Ceramic-in-polymer vs. polymer-in-ceramic polymeric electrolytes – a novel approach

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One way of enhancing transport as well as mechanical properties of polymeric electrolytes is the introduction of ceramic fillers (Weston, J.E.; Steele, B.C.H. *Solid State Ionics,* **1982**, *7,* 75). Interactions between filler grains with the polymeric matrix were proven to be substantial for the properties of composites. Confinement and entanglement of polymeric chains in the vicinity of the grains can propagate athwart the electrolyte and influence its conductivity, mechanical properties etc… Similarly to the salt-in-polymer vs. polymer-in-salt approach, we decided to study inverse materials – in which the ceramic is a continuous phase that provides mechanical support for the electrolyte and salt-polymer complex is soaked in it. It gives many opportunities and opens new ways of thinking about these materials. It's quite sure that convex vs. concave neighborhood of polymeric chains can differentiate properties of ceramic-in-polymer vs. polymer-in-ceramic polymeric electrolytes. Furthermore continuous ceramic phase enables new materials to be used as the ion-conducting phase since the mechanical integrity and rigidity of the system is assured by the ceramic phase.

This work is in certain extent an application of a widely investigated group of materials for medical application – namely polymer-ceramic composites, where outstanding mechanical properties of these systems, combined with their bio-compatibility was of great importance and relevance. Herein we focused on the transport abilities of these materials.

This work consists of preparation of porous ceramic samples based on alumina that were characterized by XRD, porosimetry and SEM. Totally new setup was developed for allowing preparation of electrolytes in vacuum/controlled atmosphere conditions and it was used for preparing the composites.

They were characterized by SEM, EDS, FT-IR, Raman and EIS – with both blocking and reversible electrodes. They exhibited excellent mechanical properties, high conductivities and good stability vs. Li metal electrodes under prolonged storage. These results are compared to those obtained for "classical" alumina filler (in the form of a powder).