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Swelling of static and evolving polymer networks during frontal photopolymerisation MATTHEW G. HENNESSY, Centre de Recerca Matematica, ALESSANDRA VITALE, JOAO T. CABRAL, OMAR K. MATAR, Imperial College London — Frontal photopolymerisation (FPP) is a directional solidification process that converts monomer-rich liquid into crosslinked polymer solid by light exposure. Inherent to this process is the creation of an evolving polymer network that is exposed to a monomer bath. A combined theoretical and experimental investigation is performed to determine the conditions under which monomer from this bath can diffuse into the propagating polymer network and cause it to swell. First, the growth and swelling processes are decoupled by immersing pre-made polymer networks into monomer baths held at various temperatures. The experimental measurements of the network thickness are found to be in good agreement with theoretical predictions obtained from a nonlinear poroelastic model. FPP propagation experiments are then carried out under conditions that lead to swelling. Unexpectedly, for a fixed exposure time, swelling is found to increase with incident light intensity. The experimental data is well described by a novel FPP-poroelastic model accounting for the simultaneous growth and swelling of the polymer network. Moreover, the model provides key insights into the interfacial instabilities seen in experiments.

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