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Soft Lithography and Microfluidic Devices

JOHN ROGERS, University of Illinois

Complex three dimensional (3D) nanostructures can play important roles in microfluidic devices. High resolution, conformable phase masks provide a means to fabricate, in an experimentally simple manner, classes of 3D nanostructures that are useful for these systems. In this approach, light passing through a phase mask that has features of relief comparable in dimension to the wavelength generates a 3D distribution of intensity that exposes, through a one or two photon process, a photopolymer film throughout its thickness. Developing this polymer yields a structure in the geometry of the intensity distribution, with feature sizes as small as 50 nm. Rigorous coupled wave analysis reveals the fundamental aspects of the optics associated with this method. A broad range 3D nanostructures patterned with it demonstrates its patterning capabilities. Filter elements, passive mixers, separators and optical sensors built inside microfluidic channels represent examples of the many types of devices that can be constructed.