Solid polymer electrolytes based on polymer blends

Tingzi Yan[a], Zhaopeng Zhang[a], Guilhem Baeza[b], Jacques Jestin[c], Johan Mattsson[a],

[a] *School of Physics and Astronomy, University of Leeds, Leeds, LS2 9JT, United Kindom*
[b] *Universite de Lyon, MATEIS, INSA-Lyon, CNRS UMR5510, F-69621, France*
[c] *Laboratoire Léon Brillouin, CNRS-CEA, 91191 Gif-sur-Yvette, France*

E-mail: t.yan@leeds.ac.uk

Lithium ion batteries are important as power sources for many portable electrical devices (e.g. laptops and mobile phones) and the use of Li-ion batteries is predicted to grow substantially in the near future, whilst branching out into new application areas. Despite this rising demand, we presently lack safe, easy-to-process and thus low-cost, ideally mechanically flexible batteries. One way to achieve safe and flexible batteries is to use solvent-free polymeric electrolytes. However, a key challenge is to resolve how to decouple the ionic transport from the segmental relaxation and thus to achieve good transport properties combined with mechanical rigidity. Recent work has indicated the possibility of tuning the monomer structure in co-polymers to control the local packing properties, dynamics and ionic decoupling [1]. Another route is the use of polymer blends [2]. We will here present work that aims at a better understanding and control of the decoupling between ionic transport and polymer dynamics based on polymer blend based solid polymer electrolytes.

We present results for a range of different polymer blends based on ionically conducting polyethers (PEG or PPG) and more rigid, higher glass-transition polymers including polycarbonates and polyalkyl methacrylates to which Li-ions are added. We present results from a wide range of experimental techniques including broadband dielectric spectroscopy (BDS), calorimetry, dynamic mechanical thermal analysis (DMTA), (cryo-) scanning electron microscopy (SEM/Cryo-SEM), small angle neutron scattering (SANS), small/wide angle X-ray scattering (SAXS/WAX), nuclear magnetic resonance (NMR) and Atomic Force Microscopy (AFM). We present a systematic investigation of the ion transport, molecular dynamics and structure as well as rheology for a wide range of material compositions of these systems and discuss our results in the light of relevant previous literature and suggested models for ion conductivity and polymer blend behaviour.

References:

[1] Y. Wang *et al*., *Polymer*, **55** (2014) 4067.

[2] D. Cangialosi *et al*., *Macromolecules*, **41** (2008) 1565.