Surface Energy Driven Marangoni Flow in Polymer Films to Generate Topographic Patterns

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The Marangoni effect causes liquids to flow toward localized regions of higher surface tension. In a thin film, such flow results in smooth thickness variations and may represent a practically useful route to manufacture topographically patterned surfaces. An especially versatile material for this application should be able to be spatially programmed to possess regions of higher or lower relative surface tension so that the direction of flow into or out of those areas could be directed with precision. To this end, we describe here a photopolymer whose melt-state surface tension can be selectively raised or lowered in the light exposed regions depending on the wavelength and dose of applied light. The direction of Marangoni flow into or out of the irradiated areas agreed with expected surface tension changes for photochemical transformations characterized by a variety of spectroscopic techniques and chromatographic experiments. We believe this patterning methodology will be potentially useful for high throughput fabrication environments that can exploit contact-free and solvent-free topography development.