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High-resolution multi-material 3D printing by stereolithography

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3D printing has become widespread in recent years with the majority of printers being based on serial deposition of a narrow molten polymer filament (so-called fused deposition modeling). Recently, 3D printing by local light-induced polymerization of a polymer solution, commonly termed stereolithography, has gained momentum due to inherent possibilities for higher spatial resolution and higher fabrication speeds by parallel light exposure using commercially available light projectors. Stereolithography is currently limited to a single material in a printed object, since shaping of multiple materials will require separate polymerization of each material with different light sources. Such materials and printing systems have so far been unavailable.

We have addressed this challenge in a joint effort by polymer chemists and fabrication technologists to develop a multi-color printing system matched to a newly developed starting material. Based on the exposure color and time, the local mechanical properties of the resulting 3D object can be varied by more than 100 times with high spatial resolution. In addition, the new printer system can achieve a printing resolution of <15 µm which is superior to any commercially available system (Figure 1). In this presentation we will discuss current limitations and possible solutions to enhance printing resolution as well as printing throughput to make the technology commercially attractive.

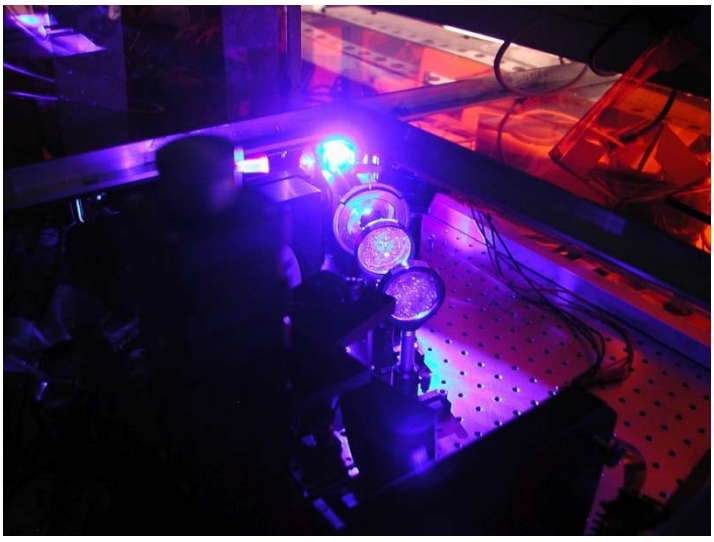

Figure 1. The recently developed 3D polychromic stereolithography printer at DTU Nanotech can expose with multiple wavelengths, here 365 nm and 450 nm, at <15 µm pixel size to freely combine multiple materials within a printed object.