Sensors and Materials, Vol. 17, No. 2 (2005) 065–075
MYU Tokyo

S & M 0587

Direct Fabrication of Micropatterns and Three-Dimensional Structures Using Nanoreplication-Printing (nRP) Process

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(Received April 10, 2004; accepted November 16, 2004)

Key words: nanoreplication printing (nRP), two-photon-absorption polymerization (TPP), three-dimensional microstructure, direct patterning, femtosecond pulse laser.

A method for the direct fabrication of submicron-scale detailed patterns without the use of a photomask was developed by means of a nanoreplication-printing (nRP) process. Some patterns can be fabricated easily in the range of several microns inside a polymerizable resin by a scanning process using a volume-pixel (voxel) matrix that is transformed from a bitmap figure file. In the nRP process, liquid monomers are polymerized by the two-photon absorption (TPA) induced using a femtosecond pulse laser. Voxels are merged consecutively by overlapping in a range of several microns to fabricate various patterns, and the resolution of the process can be determined as the diffraction limit of the laser beam used to induce two-photon absorption polymerization (TPP). In this work, a beam expansion technique has been applied to enlarge the working area used to fabricate patterns. The establishment of a mechanism capable of the three-dimensional (3D) fabrication of microstructures by use of a lamination technique, which fabricates a structure layer by layer, has been attempted. The technique does not require the use of sacrificial layers or structures in 3D microstereolithography. Through this work, the usefulness of the nRP process is demonstrated by the fabrication of several patterns and 3D microstructures with a resolution of approximately 200 nm.

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