Master thesis proposal

Studies of water's influence on conductivity and structure for polymer-salt-H_2O systems

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Aim

This proposal concerns basic experimental research on electrolyte solutions. The aim of the master work is to gain knowledge on the influence of controlled amounts of water on the preparation, the electrical conductivity and on the interaction of polymer-electrolyte-water in the polymer electrolyte solutions, using experimental techniques FTIR (Fourier Transform Infrared Spectroscopy, Fig.2), impedance spectroscopy, thermal gravimetric analysis and differential scanning spectroscopy.

Background

Electrolytes find applications in different areas of chemistry, physics and technology, the most known areas is battery and solar cells technology.

We are investigating electrolyte solutions consisting of polymers as solvents and different salts which makes the polymers conducting. We have observed that small amounts of water added to a polymer-salt solution increase the electrical conductivity considerably, e.g. for the solution PPG4000- $LiCF_3SO_3$.

The water molecule exhibits remarkable chemical and physical properties, among other due to its very high dipole moment. Polymers, electrolytes and water are materials with very different physical and chemical properties. Nevertheless, together they are building complex systems with attractive properties. The microscopic structure of the ternary systems polymer-electrolyte-water is very complex due to a large number of different types of intermolecular interactions: ions-water, ions-polymer and water-polymer. Water can create with ions a large number of complexes with different dipole structures (Fig.1) influencing thus the structure of the bindings and the properties of the electrolyte solution.

The aim of the research is to gain a detailed knowledge of the ternary systems´ microstructure in order to create electrolyte solutions exhibiting high ionic electrical conductivity, chemical and thermodynamic stability, and to be environment friendly.

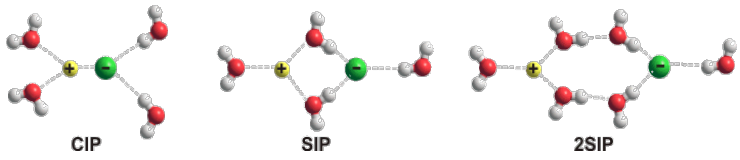

Fig.1: Some water binding types to ions - a dipole

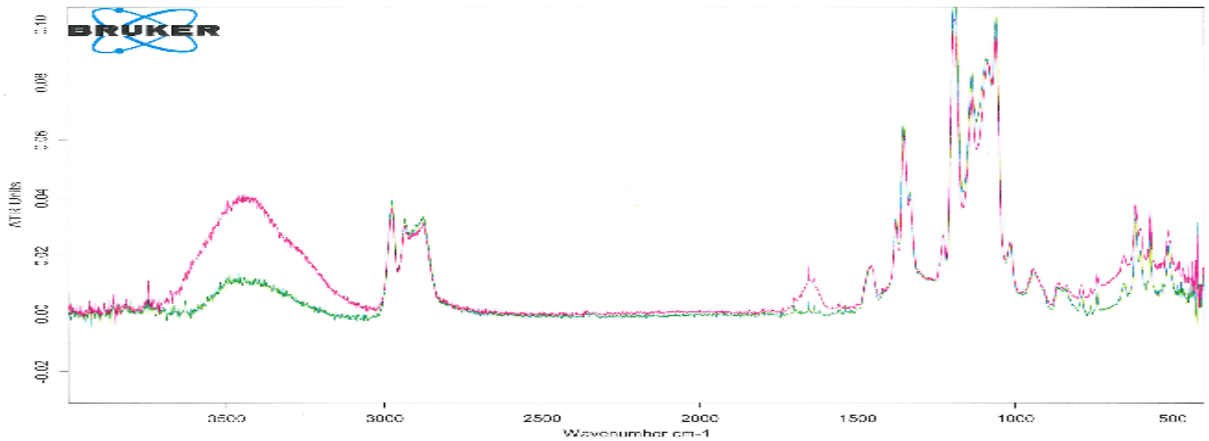

Fig.2: Examples of FTIR spectra of polymer electrolyte PPG400-LiTFSI and PPG400-LiTFSI-H_2O, resp.

Interested? Do you want to know more, please, contact: Milan Friesel (friesel@chalmers.se), Bengt-Erik Mellander (f5xrk@chalmers.se) or Ingvar Albinsson (Ingvar.Albinsson@physics.gu.se)