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Facile Route to Vertically Aligned High-Aspect Ratio Block Copolymer Films via Dynamic Zone Annealing[1] GURPREET SINGH, MANISH KULKARNI, Department of Polymer Engineering, University of Akron, Akron OH 44325, KEVIN YAGER, Center for Functional Nanomaterials, Brookhaven National Laboratory, Upton, NY 11973, DETLEF SMILGIES, 3Cornell High Energy Synchrotron Source, Cornell University, Ithaca, New York 14853, DAVID BUCKNALL, Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA 30332, ALAMGIR KARIM, Department of Polymer Engineering, University of Akron, Akron OH 44325 — Directed assembly of block copolymers (BCP) can be used to fabricate a diversity of nanostructures useful for nanotech applications. The ability to vertically orient etchable high aspect ratio (∼30) ordered BCP domains on flexible substrates via continuous processing methods are particularly attractive for nanomanufacturing. We apply sharp dynamic cold zone annealing (CZA-S) to create etchable, and predominantly vertically oriented 30nm cylindrical domains in 1 μm thick poly(styrene-b-methylmethacrylate) films on low thermal conductivity rigid (quartz) and flexible (PDMS & Kapton) substrates. Under similar static conditions, temporally stable vertical cylinders form within a narrow zone above a critical temperature gradient. Primary ordering mechanism of CZA-S involves sweeping this vertically orienting zone created at maximum thermal gradient. An optimal speed is needed since the process competes with preferential surface wetting dynamics that favors parallel orientation. GISAXS of etched BCP films confirms internal morphology.

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