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Reaction-Diffusion Processes in Ultrathin Films of Photoresist[1]
GINUSHA PERERA, GILA STEIN, Univ. of Houston — Projection lithography is the primary technology used for patterning semiconductor devices. High-throughput manufacturing requires imaging materials (resists) that are highly sensitive to radiation, and this demand is satisfied through a process termed chemical amplification (CA). CA resists are comprised of a polymer resin (reactant) and photoacid generator (catalyst); a coupled reaction-diffusion mechanism drives image formation, where image resolution is limited by slow diffusion of the acid catalyst. There is evidence that thin film reaction rates deviate from the bulk behavior, and current models for image formation do not capture such effects. We demonstrate that X-Ray Diffraction can measure spatial extent-of-reaction in ultrathin films of a nanopatterned poly(4-hydroxystyrene-co-tertbutylacrylate) CA resist. The feedback acquired is used to construct predictive models for the coupled reaction-diffusion processes that incorporate the physics of confined polymers.

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