Modification of the Wetting Behavior of PS Brush Layer by Inserting PMMA Molecules

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Over the past decade interest has grown in using block copolymers to improve the capabilities of advanced lithography.[1-6] The use of chemical[7, 8] patterns to direct the assembly of block copolymer films have enhanced the order and control of domain orientation in the assembled block copolymer films. Chemical patterns are usually modified from an imaging layer, for example polystyrene (PS) brush, through a lithographic process.[9] Here we demonstrate that the chemistry of the PS brush layer can be modified by addition of hydroxyl terminated PMMA molecules. The initial PS brush serves as a steric-barrier to the insertion of PMMA onto the substrate. Depending on the thickness of the PS brush, PMMA molecules can penetrate through the barrier and graft onto the substrate, resulting in changing the wetting behavior of the initial PS brush. PMMA molecules without functional groups, however, cannot modify the initial PS brush layer. This gives insight in the applications of making appropriate brush layer for block copolymer interpolation and molecular transfer printing.

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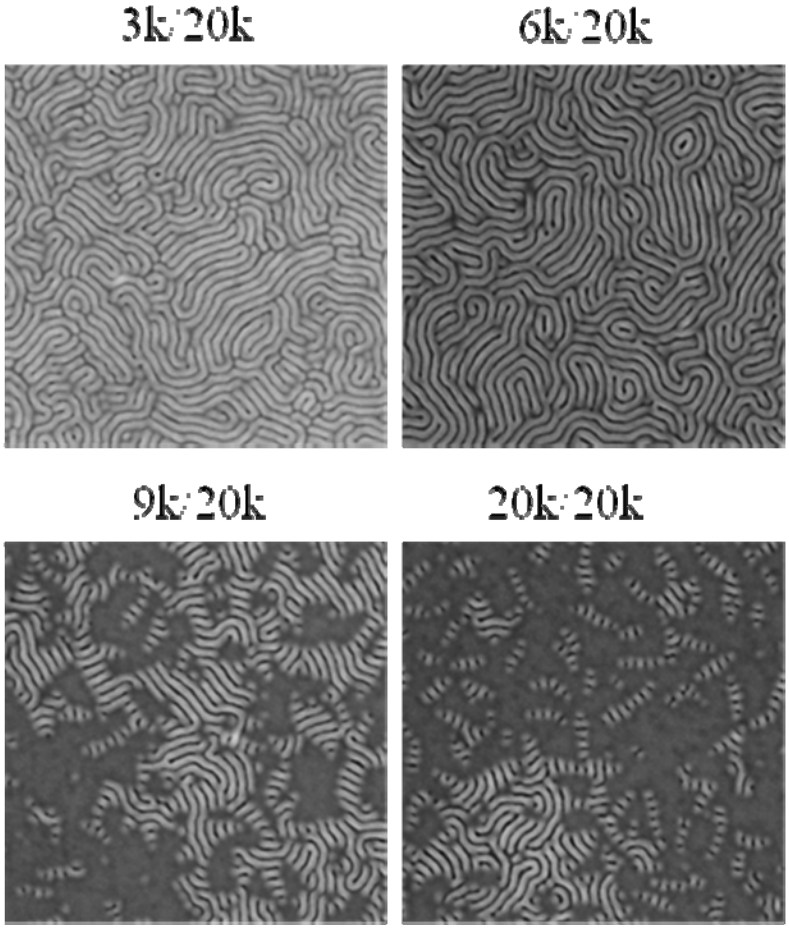

Fig 1: Wetting behavior of the modified PS brushes: Lamellae forming PS-b-PMMA were annealed on the PS brush layer (molecular weight of 3, 6, 9, and 20 kDa) which are subsequently inserted by hydroxyl terminated PMMA brush (molecular weight, 20 kDa). The final brush tends to be more “neutral” to PS-b-PMMA and induces “finger print” like lamellae perpendicular to the substrate as the molecular weight of PS brush decreases. Note: In the figure, “3k/20” denotes a 3 kDa PS brush layer modified by a 20 kDa PMMA brush.