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Direct measurement of the critical pore size in a polymer membrane MARK ILTON, CHRISTIAN DIMARIA, KARI DALNOKI-VERESS, Department of Physics Astronomy, McMaster University, Hamilton, Ontario, Canada, L8S 4M1 — The formation of pores is an important process in cellular membranes. Here we use freestanding polymer films as model membranes to study the stability of nucleated pores. Polymer membranes with pores of varying size are patterned using a lithographic technique. The membranes are heated above their glass transition temperature to allow viscous flow to occur. Pores with a radius larger than a critical value grow, while pores smaller than the critical radius are observed to shrink and eventually close. Remarkably, holes that are close enough to the critical radius neither grow nor shrink, even though the film is in the melt state. A simple model which takes into account the energy cost of having additional surface area at the edge of a pore describes the experiments with no free parameters. Biological membranes have an additional energetic cost of forming a pore, which we mimic using a lamellar-forming diblock copolymer. Indeed, we find that the critical pore radius is increased when pore formation is frustrated by molecular architecture.

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