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Thickness-Dependent Surfactant Behavior in Trilayer Polymer Films YAN SUN, KENNETH SHULL, Northwestern University, JIN WANG, Argonne National Laboratory — The ability for thin liquid films to wet and remain thermodynamically stable on top of one another is a fundamental challenge in developing high quality paints, coatings, adhesives, and other industrial products. Since intermolecular interactions and interfacial energies dominate in the film thickness regime from tens to hundreds of nanometers, it is desirable to tune these long-range and short-range forces in a simple, controllable manner. Starting from an unstable model homopolymer bilayer (poly(styrene)/poly(4-vinylpyridine)), we demonstrate that sandwiching an additional homopolymer layer (poly(4-bromostyrene)) between the two layers can provide needed surfactancy. As the thickness of this center layer is increased, the full trilayer transitions from unstable (thin) to stable (moderate) to unstable (thick). We experimentally show using x-ray standing waves generated via total external reflection (TER-XSW), atomic force microscopy (AFM), and time-of-flight secondary ion mass spectroscopy (ToF-SIMS) that this behavior can be directly attributed to the autophobic dewetting phenomenon, in which the surfactant layer is thin enough to remain stable but thick enough to shield the neighboring layers, highlighting a general approach to stabilizing multilayer systems.

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