277d Functional Hydrogel Nanostructures Fabricated by Direct-Write E-Beam Patterning

Vijay R. Tirumala, Ralu Divan, Leonidas Ocola, and Derrick C. Mancini

Functional hydrogel microstructures have long been micropatterned using photopolymerization, which was shown to resolve features down to 10-micron level. To extend the resolution, Prof. Siegel's group have recently modified the approach by first polymerizing a hydrogel thinfilm in a micromold, spincoating a photoresist, patterning the photoresist by following conventional photolithography (exposing and developing the resist), and then dry etching the hydrogel features using oxygen plasma. The best linewidth resolution they claim to have obtained using that approach was 2.5 microns. Both the approaches, however, are hard to extend to nanoscale: photopolymerization requires transfer of photopatterns through liquid while the second approach requires nanopatterning on the surface of the hydrogel. We have recently fabricated functional nanostructures based on hydrogels, such as poly (N-isopropylacrylamide), using direct-write electron-beam lithography. Our approach allows to extend the resolution to sub-100-nm regime and still follow their stimuli-response nature at that size scale. The procedure allows for nanopatterning features of multiple response functionalities and can also be directly integrated into the fabrication of micro- and nanodevices. We discuss the patterning method of these materials and the issue of stimulus response at nanoscale.

*This work is supported in part by the Department of Energy, Office of Science, Basic Energy Sciences, under contract no. W-31-ENG-104.