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Programming Surface Energy Driven Marangoni Convection in Polymer Thin Films to Generate Topographic Patterns CHAE BIN KIM, DUSTIN JANES, TALHA ARSHAD, JOSHUA KATZENSTEIN, NATHAN PRISCO, DANA MCGUFFIN, ROGER BONNECAZE, CHRISTOPHER ELLISON, University of Texas at Austin - McKetta Department of Chemical Engineering — The Marangoni effect describes how fluid flows in response to gradients in surface energy. We recently developed a method for photochemically preprograming spatial surface energy patterns in glassy polystyrene (PS) thin films. UV irradiation through a mask selectively dehydrogenates the PS, thus increasing surface energy in the UV exposed regions compared to the unexposed regions. After heating the film to the liquid state, transport of polymer occurs from regions of low surface energy to regions of high surface energy. This method can be harnessed to rapidly manufacture polymer films possessing prescribed three-dimensional topographies reflective of the original light exposure pattern. To quantify and verify this phenomenon, a theoretical model that gives a more thorough understanding of the physics of this process, its limits and ways to apply it efficiently for various target metrics will also be presented along with comparisons between theoretical predictions and experimental observations. Finally, while PS dehydrogenation can be used to produce a variety of topographical patterns, judicious selection of the photosensitizing compounds in an otherwise transparent polymer expands the use of this method to more readily available light sources.

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