

Patterned Polymer Films Via Reactive Silane Infusion-Induced Wrinkling

Yinyong Li[‡], Joseph J. Peterson[‡], Sarav B. Jhaveri, and Kenneth R. Carter*
Polymer Science and Engineering Department, University of Massachusetts – Amherst
Conte Center for Polymer Research, 120 Governors Drive, Amherst, MA 01003.

Submitted for Publication: October 2012

Abstract

A method for patterning and functionalizing thin poly(2-hydroxyethyl methacrylate) films simultaneously through a reactive silane infusion based wrinkling is developed. The wrinkling based patterns with tunable wavelengths on submicron size, are easily produced over large areas, and can display a variety of functional groups on the surface. Wrinkled nanopatterns can be transferred to a variety of other materials using nanoimprint lithography. The characteristic wavelength of wrinkling scales linearly with initial film thickness. Results from X-ray photoelectron spectroscopy indicates the wrinkling film composes of two layers: gradient crosslinked top layer and uniform uncrosslinked bottom layer. Quartz crystal microbalance measurements reveals a mismatch of solvent swelling between these two layers, leading to stresses that result in wrinkling of the surface. Meanwhile, surface chemical properties of wrinkles can be easily tuned by infusion of different silanes and hierarchical wrinkled patterns with micro/nano structure can be achieved by combining wrinkling with other simple lithography methods.

