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The effect of pattern dimensions on the thermal decay of polymer patterns created by nanoimprint lithography KENNETH KEARNS, Saginaw Valley State University, H.W. RO, HEATHER J. PATRICK, THOMAS A. GERMER, CHRISTOPHER SOLES, National Institute of Standards and Technology — Spectroscopic ellipsometry, combined with rigorous coupled wave modeling, is used to characterize the thermal decay of polymeric patterns prepared by nanoimprint lithography. When the residual layer is on the order of 10 nm, the pattern decay kinetics of patterns with a 420 nm periodicity near their glass transition temperatures are nearly an order of magnitude slower than patterns sitting on a thick residual layer. Pattern decay is not observed when the periodicity increased to 800 nm for the 10 nm residual layers. Polystyrene, poly(methyl methacrylate), and poly(4-t-butyl styrene) all show this behavior suggesting that changes in entanglement density are not important. The difference in the radius of curvature for the two different pattern periodicities is the likely origin for the pattern decay. The sensitivity of the technique to thin residual layers and nanoscale patterns is enhanced with an optical cavity of SiO_2 between the polymer and Si substrate. The SiO_2 layer enhances the changes in the ellipsometric parameters alpha and beta, which are related to psi and delta. The model dependent scatterometry data is corroborated by atomic force microscopy.

Kenneth Kearns
Saginaw Valley State University

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