Probing Interphases of Immiscible Polymer Blends by Forced-Assembly

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When two immiscible polymers are brought into intimate contact, highly localized mixing of polymer chains creates an "interphase" region. Polymer nanolayers of an amorphous polyester (PETG) and a series of styrene-acrylonitrile copolymers (SAN) with 17wt%, 25wt%, and 30wt% AN content were fabricated by forced-assembly using layer-multiplying coextrusion to form assemblies containing thousands of layers. The interphase thickness was extracted by modeling the layer-thickness dependent oxygen permeability. Relationship of the interphase thickness and polymer interactions were interpreted by Helfand's interphase theory. The interfacial strength was correlated with the interphase thickness as predicted by the Wool's minor chain diffusion model. The difference in free volume structure of the interphase materials and their bulk counterparts resulted in non-additive volumetric properties of interphase materials. The entanglement molecular weight appears to be responsible for the observed volumetric differences.