Real time GISAXS study of magnetic nanoparticle assemblies on polymer templates

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Abstract

Hybrid materials consisting of metal nanoparticles dispersed in a polymer matrix open pathways for engineering composites that exhibit advantageous electrical, optical, or magnetic properties. Using a portable DC magnetron sputtering deposition system [1-2], the incorporation of cobalt atoms into a microphase-separated polystyrene-block-polyethylene oxide *P(S-b-EO)* diblock copolymer film with parallel cylinder morphology is achieved. Time-resolved in situ grazing incidence small angle X-ray scattering (GISAXS) allows successfully to investigate the systematic formation and growth of Co nanoparticles into the polymer template. Cobalt atoms were found to wet selectively the polystyrene domains of the microphase-separated polymer film and then aggregates to form surface metal nanopatterns. Upon increasing the amount of metal content, the selectivity nature of the sputtering process was found to diminish with the formation of a pseudo-uniform metal layer. This study utilizes the real time GISAXS method to gain a better understanding of how the self-assembly process correlate with the structure of the copolymer domains in the polymer film.

[1] E. Metwalli, S. Couet, K. Schlag, R. Röhlsberger, V. Körstgens, M. Ruderer, W. Wang, G. Kaune, S.V. Roth, P. Müller-Buschbaum; *Langmuir* **24**, 4265 (2008)

[2] G.Kaune, M.Ruderer, E.Metwalli, W.Wang, S.Couet, K.Schlage, R.Röhlsberger, S.V.Roth, P.Müller-Buschbaum ACS Appl. Mater. Interfaces **1**, 353 (2009)