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Coupling frontal photopolymerization and surface instabilities for a novel 3D patterning technology ALESSANDRA VITALE, MATTHEW HENNESSY, OMAR MATAR, Imperial College London, JACK DOUGLAS, NIST, JOÃO CABRAL, Imperial College London — Patterning of soft matter provides an exceptional route for the generation of micro/nanostructured and functional surfaces. We describe a new 3D fabrication process based on coupling frontal photopolymerization (FPP) with precisely controlled, yet spontaneous, interfacial wrinkling. FPP is a complex spatio-temporal process that can lead to well-defined propagating fronts of network formation, both stable and unstable. We investigate this process focusing on the interfacial monomer-to-polymer conversion profile and its wave propagation. A simple coarse-grained model is found to describe remarkably well the planar frontal logarithmic kinetics, capturing the effects of UV light exposure time (or dose) and temperature, as well as the front position. In defined conditions, surface instabilities are introduced and interfere with wave planarity, resulting in the formation of "minimal" surfaces with complex 3D geometries. Building on this understanding on the propagation of wavefronts of network formation during photopolymerization, we demonstrate the design and fabrication of 3D patterned polymer materials with tunable shapes with optical and surface functionality.

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