SIMULTANEOUS SAXS/WAXS/XAFS MEASUREMENTS ON IONIC POLYMER-METAL SYSTEMS

Giuseppe Portale

Netherlands Organization for Scientific Research (NWO), DUBBLE@ESRF, BP220, Grenoble, F38043, France
*Email:**portale@esrf.fr***

Ionomers are polymers containing a relative small amount (<15%) of ionic groups and able to combine peculiar properties of charged materials with good mechanical properties. They are interesting materials not only from a scientific point of view, but also for their commercial importance due to their wide applicability ranging from electrochemical to high performance material applications (form fuel cells to golf ball covers). The properties of ionomers are mainly dictated from their phase-segregation behavior between the hydrophobic backbone and the hydrophilic groups, process that brings to the formation of ionic clusters inside the polymeric matrix. For such materials, the complete knowledge of the structure at the atomic as well as at the nanoscale level represents the key of understanding of their peculiar properties.
A dedicated setup able to measure SAXS, WAXS and XAFS data during the same experiment was built at the BM26A beamline at the ESRF. The setup, already tested on inorganic samples [1], was improved and applied in this work to perform detailed studies on the thermal stability and on the effects of the thermal treatments on metal containing ionomers.
The special setup allow us to obtain structural information over an extensive range in real space, ranging from the fine structure XAFS data (1-5 Å) to the SAXS ones (600 Å). In this way it is possible to record in a single experiments x-ray data useful to study both the intercluster and the intracluster structure.
Several amorphous and low-crystalline ionomeric systems were investigated: perfluorosulphonated ionomers, like Nafion (DuPont), non-fluorinated ionomers and the commercial poly(ethylene-*co*-methacrylic acid) ionomers, marketed as Surlyn by DuPont. The correlation between electrochemical properties and nanostructure of some of these systems was already studied in our previous works by SAXS analysis [2].
We focused our investigation on samples fully neutralized with Zn^{2+} and Cu^{2+} in both the dry and hydrated state. A close correlation between the intradomain atomic arrangement and the interaggregate arrangement on the basis of the acquired structural data as is presented in this contribution.

References

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