Supplementary Material (ESI) for Soft Matter

SUPPORTING INFORMATION

Self-Assembled Nanostructures from Homopolymer Induced by UV and Solvent Exposure

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Experimental Details

Monodisperse polystyrene samples of molecular weights 2,043,000, 1,045,000, 570,000, 393,400, 223,000, and 111,400 were purchased from Scientific Polymer Products Inc. (Ontario, NY). Toluene (Acros Chemicals), acetonitrile (Fischer Scientific), and 2-propanol (Sigma-Aldrich) were used as received without further purification. Spin coating was performed using a P6204 spin-coater (Specialty Coating Systems, Indianapolis, IN). Irradiation was executed with a medium-pressure Hg lamp (450W, 222.4-1367.3 nm, Hanovia). The intensity of lamp at the location of the sample was measured to be 2.3 mW/cm^2 using a 254-nm sensor. The irradiation time included a 2-minute warm-up for the lamp to reach its full intensity.

Silicon wafers with a ~10 Å native oxide layer were cut with a diamond pen into 1 cm x 1 cm in size and were cleaned by sonication in 2-propanol for 30 min and dried under a stream of nitrogen. Polystyrene solutions of different concentrations (20 mg/mL, 40 mg/mL, and 100 mg/mL) were prepared by dissolving monodisperse PS of various molecular weights in toluene. The PS solution was spin-coated onto the cleaned wafer at 2000 or 1000 rpm for 60 seconds. For samples that required baking, the films were placed in an oven pre-heated to the desired temperature and were left in the oven for 30 min. The films were then irradiated with the 450 W medium-pressure Hg lamp at ambient conditions for various lengths of time, soaked in toluene for 12 h and dried with a stream of nitrogen.

For films prepared under argon, the PS solution (20 mg/mL in toluene), was purged with argon. The solution was then spin-coated at 2000 rpm for 60 s, baked 172 ^{o}C for 30 min, UV irradiated for 75 min, and soaked in toluene for 12 h. All steps were executed under an Argon environment. For films used in the IR experiments, PS (20 mg/mL) in toluene was spin-coated on a salt plate at 2000 rpm for 60 s, placed in a desiccator for 2 days, and irradiated for the specified amount of time. The films were then treated with either acetonitrile or toluene.

Film thicknesses were measured on an Ellipsometer (Gaertner Scientific, LSE). Refractive indices of 1.465 (SiO_2) and 1.592 (PS) were used to determine the thickness of the films. Infrared spectra were obtained using a Perkin-Elmer 2000 series FT-IR spectrometer. Optical images were obtained on an Olympus BHM microscope in the dark field using a digital camera. Atomic force microscopy images were collected on a Nanoscope III (Veeco, Santa Barbara, CA) using a silicon tip (Mikromasch, Wilsonville, OR) in the tapping mode at an oscillating frequency of ~300 KHz. XPS measurements were performed on a Physical Electronics Quantum 2000 Scanning ESCA Microprobe equipped with a focused monochromatic Al K_α X-ray source at 1486.7 eV for excitation and a spherical section analyzer with a 16 element multichannel detector system.

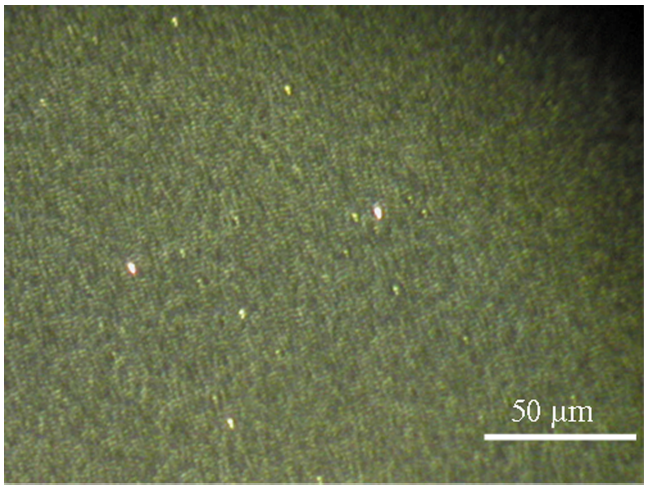

Figure S1. Optical image of PS film irradiated for 65 min and treated in acetonitrile for 20 min followed by toluene for 5 min. The films were prepared from a 20 mg/mL solution of PS (MW 570,000) in toluene.

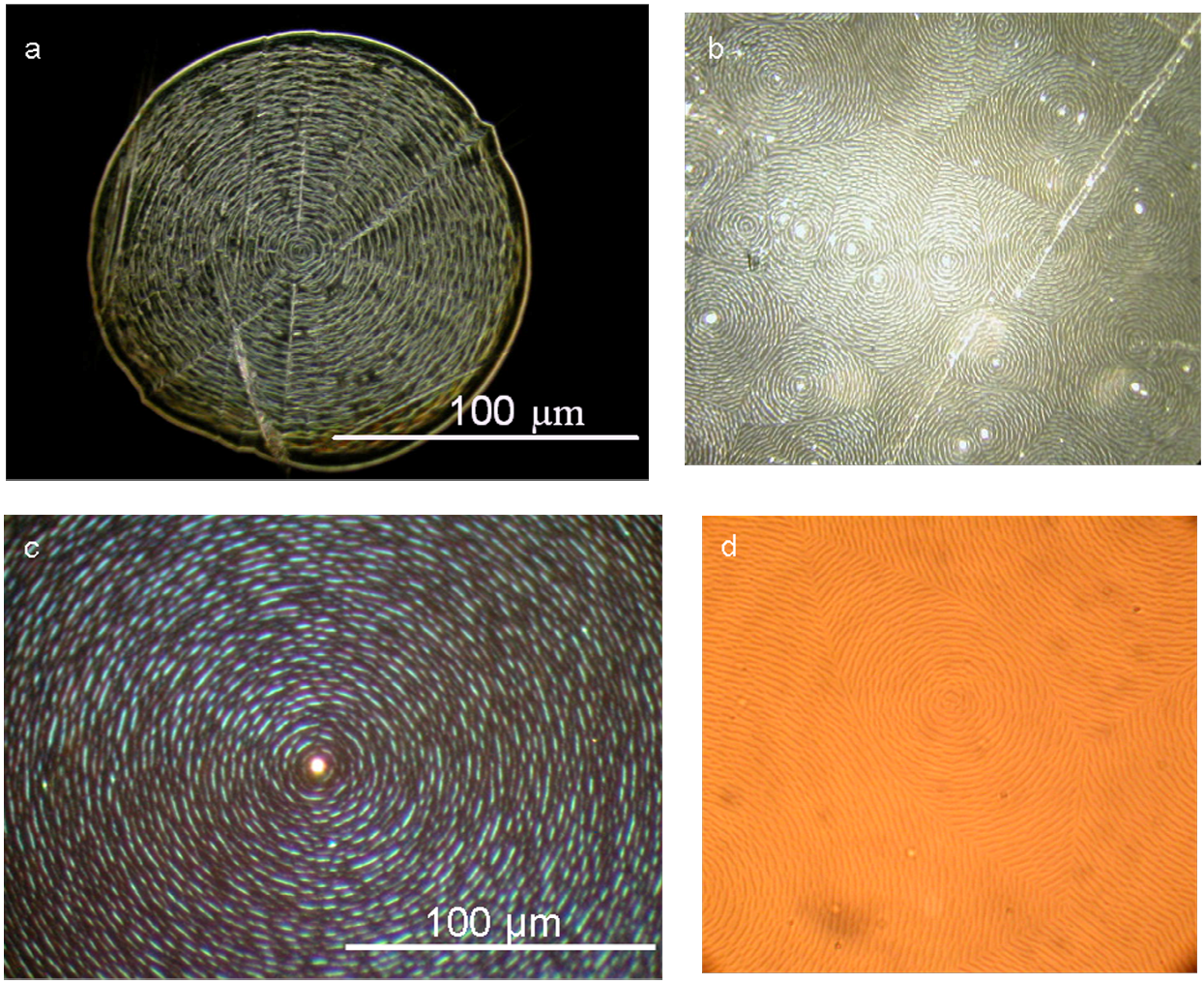

Figure S2. Optical images of PS films formed on a) NaCl disc, b) mica, c) ODTMS, d) glass.