Investigating Structures with Preferred Orientation Using X-ray and Neutron Scattering Techniques

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Abstract

Two examples are given to illustrate the usefulness of synchrotron wide- and small-angle X-ray scattering (WAXS/SAXS), and small-angle neutron scattering (SANS) techniques in understanding anisotropic systems. Preferred orientation of structures can be induced by different methods, such as flow, magnetic or electric field. Under these conditions, data interpretation based on 2D whole scattering pattern analysis becomes critical. In the first example, *in situ* WAXS/SAXS study on structure development during uniaxial stretching of poly(propylene-1-butylene) (PB) random copolymer is discussed. The inclusion of comonomer, namely, 1-butylene, into isotactic polypropylene (*i*-PP) chain backbones can cause complex crystalline structures featured by a mixture of γ- and α-phase of *i*-PP. Two polymorphs responded to uniaxial stretching in different ways, which can be fully characterized using 2D whole pattern analysis method. Similar experiment can be carried out at SANS beamlines, where deuterium labeling becomes an important tool, allowing researchers to focus on the targeted component of a complex system. The instrumentation, however, is not as straightforward as compared to that in X-ray scattering technique. Combinatorial sample environments at SANS beamlines in NIST center for neutron research (NCNR) is introduced. Recent instrumental development allows *in situ* study on rheological behaviors of samples, which is of particular importance to soft condensed matter research.