Synthesis and investigation of properties of comb-type polymers for solid polymer electrolytes

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Nowadays, development of new and more efficient methods of energy storage and conversion is one of the major problems facing scientists. This includes the efficient storage of electricity. Therefore, development of new type organosilicon solid polymer electrolyte membranes for Lithium batteries is a actual problem.

Hydrosilylation reaction of 2.4.6.8-tetrahydro-2.4.6.8-tetramethylcyclotetrasiloxane (D_4^H) with electro donor group containing allyl butyrate, allyl acetoacetate and vinyltriethoxysilane, as in solvent as without it, in the presence of platinum (Pt/C, H_2PtCl_6, Karstedt's) catalysts at various temperature have been studied. It was shown that during hydrosilylation reaction with allyl butyrate without solvent side reactions take place. For obtaining of fully substituted products the hydrosilylation reactions have been carried out in dilute solutions (toluene or tetrahydrofuran) at various 30–60^{0}C temperatures. There was obtained D_4^R and $D_4^{R,R'}$ type compounds, which structure and composition were determined via physical-chemical investigations: by determination of molecular masses, molecular refraction, FTIR, ^{1}H, ^{13}C and ^{29}Si NMR spectra data. Hydrosilylation reaction order, rate constants and activation energies have been determined.

Polymerization and co-polymerization reactions of D_4^R and $D_4^{R,R'}$type organocyclotetrasiloxanes with terminated agent – hexamethyldisiloxane with various type of catalysts metal fluorides and anhydrous potassium hydroxides have been studied. It was shown that polymerization and copolymerization reactions run with formation of comb-type polymers with regular arrangement of side groups. It was established that in copolymerization reaction by varying of ratio of terminated agent it is possible the regulation of molecular masses of obtained polymers. Polymerization and copolymerization reaction order, rate constants and activation energies have been determined.

Hydrosilylation reaction of linear PMHS with allyl butyrate and vinyltriethoxysilane at various ratio of initial compounds, in the presence of Karstedt's catalysts have been studied and various linked comb-type polymers with electro donor side groups have been obtained. The structure and composition of obtained polymers have been determined by FTIR, ^{1}H, ^{13}C and ^{29}Si NMR spectra. For obtained polymers, gel-permeation chromatographic, roentgenographic, differential scanning calorimetric investigation have been carried out. The obtained polymers are represented as amorphous systems with low glass-transition temperature, which is a required property to use it in solid polymer electrolyte membranes.

Via sol-gel processes of doped with Lithium salts polymer systems solid polymer electrolyte membranes have been obtained.