Block Copolymer Directed Self-Assembly Using Chemoepitaxial Guiding Underlayers with Topography

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Guiding underlayers are used in the directed self-assembly (DSA) of block copolymers (BCPs) in order to form large defect free arrays. These underlayers traditionally have fallen into two categories: chemoepitaxial underlayers which guide the assembly of BCPs using regions of differing chemical preference, and graphoepitaxy which guides using topographic features built into the underlayer. Recently, these two guiding strategies have been merged in a few processes such as the SMART and COOL process flows, each of which employs both topographical and chemoepitaxial strategies. In this work, a coarse-grained molecular dynamics model was used to explore aspects of topographic underlayers of the style formed in the SMART process. The optimal width of the topographic features were simulated in order to determine the sensitivity of DSA to the size of the features. The optimal height of the features were explored in order to find the minimum height of the topography required to form defect free arrays. The ideal chemical preference of the summit, valleys, and sidewalls of the topographical pattern were explored. Finally, the effect of having a sloped sidewall was analyzed. In varying all of these parameters, underlayers were judged on whether they effectively guide the portion of the BCP film above the topography to a defect free array as well as observing the defect frequency of the BCP inside the valleys of the topographic features.

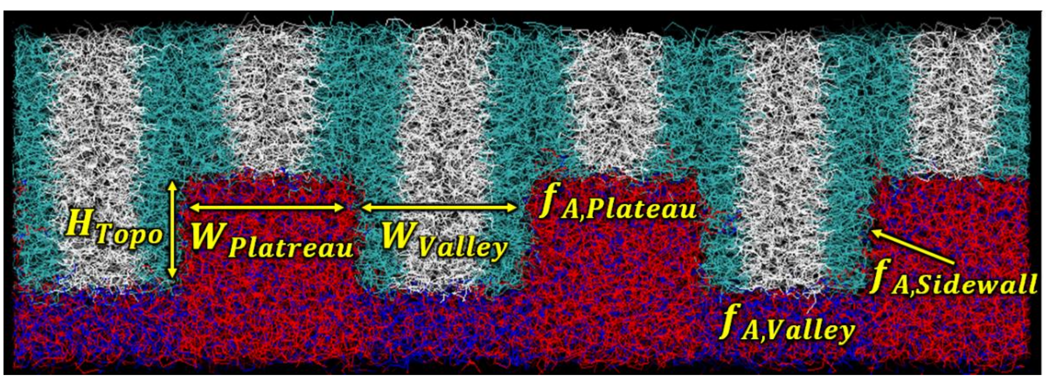

Figure 1: Example cross-section of simulation to be performed in this work. The width and height of the topographic features in the underlayer (red and blue) is to be varied, as well as the composition (f_A) of the underlayer and the slope of the sidewalls.