Synchrotron Grazing Incidence X-Ray Scattering and Its Applications in Nanotechnology

Moonhor REE*, Jinhwan YOON, Kyuyoung HEO, Kyeong Sik JIN, Sangwoo JIN, Byeongdu LEE, Gahee KIM, Seung Chul CHOI, Weontae OH, Young-Hee PARK, Yongtaek HWANG, Jong-Seong KIM, Jehan KIM, Kwang-Woo KIM
Pohang Accelerator Laboratory (Pal), Department of Chemistry, National Research Lab for Polymer Synthesis and Physics, Center for Integrated Molecular Systems, Polymer Research Institute, and BK21 Program, Pohang University of Science & Technology (Postech), Pohang 790-784, KOREA
E-mail, ree@postech.edu; Tel, +82-54-279-2120; Fax, +82-54-279-3399

Synchrotron grazing incidence X-ray scattering (GIXS) has several important advantages: a highly intense scattering pattern is always obtained, even for films of nanoscale thickness as well as nanostructures on substrates, because the X-ray beam path length through the film plane is sufficiently long; there is no unfavorable scattering from the substrate on which the film is coated; and easy sample preparation. For these advantages, in recent years the GIXS has become the major analytical tool for characterizing structures and properties of a variety of nanostructures and nanoscale thin films in a single and multilevels. However, the quantitative analysis of measured GIXS data requires a proper scattering theory because of the complexity of GIXS phenomenon due to the scatterings from the transmission and reflected X-ray and the refraction effect, which is very far from the conventional transmission and reflection X-ray and neutron scattering. In our study, GIXS measurements with synchrotron radiation sources were conducted statically and in-situ for a series of nanostructures supported with substrates: nanoporous dielectrics, block copolymers, brush polymers, molecular assemblies, and so on. All GIXS measurements were performed at the Pohang Accelerator Laboratory (PAL). The measured GIXS data were analyzed in detail by using the newly developed GIXS scattering theory of ours. All GIXS results will be discussed in details with considering the materials chemistry and nanostructure formation process parameters.

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