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Measuring Correlation Functions and Elastic Constants of 2D Layers of Block Copolymers by Single Crystal Diffraction[1] GILA STEIN, EDWARD KRAMER, UCSB, XUEFA LI, JIN WANG, Advanced Photon Source — Monolayers of spherical-domain block copolymer, exhibiting hexagonal symmetry with a periodicity of 29nm, are laterally confined in hexagonal wells 12μm wide and 26nm deep that span the entire area of a 2-inch diameter silicon wafer. At 210 °C, films that are 41nm thick (monolayer plus brush) form oriented single crystals in each well, where the close- packed rows of the lattice are aligned parallel to the edges. The structure is characterized with grazing-incidence small- angle x-ray diffraction, and results are interpreted within the KTNHY framework for a 2D crystal. Translational order decays algebraically with a correlation function of the form $g_t(r) \sim r^{-0.25}$, and from the magnitude of the decay exponent, the 2D shear modulus of the crystal $\mu = 1.7 \times 10^{-4}$N/m can be extracted. Orientational order is long-range, with a full width at half maximum of 1.1°. Decreasing the film thickness by 1nm produces hexatic ordering with a translational correlation length on the order of 0.5μm, and diminished orientational order with a full width at half maximum of 2.4°. These results agree qualitatively with high resolution scanning force microscopy images of the lattice.

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