Keywords: Nano-LiMnPOsub4, Li+ diffusion, crystal structure, lithium ion battery

MS38-O4 X-ray studies on polymers and composites: the combination of 2D WAXS, SAXS and X-ray imaging techniques

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Polymers, elastomers, composites, foams and textiles find their applications in growing industrial markets such as aerospace, automotive, building products, electronics, energy and medicine. While some of these polymer materials are amorphous, a large proportion exhibit local order with regularly arranged chains (crystallite domains) leading to varying amounts of crystallinity and hence can be characterized by X-Ray diffraction techniques. Structural information beside phase identification and quantification can be obtained for the polymer crystallinity, the polymer orientation, the crystalline microstructure and the non-crystalline periodicity and size. Structural variations, such as those induced by e.g. inorganic phases as in composites can be monitored by dynamic studies through in-situ experiments at process conditions (temperature, humidity, mechanical load). Preferred orientation or texturing is a dominant effect in polymers, especially in processed parts. Orientation is also the dominant feature in controlling the mechanical and physical properties of polymers which is of major interest for researchers and manufacturers. For the study of those orientation behaviors, a combination of SAXS and WAXS transmission experiments are conducted using a BRUKER Nanostar and an IPDS-II X-ray machine; both containing a 2D detector.

Investigations have been made for different synthetic polymer fiber and composite systems[1,2]. The figure 1 shows 2D images obtained for a carbon fibre reinforced polymer system with a strong texturing. The evaluation of the WAXS 2q range reveals information about the crystal structure parameters and the crystalline domain size (a). In contrast, integrating the azimuth (360° in Phi at 2θ 12.02° for C(002)) gives the possibility to quantify polymer ordering through the determination of peak width (FWHM). SAXS enables the study of nano-particle and nano domain sizes in dependence of their orientation distributions (b). X-ray phase contrast imaging (XPCI) reveals materials voids and cracks (c).

[1] Polymer, **55**, 5695-5707 (2014).

[2] Journal of Polymer Science, Part B: Polymer Physics, **52**, 496–506 (2014).

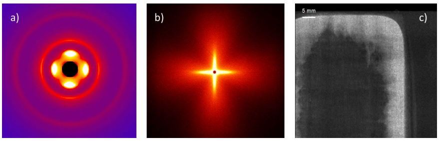

Figure 1. 2D images from WAXS (a), SAXS (b) and X-ray phase contrast imaging (c).

Keywords: SAXS, WAXS, X-ray phase contrast imaging, 2D detection techniques