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# Submicron scale stereolithography using HD-DVD optical pickup unit

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## ABSTRACT

It is challenging for stereolithography systems to print submicron features without two-photon lasers. For the first time, we implement an HD-DVD optical pickup unit (OPU) for building a customized stereolithography 3D printer. The OPU equips a 405 nm single-photon laser and an objective lens with a numerical aperture of 0.65. This has a focal laser spot diameter of 430 nm ( $1/e^2$ ) and can thereby, achieve submicron scale features photopolymerization. Moreover, the OPU embeds astigmatic optical path and voice coil motor which can be used for closed-loop printing alignment and this increases printing stability significantly. The OPU 3D printing system integrates an XYZ linear stage, providing nanoscale positioning resolution and macroscale printing area (c.a. 50 X 50 X 25 mm). A commercial photo-resin is utilized for the assessment of the system performance. The OPU printer crosslinks structures ranging from tens of microns down to submicron scale by tuning the printing parameters (laser intensity, printing speed, and photo-resin thickness). After optimization of the system, the OPU printer achieved the highest printing resolution of 210 nm which is beyond conventional stereolithography systems. Furthermore, several microstructures have been printed for verifying multiple layer printing performance. In conclusion, the mass-produced, low-cost and compact size OPU can not only dramatically simplify the stereolithography 3D printer design, but also achieve submicron printing performance.

**Keywords:** 3D printing, HD-DVD, Optical pickup unit, Stereolithography, Submicron scale