

Synthesis of modern hydrogel polymer electrolytes

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The increasingly rapidly developing fields of electronics result in the need to look for new ways of energy storage methods. At the same time, much attention is paid to issues related to environmental protection. Due to this, there is a growing interest in, among others, searching for modern electrolytes that will ensure efficient operation of energy storage devices and at the same time be cheap to obtain and non-toxic. The answer to this problem may be the synthesis of hydrogel polymer electrolytes (HPE) using choline compounds. As part of the work, the synthesis of a methacrylic monomer, the synthesis of an electrolyte containing the choline cation, and the composition of hydrogels were selected in order to obtain HPE with the desired characteristics enabling their use in electrochemical capacitors.

Experimental part: The first stage of the research was to obtain a methacrylate monomer modified with choline. In the next step, a solvent N-Methyl-2-pyrrolidone, a resin (Dyma XR-741, Exothane 8, Ebecryl 264) in various proportions and a photoinitiator were added to the synthesized monomer and subjected to a photopolymerization reaction. The weight ratio of solvent in all prepared compositions was always 70 wt.-%, but the ratio of monomer to resin was changed from 1:1 to 2:1. The obtained organogels were placed in distilled water and then, after washing the solvent out, in an aqueous solution of choline sulfate (also synthesized as part of the research) with a concentration of 1.5 mol / kg H₂O. The conductivity and mechanical properties of the obtained hydrogel polymer electrolytes were tested to check the possibility of their use as HPE in electrochemical capacitors.

Results of conductivity varied from 3.1 mS/cm for hard and brittle hydrogels up to 47.0 mS/cm for very flexible but mechanically weak gels. Most importantly, there was also obtained a sample that showed both good conductivity around 34.2 mS/cm and good mechanical properties.

Conclusions: The conducted research enabled the development of a methodology for the synthesis of two compounds with choline cation - choline sulfate and the methacrylate monomer. These compounds made it possible to obtain new hydrogel polymer electrolytes, which are characterized by high conductivity and good mechanical properties. The obtained HPEs may be successfully used as gel polymer electrolytes in electrochemical capacitors in the future.

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