstream enterprises with downstream markets and provide commercial distribution information interaction, product feedback and market dynamic information for 3D printing products, devices and materials. Such as the platform <http://www.mohou.com/> is a more successful 3 D printing cloud platform.

The downstream of the industrial chain is the application oriented market. At present, the domestic popular SLA/DLP application industry focuses on industrial manufacturing, personal consumption and biomedical markets. With the development of equipment and material technology, as well as the reduction of 3D printing cost, users accept the new technology. The application field of 3D printing based on SLA/DLP technology is expanding in China [7].

Research and Application Intellectual Property

In the last decade, the number of patent applications for 3D printing technology has been increasing in China, in which the number of patent applications for printing equipment and printing materials is obviously beyond the number of printing processes and software. But the top patent holders are foreign companies, such as Stratasys 3D System. On the one hand, it shows the rapid development of 3D printing technology and market in China, on the other hand, it also shows that the level of research and development in China is still lagging behind some advanced countries.

As the basic material of 3D printing, polymer material is the key research direction in the 3D printing technology. Figure 3 shows the patent application trend of 3D printing polymer materials in China. From the chart, we see that after 2012, the number of domestic patent applications has increased quickly. This reflects the improvement of China’s research level in the field of 3D printing polymer materials, and also reflects the importance of developing 3D printing resin materials in China.

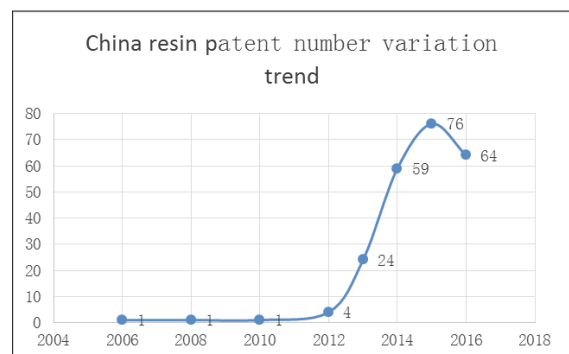


Figure 3: The number of 3D printing resin patent application in China

Figure 4 shows the distribution of 3D printing resin materials corresponding to printing patterns. It can be seen from the diagram that the photosensitive resin patent applications for SLA and DLP

technology is 15%, while the proportion of thermoplastic resins is very large. This is due to the fact that thermoplastic resins are suitable for the mode of FDM, which is easy to process, low in cost and more mature technology. However, the study of photosensitive resin used in SLA and DLP molding technology started relatively late in China [8-9].

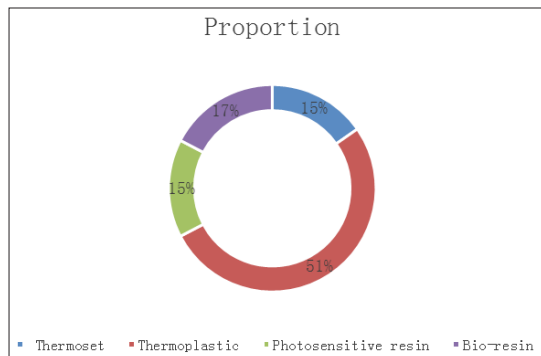


Figure 4: The distribution of 3D printing resin materials patterns.

Research and application trend

In recent years, the 3D printing technology and new application fields based on SLA and DLP in China have been continuously developed and expanded. The print format of SLA and DLP devices is becoming larger and larger, and the printing accuracy is becoming higher and higher. For example, Sprintray (located in Shaoxing China) has recently developed a DLP machine with a resolution of 3840*2160px, with very high printing accuracy.

Ceramic photo-curing 3D printing technology is a hot research field in China. The ceramic powder was added into the photo-curable liquid resin to disperse the homogeneous ceramic slurry, and then printed into the ceramic green body by SLA or DLP printer. Finally, the ceramic parts were obtained by drying, degreasing and sintering.

At present, only France, Austria, Netherlands and a few countries have better ceramic 3D printers and photo-curable ceramic slurry products. In 2016, 3DCeram introduced their ceramic stereolithography technology to China, but their products are extremely expensive. Therefore, Chinese companies such as Leyi (located in Hangzhou China), develop their relatively cheap 3D printers and slurry products. China pays more and more attention to related technology research.

According to the statistics, 94% of the population in China had some form of dental problems; 85% of the population had periodontitis, and 30-50% people had dental occlusion. After the application of 3D printing to dental surgery, the commonly used dental models and dental surgical instruments are handmade from traditional technicians to 25 microns high precision 3D printing, which can meet the needs of complex, highly customized and rapid production of oral products.

In the 3D printing technology, digital light processing (DLP) technology is very suitable for making customized products for various kinds of dental needs. Hangzhou Shining 3D Technology combines a set of digital solutions from scanner design to 3D printing production. The scheme makes the drawing simpler and makes the error minimized by digital docking. The digitalization of the mouth makes the transmission more convenient, and the machine production

is more efficient and cheaper. According to the requirements of the dentistry industry, Hangzhou Leyi New Material Technology, A high-tech enterprise specializing in the development, production, sale and service of 3D printing new materials, launched a special model material, and summed up a complete set of practical steps in the related process. The practical and powerful material research and development ability becomes an important part of Hangzhou Shining 3D's initial solution for digital denture processing [10-12].

Conclusion

The 3D printing market is growing rapidly in China, in which SLA and DLP print account for a large proportion. Although some high-end technology fields are still occupied by well-known foreign enterprises, with the government's policies support for 3D printing, the influx of venture capital funds, the attention to intellectual property rights, SLA and DLP technology are increasing a high level in some areas. The application of SLA and DLP technology extends from traditional manufacturing industry to new fields with higher added value.

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