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Nanoscale Single Photon 3D Printing

Single-photon 3D nanoprinting achieves 120 nm resolution at high throughput using low-cost diode lasers.

Researchers at Purdue University have developed a single photon 3D nanoprinting technology. This mechanism transforms current laser-based 3D additive nanoprinting technologies by direct-writing 3D nanostructures at a significantly higher throughput. Femtosecond laser two-photon polymerization is widely used for 3D nanostructure fabrication. However, this technique is expensive and slow, which presents significant obstacles for commercial use in manufacturing. Alternative options include sensitized absorption processes that increase speed and reduce cost, but they deliver limited resolution and require high power lasers.

This 3D nanoprinting mechanism does not rely on point-by-point scanning processes and therefore produces high-speed and high-resolution results. The single photon-based method allows 3D nanoprinting at lower laser intensities without the need for femtosecond lasers. This technology enables large scale manufacturing of 3D nanostructures and significantly reduces overall production costs. Fast panel writing is implemented to construct high-volume and complex nanostructures for wide ranges of use. Notable applications include nanolithography, zero-stiffness microstructures, and thermal interface structures.

Technology Validation:

The researchers demonstrated the method to print 120 nm resolution structures using a low-cost diode laser. The researchers also demonstrated parallel nanoprinting using a 9Ã—9 array laser beams.

Advantages:

- Orders-of-magnitude lower process cost

- High throughput

- High resolution

Technology ID

2022-PAN-69873

Category

Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Materials Science & Nanotechnology/Thermal Management Materials & Solutions
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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- Non-linear printing

Applications:

- Nanotechnology research and industry

- Healthcare

- Manufacturing processes

TRL: 2

Intellectual Property:

Provisional-Patent, 2023-08-29, United States

Utility-Gov. Funding, 2024-08-28, United States

Keywords: 3D nanoprinter, 3D nanostructure, 3D Printing, Mechanical Engineering, Micro & Nanotechnologies