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Multicomponent non-aqueous electrolytes for high temperature operation of supercapacitors

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Abstract

Multicomponent non-aqueous electrolytes based on cyclic carbonates and tetraethylammonium tetrafluoroborate have been developed for the operation of supercapacitors at elevated temperatures.

Propylene carbonate, which has a high dielectric constant and a high boiling point, was used as the main solvent of electrolytes. However, a significant drawback of propylene carbonate is its high viscosity, which leads to decrease in the electrical conductivity of electrolytes based on it compared to electrolytes based on acetonitrile.

To increase the electrical conductivity, an additional component was introduced into the electrolyte – a cosolvent with the necessary set of properties. When choosing cosolvents, two approaches were used. In the first case, to increase the dielectric permittivity of the liquid phase, ethylene carbonate having a higher dielectric constant than propylene carbonate was introduced into the electrolyte. This approach made it possible to significantly increase the electrical conductivity of the electrolyte and to achieve high resource stability of the supercapacitor. The values of the specific capacitance and energy of the supercapacitor with the introduction of ethylene carbonate in the electrolyte practically did not change. In the second case, butyl acetate, which has a low viscosity but has a moderate polarity and a sufficiently high boiling point, was used as a co-solvent. In this case, not only an increase in the electrical conductivity of the electrolyte was observed, but also a significant increase in the capacitive characteristics of the supercapacitor.

It is shown that the use of a mixture of cyclic carbonates and esters as a solvent in the composition of the electrolyte can increase its specific conductivity by 40%, and the specific energy consumption of a supercapacitor by 20%. The developed electrolytes provide long-term operation of supercapacitors both at room temperature and at elevated temperatures up to 80 °C.

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