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Polyelectrolyte effects in polymers for lithography

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The transformation of a solid-like film into a solution upon exposure to a miscible solvent is a complex process involving sluggish kinetic pathways associated with the slow transport of the liquid into the film and the evolution of the thermodynamic driving forces during the course of the dissolution process. In complex materials such as polymers, this process occurs in stages from the transformation of the glassy or crystalline film into a swollen state, followed at longer times by the final dissolution of the film. Dissolving polyelectrolyte films exhibit additional complexities in their dissolution dynamics over uncharged polymer films. Interfacial charge density, the dielectric constant of the medium, ionic strength and valence influence the phase behavior of charged polymers thus affecting their dissolution behavior. The dissolution mechanism can be tailored for different applications, for instance the microelectronics industry utilizes the selective dissolution of one component enabling lithographic pattern formation. We present neutron reflectivity and quartz crystal microbalance results to address polyelectrolyte effects in thin films such as the counterion distribution, quasi-equilibrium swelling and kinetics. V.M. Prabhu, R.L. Jones, E.K. Lin, W-L Wu. "Polyelectrolyte effects in model photoresist developer solutions." J. Vac. Sci. and Tech.B, 21, 1403 (2003). V.M. Prabhu, B.D. Vogt, W-L. Wu, J. Douglas, E. Lin, S. Satija, D. Goldfarb, and H. Ito. "Direct measurement of the counterion distribution within swollen polyelectrolyte films" Langmuir Letter, 21, 6647 (2005).