Supporting Information

Mechanics of an asymmetric hard-soft lamellar nanomaterial

Weichao Shi[†], Glenn H. Fredrickson^{†,‡,*}, Edward J. Kramer^{†,‡,§}

[†]Materials Research Laboratory, [‡]Department of Chemical Engineering, [§]Department of Materials, University of California at Santa Barbara, California, United States, 93106

Christos Ntaras[#] and Apostolos Avgeropoulos^{#,*}

[#]Department of Materials Science and Engineering, University of Ioannina, University Campus, Ioannina, Greece 45110

Quentin Demassieux^{II} and Costantino Creton^{II}

"Laboratory of Soft Matter Science and Engineering, ESPCI Paristech-CNRS-UPMC, 10 rue Vauquelin, 75005 Paris, France

Content:

Part A: Samples used and molecular characterization

Part B: TEM image of miktoarm/hPS (50 wt%) blends before/after deformation

Part C: Monotonic tensile-SAXS data for miktoarm/hPS (80 wt%) blends

Part D: Step-cycle tensile-SAXS data for miktoarm/hPS (50 wt%) blends

Part A: Samples used and molecular characterization

Sample	$\overline{M}_n \mathrm{PS}$	$\overline{M}_n \operatorname{PI}$	$\overline{M}_n \mathbf{PS'}$	\overline{M}_n total	PDI	\overline{M}_{w} total	%wt _{PS}	f_{PS}
	(kg/mol)	(kg/mol)	(kg/mol)	(kg/mol)	total	(kg/mol)	$(^{1}\text{H-NMR})$	
S(IS')3	81.5	17.1	11.0	165.8	1.03	170.8	0.70	0.67

Table S1. Molecular parameters of miktoarm block copolymers for TPs.

Table S2. Molecular characterization of PS homopolymers for TPs.

Sample	\overline{M} , (kg/mol) ^a	$\overline{M}_w (\mathrm{kg/mol})^a$	PDI^{a}	\overline{M}_n (kg/mol) ^b	$\overline{M}_w (\mathrm{kg/mol})^b$	PDI^b
hPS	80.5	85.0	1.06	81.7	86.2	1.05

^{*a*} Molecular parameters were given by the vendor (Polymer Source); ^{*b*} Molecular parameters obtained by GPC in our own lab, referencing to standard PS homopolymer.

Part B: TEM image of miktoarm/hPS (50 wt%) blends before/after deformation



Figure S1. TEM image of miktoarm/hPS (50 wt%) blends before deformation shows the intact lamellar regions as well as kink defects.



Figure S2. More evidence of deformation regions in miktoarm/hPS (50 wt%) blends after deformation. The five regions defined in the manuscript can be clearly identified in the material.



Figure S3. Monotonic tensile-SAXS experiments for the miktoarm block copolymer blended with 80 wt% hPS. The 2-D SAXS patterns are shown in image (a) at different strains. The arrow indicates the tensile direction. Images (b) and (c) are scattering curves in the tensile direction and horizontal direction, respectively. Notably, the scattering peaks (0.12 nm⁻¹) from correlation of voids appear under stretching in image (c).



Figure S4. Step-cycle tensile-SAXS experiments for the miktoarm block copolymer blended with 50 wt% hPS. The 2-D SAXS patterns are shown in image (a) at different strains in a load-unload cycle. The arrow indicates the tensile direction. Images (b) and (c) are scattering curves in the tensile direction and transverse direction, respectively. Notably, in image (c), the scattering peaks (0.12 nm⁻¹) from correlation of voids were enhanced under stretching and attenuated after unloading.