PROPERTIES AND APPLICATION OF TIOL-ENE IONOGELS WITH METHACRYL-POSS

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Ionogels, a modern type of gels with unique properties, are made of a matrix, usually a polymer matrix, and an ionic liquid. They exhibit an ionic conductivity and therefore can be used in batteries and electrochemical capacitors as a gel polymer electrolytes (GPE). However, for such an application to be possible, gels must be characterized by high ionic conductivity and good mechanical properties. Our preliminary studies have shown the great potential and the possibility of using ionogels with a thiol-en matrix as gel polymer electrolytes [1]. However, it was required to obtain ionogels with better mechanical properties and higher conductivity. Therefore, we decided to investigate the effect of octakis(methacryloxypropyl) silsesquioxane (methacryl-POSS) and additives of propylene carbonate (PC) on the synthesis and properties of hybrid organic–inorganic ionogels. Ionogels were prepared *in situ* by thiol-ene photopolymerization of triallyl isocyanurate with pentaerythritol tetrakis(3-mercaptopropionate) in a mixture of 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ($EMImNTf_2$) and propylene carbonate (PC). Investigations have included the kinetics of hybrid materials formation and selected physicochemical properties: puncture resistance, conductivity and morphology. Finally ionogel with high conductivity and good mechanical properties was applied and investigated as gel polymer electrolyte in electrochemical capacitors (EC).

The addition of methacryl-POSS during the synthesis of thiol-ene ionogels improved the mechanical and conductive properties of investigated materials. Maximum values of puncture resistance and ionic conductivity are obtained for ionogels with 1.5-5% and 1-3% of methacryl-POSS, respectively. Based on obtained results it was decided to investigate ionogel with 1.5% of methacryl-POSS as gel polymer electrolyte in ECs. EC with modified ionogel present very good electrochemical properties.

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[1] Marcinkowska, A. et al., Ionogels by thiol-ene photopolymerization in ionic liquids: Formation, morphology and properties. Polymer 2019, 160, 272–281.