# Method for Fabricating Tall 3-D Structures in Su-8 with Smoothly Varying Elevations

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This paper describes a new process for fabricating complex 3-D structures with smoothly-varying elevations in thick layers of SU-8 photoresist. The method may be applied to the fabrication of micro-optical, micromechanical and microfluidic devices as high as 1 mm.

Techniques have been described for fabricating simple 3-D microlens arrays in positive photoresist, including an array of photoresist buttons that are then melted to form spherical lens shapes, as well as exposure of positive photoresist using gray-scale illumination. In both cases, the maximum lens thickness is approximately 20 μ. Although thicker lens structures have been fabricated by dry-etching into suitable substrates using these thin photoresist structures as masks and manipulating the dry-etch conditions to increase the rate of substrate etch versus mask erosion, these techniques are complex and difficult to control. On the other hand, because of its extremely low optical absorption, SU-8 may be processed in layers as thick as 1.2 mm. Nearly vertical walls can be achieved in SU-8 layers with aspect ratios reported better than 50:1.

This work extends the range of structures that may be fabricated in SU-8 to those having smoothly varying elevations with an enormous flexibility in design. This is accomplished using gray-scale illumination and a unique development technique. Details of these processing innovations will be presented. Examples of structures that have been fabricated using this method include linear ramps (prisms) and aspheric lenses approximately 500 μ in height. Other applications include the fabrication of molds for electroplated structures of complex-shape or molds having side walls with controlled slope to enhance release.