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Bad-solvent Induced Tunable Nanoscale Roughness in Polymer, Block Co-polymer and Carbon Thin Films MANISH KULKARNI, The University of Akron, CHANDRASHEKHAR SHARMA, Indian Institute of Technology, Hyderabad, ALAMGIR KARIM, The University of Akron — Nanoscale surface roughness of a material plays significant role in various applications such as adhesion, micro-/nano-electromechanical systems and antireflective coatings. We demonstrate here a novel and simple method for tuning nanoscale surface roughness of polymer coatings using a modified flow coater assembly. A dual-blade flow coating assembly was used to coat films of Poly(styrene) (PS), poly(methylmethacrylate) (PMMA) and PS-b-PMMA block co-polymer (BCP) dissolved in toluene on silicon substrates with a secondary blade flow coating a bad-solvent (water, ethanol) on top of the polymer film after a controlled delay. The bad-solvent and good–solvent miscibility and evaporation dynamics dictates the surface roughness/porosity in the polymer-liquid-air-interface. Combination of miscible ethanol-toluene solvents led to PS-chain formation of iterated function system (IFS) like fractal patterns with a root-mean-square (RMS) roughness ~ 250 nm. However, PS films with much smaller roughness (< 20nm) were obtained for immiscible water and toluene solvents. The rough polymer coatings were also pyrolysed under optimized conditions to obtain carbon films with similar morphologies. Surface morphology and chemistry of the polymer and carbonized films were studied using AFM and XPS.

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