Self-Assemblies of Functional Polymers and Their Impact on Property Performances

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Polymer can generally reveal very unique and specific properties depending on their molecular topology, chemical composition, molecular weight, polydisperty index, monomer sequence, chain structure, morphological structure, and so on. When a functional polymer is synthesized in the base of molecular topology, composition, molecular weight, polydisperty, and monomer sequence, its functional and property performances can be further maximized via controlling or optimizing molecular assembly (self-assembly), namely morphological structure, consequently providing good opportunities for better uses of the polymer product in human life (Figure 1).

The morphological structure of a functional polymer can be characterized and further optimized by scattering and microscopic analyses combined with processing. So far, several scattering and microscopic analysis techniques have been developed: light, neutron, and X-ray scatterings; optical, electron, and atomic force microscopies. All scattering techniques are nondestructive methods and indeed so convenient and applicable for all polymers. In contrast, microscopic techniques have some requirements in sample preparations because of their resolution limits; for example, electron microscopy is a destructive method because of requiring microtoming in sample preparation for getting a certain level of image resolution.

Grazing incidence scattering technique has emerged as a powerful and versatile tool for determining the morphological characteristics of nanostructures and atomic structural information. In particular, grazing incidence X-ray scattering (GIXS) is widely adopted in various advanced science fields including polymer science and nanoscience because of the availability of high quality X-ray sources which are produced by the 3rd- and 4th-generation synchrotron radiation facilities.

This presentation is covering most recent GIXS works of Ree reserach group on self-assemblies in a series of topological polymers, including miktoarm star polymers, macromolecular rotaxane block copolymers, and brush polymers, and their impact on proerties, specially electronic device performances. This presentation further covers structural details of various nanoparticles for nanoscience and applications.

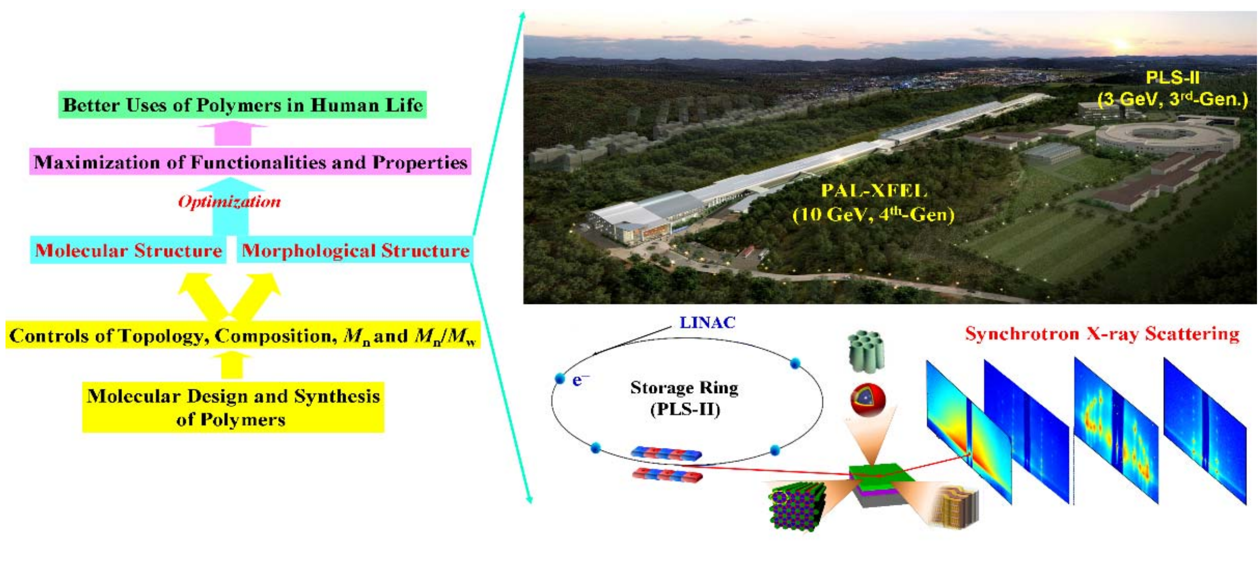

Figure 1. A schematic diagram of functional polymer developments with the aids of synchrotron photon source facilities.