

Synthesis of novel proton-conductive ionic liquids from 1-*H*- and 1-alkylimidazoles and hypophosphorous acid

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Keywords: 1-alkylimidazoles, hypophosphorus acid, hypophosphites, proton-conductive ionic liquids, polyethylene terephthalate (PET).

Abstract

Hitherto unknown 1-*H*- and 1-alkyl-3*H*-imidazolium hypophosphites have been synthesized from imidazole, 1-alkylimidazoles and hypophosphorous acid (50% aqueous solution) under mild conditions (room temperature, 30 min) in 90-95% yields. Their structure is proved by ¹H, ¹³C, ³¹P NMR and IR techniques and composition is confirmed by the data of elemental analysis. The synthesized 3*H*-imidazolium hypophosphites are viscous glycerol-like yellow liquids. They represent promising proton-conductive ionic liquids and can be employed to impart conductivity to the dielectric polymeric materials that is demonstrated on the example of industrial dielectric microporous track films from polyethylene terephthalate (PETF). The comparative analysis of IR spectra of the 3*H*-imidazolium hypophosphites, initial PETF film and PETF films impregnated by the synthesized ionic liquids shows that the latter are incorporated into the initial PETF film. The films, obtained by modification of PETF with imidazolium hypophosphites, possess high proton conductivity 1.92-3.81·10⁻⁴ S·cm⁻¹ (according to the data of impedance spectroscopy) whereas the electric conductivity of the initial PETF film does not exceed 10⁻¹¹-10⁻¹² S·cm⁻¹. The temperature dependence of proton conductivity (σ) obtained for PETF film modified with 1-methyl-3*H*-imidazolium indicates that σ value increases in the range from 3.81·10⁻⁴ to 1.53·10⁻³ S·cm⁻¹ at 303-363 K. Activation energy of the proton transfer process for this sample is 18.85 kJ/mol·K. Thus, application of novel proton-conductive ionic liquids for modification of industrial dielectric microporous PETF track film with through micropores (a model of proton-conductive membrane for the fuel elements) increases by 7 orders the electric conductivity of this film.

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