

## COMBINING POLYMER DEMIXING AND MICROPHASE SEPARATION OF BLOCK COPOLYMERS TO OBTAIN STRUCTURING ON DIFFERENT SCALES

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**INTRODUCTION:** Patterning of surfaces has been of particular interest in trying to achieve chosen functionalization at desired areas of the substrate<sup>1,2,3</sup>. Block copolymers have been a favorite choice due to their ability for nanoscale self - organization. This work demonstrates the use of phase separation of homopolymer/block copolymer blends to form larger structures (~100nm) and incorporate the smaller microphase phase separated structures (~30nm) of block co-polymer domains within them. The importance of the work lies in the tunability of structures on two different length scales

**METHODS:** A polymer blend consisting of 1% solutions of the block co-polymer Polystyrene block Polyferrocenyldimethylsilane (PS-b-PFS, 60 kg/molPS, 17.7kg/mol PFS) and the homopolymer PMMA were prepared in toluene. The solution was spin coated at 3000 rpm on Si substrate to obtain thin films (<100nm). The samples were annealed in vacuum at 150°C for 17h and reactive ion etched with O<sub>2</sub> plasma (50 mT, 30 W, 3min). This leaves the substrate with iron containing oxide nanoparticles in the areas initially occupied by the block copolymer<sup>3</sup>. The ratio PMMA: PS-b-PFS in the blend was varied from 6:1 to 24:1. The structures were characterized using Atomic Force Microscopy (AFM).

**RESULTS & DISCUSSION:** The phase separation of the PS-b-PFS block co-polymer/PMMA homopolymer blend forms PS-b-PFS domains in a continuous phase of PMMA. The size of these domains and their spacing are tunable by varying the composition of the initial blend and decreases monotonously with decrease in PS-b-PFS proportion in the blend. The additional microphase separation of the PS and PFS blocks in the block copolymer forms PFS dots in a PS matrix within these domains. Annealing of the samples increase the ordering of PFS domains.

**APPLICATIONS:** The iron containing oxide nanoparticles formed after O<sub>2</sub> RIE have been shown to act as etch masks to transfer the structures into Si

using RIE in earlier publications<sup>4,5</sup>. Iron containing oxide nanoparticles on the patterned substrates are currently explored for use as catalyst in carbon nanotube growth.

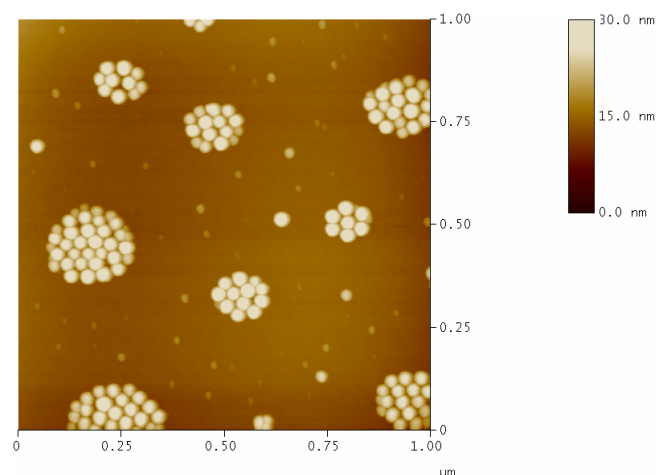


Fig. 1: AFM image of oxide nanoparticles within microstructures obtained by polymer demixing of a 6:1 PMMA: PS-b-PFS blend after O<sub>2</sub> RIE

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