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Surface morphology of pre-stressed bilayer shells for tunable optical transmittance RASHED AL-RASHED, FRANCISCO LPEZ JIMNEZ, JOEL MARTHELOT, ANNA LEE, PEDRO REIS, Massachusetts Institute of Technology
— We introduce a new class of pre-stressed bilayer shells, whose surface morphology can be used to smoothly tune their optical transmittance by pneumatic actuation. Each sample is fabricated by pressurizing a disk made out of an optically clear silicone-based rubber to bulge it into a nearly hemispherical pre-strained shell. The surface of this shell is then taken as a substrate and coated with a thin layer of a polymer suspension with black micron-sized dye particles, which, upon curing, can make the samples opaque. The sample becomes planar when it is depressurized to remove the pre-strain, and its surface develops a complex topography that significantly affects its optical transmittance (i.e. the amount of light that passes through the sample). Re-pressurization of the samples allow for their transmittance to be smoothly tuned in a reversible manner. We explore the parameter space of the system by systematically varying its geometric and material properties. A phase diagram is then constructed where we characterize the transmittance of each of the surface patterns at varying levels of pre-strain.

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