Surface relief nano-micro structures from Rayleight's instabilities in block copolymers

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Hierarchical surface relief nano-micro structures on thin films of block copolymers/ of Fe and Sm-Fe hybrid materials were induced either by wet chemistry or laser vacuum ultraviolet (VUV) light at 157 nm. Poly(styrene-b-2-vinylpyridine) polymers were synthesized by anionic polymerization high vacuum techniques using the sequential monomer addition technique. Micelle preparation has taken place in toluene solutions. The loading of the micelle cores was accomplished by addition of varying amounts of salt precursors $FeCl_3$ or $SmCl_3$ and $FeCl_3$ [1]. Reduction was achieved either by wet chemistry or by vacuum ultraviolet (VUV) laser irradiation of the film. Furthermore, a variety of self-assembled and surface relieved structures in the nano/ micro scale were obtained and analyzed by imaging and other analytical techniques, including SEM and AFM, Fig.1. The structures have their origin at the thermal instabilities, which were developed in the polymer films due to the temperature gradient induced between the film and the substrate either by fast film evaporation following chemical reduction or the VUV light. The laser light disturbs the thermodynamic equilibrium of the diblock polymer/intermetallic hybrid surface and the average surface roughness was progressively increasing with prolonged irradiation. At the onset of instability the layer of the fluid on the substrate resolves itself into a number of cells, which form regular patterns with characteristic spacing depending on the film thickness. The obtained results confirm the surface modification changes of diblock copolymer/hybrid materials after the disturbance of the thermodynamic equilibrium by VUV light.

References

[1] E. Sarantopoulou, K. Gatsouli, Z. Kollia, S. Pispas, S. Kobe, and J. Kovač, phys. stat. sol. (a), 1– 8 (2007)

Figures:

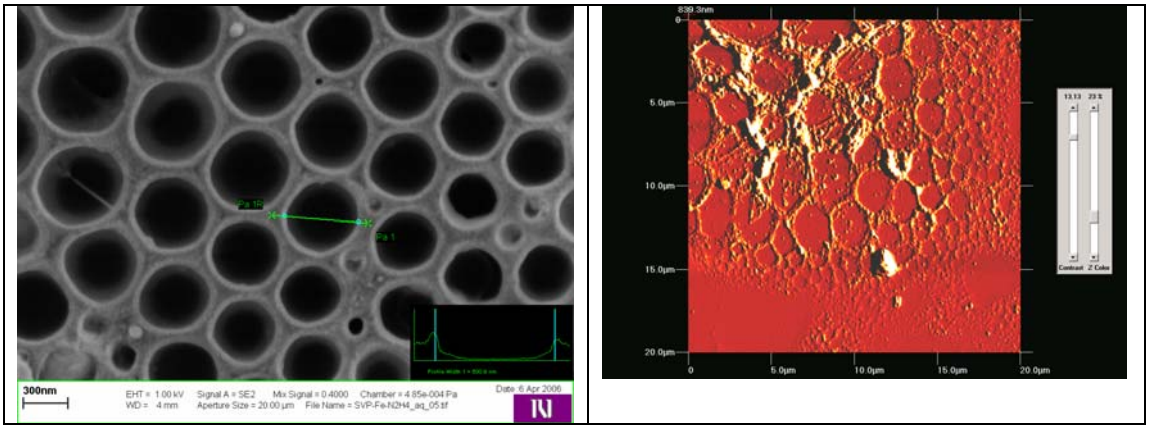

Fig. 1 Cylindrical (SEM) and hexagonal (AFM) surface relieved gratings at Fe block copolymers