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Dimension-Dependent Mechanical Properties of Pure and Antiplasticized Polymer Nanostructures SEAN DELCAMBRE, ROBERT RIGGLEMAN, JUAN DE PABLO, PAUL NEALEY, Department of Chemical and Biological Engineering, University of Wisconsin - Madison — Dense arrays of poly(methyl methacrylate) (PMMA) grating nanostructures 80 nm to 120 nm in pitch were fabricated by electron-beam and extreme ultraviolet interferometric lithography. During development and rinse drying, the nanostructures are subjected to capillary forces that are defined by the rinse fluid properties and spacing between adjacent structures. The applied capillary forces and structure aspect ratios were varied experimentally to induce structure collapse. By coupling nanostructure collapse data with continuum cantilever beam bending models, mechanical properties such as the elastic modulus and yield stress are determined. The elastic moduli of PMMA structures at this scale are observed to decrease with structure linewidth. This behavior is counteracted by the addition of a low molecular weight diluent, tris(2-chloropropyl) phosphate (TCPP). At concentrations up to 5 wt%, TCPP acts as an antiplasticizing agent, decreasing the glass transition temperature while simultaneously increasing the elastic modulus. For a given applied capillary force, nanostructures containing 5 wt% TCPP are observed to remain stable at aspect ratios up to 20% higher than the pure material.

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