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Challenges for nano-scale imaging of polymeric nanostructures by electron microscopy

In order to fabricate structures for many applications, e.g., nanotechnology, photovoltaic devices, drug delivery, etc., choice of three-dimensional (3D) structures is a key issue. Control of dispersion state of nano-particles in (polymeric) matrix, for example, is an important industrial problem. For more precise structural control, block copolymers (BCP) are often used because of their variety of periodic morphologies. Combining well-ordered 3D morphologies of BCPs with nano-particles offers a way for well-controlled spatial arrangement of nano-particle inside materials. Transmission electron microscopy (TEM), electron tomography (3D TEM) in particular, plays an important role to characterize such nano-structures. In order for better understanding and precise control of 3D structures, direct observation of ordering processes of nano-structures during phase transition are essential. Unfortunately, TEM has not been a useful method for such dynamical imaging. One of the biggest reasons for this is “staining” of (polymeric) samples is almost always necessary for contrast enhancement because of their weak contrast for electrons. Consequently, the staining “fixed” the nano-structure, which makes it impossible to perform “*in-situ*” dynamical observations. Here, we show some preliminary results of direct imaging of nano-structures from an unstained BCP that have never been observable without staining in the past. This new methodology in electron microscopy may open up a way of “*in-situ*” 3D imaging in the near future. In our talk, we will show some examples of structure control of polymeric materials and their characterization with TEM.

Biography

Hiroshi Jinnai has completed his DEng from Kyoto University in 1993. He is a Professor of Tohoku University. He has published more than 200 papers in reputed journals and has been serving as an Editorial Board Member of Polymer (Elsevier) and Microscopy (Oxford University Press). He is the Fellow of American Physical Society (APS) since 2011. He is a recipient of the SPSJ (The Society of Polymer Science, Japan) Wiley Award (2006), Ernst-Ruska-Prize (2007), The Japanese Society of Microscopy Society Award, Setoh Prize (2012) etc. He is the Fellow of American Physical Society (APS) since 2011.

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