SURFACE PHASE SEPARATION AND SELF-ORGANIZED 2D STRUCTURES OF BLOCK COPOLYMER/Fe HYBRIDS

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Abstract
Hierarchical micro/nano self-assembled 2D structures on thin films of block copolymers/Fe hybrid materials were induced on Si/Ta substrates, either by wet chemistry or by laser vacuum ultraviolet (VUV) light at 157 nm. Formation of either lamellas or micelle depends on the symmetric diblock copolymer composition and the volume fraction of the solutions. Honey comb-like nano-self-assembled cylindrical structures were formed for one of the diblock copolymer hybrid material. The honey comb-like structures have a different chemical composition than the rest areas of the film and they are rich in iron concentration. VUV irradiation is altering the surface morphology, and under certain illumination conditions semi regular micro ordering on the film surface was induced. Inside the micro-structured domains nano-structured aggregations were formed rich in iron concentration.

Experimental set up

Results

SYNTHESIS OF BLOCK COPOLYMERS
Diblock copolymers poly(styrene-b-2-vinylpyridine) (PS-P2VP) precursors were synthesized by anionic polymerization high vacuum techniques.

CHARACTERIZATION METHODS

Molecular and nano-composite preparation:

Micelle and nanocomposite characterization:

The film morphology and phase separation structures strongly depended on the film thickness. For thicker films, elongated star-like shape lamellas, 5 μm long and 1 μm wide on the average were formed and randomly distributed on the polymer surface, while for thinner films oval/elongated micelle-like shapes, 200 nm long on the average were formed and uniformly distributed on the surface of the film.

X-ray microanalyses of the TEM image of the honey comb like structure and the substrate across the yellow line, reveals the excess amount of iron and oxygen in the honey comb like self-assembled nano-structures in comparison to the remaining substrate and the micelle. The analyses were performed in repertive rounds for 12 islands and all of them were found to have an excess amount of iron and oxygen in comparison to the remaining substrate.

CONCLUSIONS

Micro and nano self-assembled structures and phase separation was induced on diblock copolymer hybrid materials.

The concentration of iron and oxygen in the honey comb like structures was enhanced in comparison to the concentration of the iron outside the holes of the illuminated areas.

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