

Electrochemical characteristics of the mixture of 1-ethyl-3-methyl imidazolium tetrafluoroborate and 1-ethyl-3-methylimidazolium iodide

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The use of non-aqueous electrolytes and room temperature ionic liquids (RTIL) in electrical double-layer capacitors (EDLC) was initiated due the wider region of ideal polarizability of carbon electrodes increasing the energy and power densities of EDLCs in comparison with the aqueous electrolytes based systems. There are several studies about the strong adsorption of iodide and other halide ions at Bi single crystal planes from aqueous and non-aqueous supporting electrolyte solutions demonstrating a maximum in C, E-curve in the presence of specifically adsorbed I⁻, Br⁻ or Cl⁻ anions. [1-6]

In this work the cyclic voltammetry and electrochemical impedance spectroscopy methods have been applied for investigation of electrical double layer formation and iodide anions adsorption kinetics parameters from the mixture of 1-ethyl-3-methylimidazolium iodide (EMImI) and 1-ethyl-3-methylimidazolium tetrafluoroborate (EMImBF₄) at the electrochemically polished Bi(111) electrode surface.

Mixture of EMImI in EMImBF₄ have been prepared with different concentrations (from 1 to 5 wt%) to increase the differential capacitance of the system.

Analysis of current density (j) vs. electrode potential (E) dependencies (Fig. 1) shows that the Bi(111) electrode is ideally polarizable within the potential range from -1.1 to -0.2 V for 1 wt% and for 5 wt% within -1 to -0.2 V vs. Ag|AgCl.

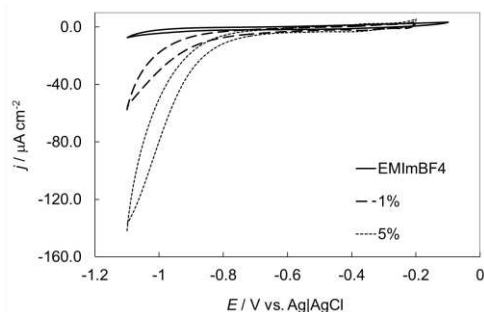


Fig.1 Cyclic voltammograms at potential scan rate 10 mV/s.

The shape of the complex impedance plane, i.e. Nyquist plots and the phase angle vs. log f dependencies (Fig. 2) depend on the potential applied. In the range of more negative potentials the mixed kinetic processes take place, but moving towards less negative potentials, the system indicates only weak deviation from the nearly ideal capacitive behavior.

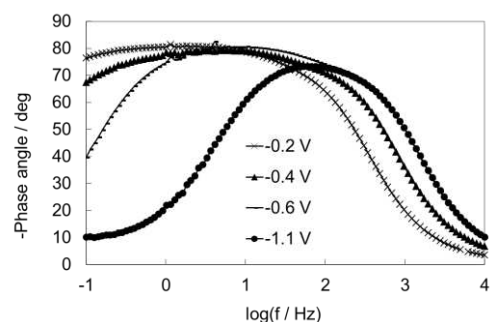


Fig.2 The phase angle vs. log f dependencies for 5 wt % mixture of EMImI in EMImBF₄.

The series differential capacitance (C_s) (Fig. 3) values have been calculated from Nyquist dependencies at different fixed ac frequencies from 0.2 to 10000 Hz ($C_s = (Z''i2\pi f)^{-1}$; where $i = \sqrt{-1}$). C_s depends on the electrode potential and ac frequency being somewhat higher for lower frequencies. The capacitance values are considerably higher than those for pure EMImBF₄, measured at less negative potentials.

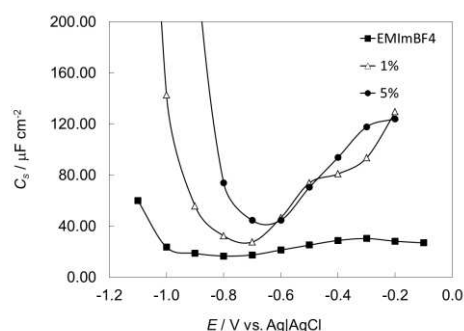


Fig.3 Series differential capacitance vs. electrode potential curves at 0.2 Hz.

Acknowledgements

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References

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