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Title:	The Orientation of Microdomains and the Progression of Shear Alignment in Block Copolymer Films: the Roles of Key Material, Film, and Process Parameters
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Keywords:	block copolymer (/jspui/browse?type=subject&value=block+copolymer) flowcoating (/jspui/browse?type=subject&value=flowcoating) shear alignment (/jspui/browse?type=subject&value=shear+alignment) thin film (/jspui/browse?type=subject&value=thin+film)
Subjects:	Chemical engineering (/jspui/browse?type=subject&value=Chemical+engineering) Materials Science (/jspui/browse?type=subject&value=Materials+Science) Plastics (/jspui/browse?type=subject&value=Plastics)
Issue Date:	2015
Publisher:	Princeton, NJ : Princeton University
Abstract:	<p>Block copolymers provide attractive templates for nanopatterning at size scales inaccessible to conventional fabrication techniques. To serve effectively for most applications, however, the need to impart well-defined orientational and/or positional order to these microdomains is paramount. Shear alignment, has the powerful ability to macroscopically align microdomains in the direction of the applied shear simply by applying a stress at the film's surface. The primary goal of this dissertation is to investigate the influence of key material, film, and process parameters on the ease and quality of alignment in sheared block copolymer films. One important parameter which influences block copolymer thin film morphology is film thickness. To probe this effect rapidly and systematically, a film casting technique known as flowcoating was utilized. Previously, the quantitative relationship between the film thickness profile and the flowcoating process parameters was unclear. We illuminate this process by comparing experimental film thicknesses with a model based on a Landau-Levich treatment; the model thus provides a design approach which allows a user to produce polymer thin films of virtually any desired thickness profile. Via flowcoating, the influence of film thickness on block copolymer thin film morphology was then investigated using a series of polystyrene-poly(n-hexyl methacrylate) (PS-PHMA) diblocks varying in composition and molecular weight. The influence of additional material, film, and process parameters was then investigated using the same series of PS-PHMAs. To quantitatively compare the alignment process across the different block copolymer films, a melting-recrystallization model was fit to the data, which allowed for the determination of two key alignment parameters: the critical stress needed for alignment, and an orientation rate constant. Collectively, these results provide useful scaling rules which enable predictions of the level of alignment which will occur under particular shearing conditions. Lastly, a separate aim of this dissertation was to explore a means for manipulating block copolymer film morphology, not through shear, but by controlling the environmental conditions at the film's surface during thermal processing in order to generate polymeric coatings with thermally switchable wetting properties (i.e., hydrophilic vs. hydrophobic).</p>
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