Direct Laser Writing of Functional 3D Microstructures: Current Trends and Future Directions

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Direct laser writing (DLW) with ultrashort laser pulses has emerged as a powerful technology that allows the freeform 3D printing of complex microstructures with nanoscale features. In DLW, the beam of an ultrafast laser is tightly focused into the volume of a photosensitive material, initiating multiphoton polymerization within the focused beam volume. By moving the focus of the beam in three-dimensions, arbitrary 3D, high-resolution structures can be written into the volume of the material. As the field advances, future development will depend not only on improvements in resolution and fabrication accuracy, but also on the integration of materials design, and application-driven structure engineering.

Current advances and future approaches in DLW will be discussed, with emphasis on the combination of material platforms with functional microarchitectures. Such combinations will enable a shift of the field from the fabrication of complex geometries alone, towards the realization of 3D devices comprising designed functionality, in photonic, micro-optical and bio-related applications. In this context, DLW is increasingly becoming not only a powerful prototyping technique, but also a versatile route for the creation of material–structure combinations that are difficult to achieve by other methods.