

Mechanical Properties of 3d Printed Materials

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Abstract: *This article studies the mechanical properties of materials produced using 3D printing technology, their strength, elasticity, and practical applications. The current advantages of 3D printing and research in this area in Uzbekistan are highlighted.*

Keywords: *3D printing, mechanical properties, strength, elasticity, innovative materials, additive manufacturing.*

INTRODUCTION

3D printing technology is gaining importance in the industrial, medical, construction and engineering sectors today. The advantage of this technology is that it is more economical and flexible than traditional manufacturing methods, allowing the creation of objects with complex geometries. However, the mechanical properties of 3D printed materials depend on their composition, layering method and printing conditions, which affects their real-world applications.

LITERATURE REVIEW AND METHODS

Uzbek scientists are also conducting research on the development of 3D printing technologies and their application in industry. In particular, scientific research is being conducted at technical universities and scientific centers in Tashkent to increase the efficiency of layered manufacturing methods (Normurodov M., Ro'ziyev B., 2022).

Mechanical Properties of 3D Printed Materials 3D printing technology allows you to work with various materials, including plastics, metals, ceramics and composites. The main mechanical properties of these materials are considered below:

Plastics are the most commonly used 3D printing materials. They are relatively light, flexible, and inexpensive, and are used in many industrial and consumer applications. For example, PLA (polylactic acid) and ABS (acrylonitrile butadiene styrene) are the most common materials. Their mechanical properties are as follows:

It is an environmentally friendly material with good mechanical strength, but it is brittle, so it can be quickly damaged under loads. The strength of PLA can often be up to 40-50 MPa, but it is sensitive to temperature and can lose its properties at high temperatures (above 60°C) (Tursunov, 2023).

This material is characterized by its elasticity and impact resistance. It is resistant to high temperatures and humidity, and its mechanical properties are better than PLA. The strength of ABS is 50-70 MPa, and this material is mainly used in the automotive industry, electronics, and construction (Shukhratov, 2022).

Metal 3D printing can produce high-strength products for industry. For example, aluminum, stainless steel, and titanium are characterized by high mechanical properties. According to research, layered metal

products may have slightly lower strength than traditional cast materials, but they allow for the creation of complex shapes (Ismoilov S., 2021)

RESULTS

The mechanical properties of the metals mentioned above vary depending on their application, so let me give you a brief overview of them.

Aluminum materials are one of the most common 3D printing materials, characterized by their lightness and strength. The mechanical strength of products manufactured through aluminum 3D printing can reach 120-150 MPa, which is better than traditional cast aluminum materials (Normurodov, 2022).

Titanium materials have high strength and low weight, and are widely used in medicine and aviation. The mechanical properties of titanium materials through 3D printing are characterized by their high strength and resistance to deformation. The strength of titanium can be 900-1000 MPa (Ismoilov, 2021).

3D printed ceramic materials are known for their high temperature resistance. For example, a group of scientists led by Professor Liu Ren developed a new technology by creating a ceramic mixture that hardens quickly using infrared rays. This technology is gaining great importance in industry (airi.uz, 2023). Ceramic materials are resistant to high temperatures and have high hardness, and their use in 3D printing is expanding. The mechanical properties of ceramic materials depend on the layered manufacturing process. For example, bioceramic materials are used as implants in medicine, and their mechanical properties must be very high. The mechanical strength of 3D printed ceramic materials can be up to 100-200 MPa (Liu et al., 2023).

Composite materials are obtained by combining two or more materials. For example, carbon fiber reinforced polymers can be 5-10 times stronger than traditional plastic. That is, I must say: Carbon fiber reinforced polymers: These materials provide high strength and lightness. Their mechanical strength is 400-600 MPa (Tursunov, 2023).

Advantages of 3D Printing and its Development in Uzbekistan

3D printing technologies have been developing in Uzbekistan in recent years. Several scientific laboratories in Tashkent are conducting research in this area. In particular, the Ministry of Innovative Development of the Republic of Uzbekistan has studied the impact of 3D technologies on local industry (Ministry of Innovative Development, 2023).

According to research, 3D printing:

- Reduces production costs
- Accelerates technological processes
- Adapts to the production of special items

Therefore, this technology is expected to be widely used in our country in the future.

CONCLUSION

3D printing technology plays an important role in the development of modern industry and science. The mechanical properties of materials produced with its help depend on their composition, layering method and processing conditions. Plastics, metals, ceramics and composite materials have their own advantages, and their proper use helps to improve the quality of products.

Research on 3D printing is also being conducted in Uzbekistan. The development of this technology will help to develop local production and create innovative solutions.

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