UNDERSTANDING THE LIMITS OF IONIC LIQUID BASED SUPERCAPACITORS

Ove Oll, Tavo Romann, Georg Gorbatovski, Jinfeng Zhao and Enn Lust

Institute of Chemistry, University of Tartu, Ravila 14a, 50411 Tartu, Estonia

e-mail: ove.oll@ut.ee

Ionic liquids are versatile solvents and electrolytes for many electrochemical applications, such as secondary batteries, capacitors, solar cells and electrochemical deposition. In order to rationally design and further develop such systems, however, a detailed understanding of the processes that govern the interfacial processes and stability of ionic liquid interfaces is required [1,2]. It is thus the focus of this work to explore the limits and provide new methods to increase both the power and energy characteristics of supercapacitors by applying different ionic liquids as the electrolytes for high specific surface area carbon-based supercapacitors [3].

A novel technique of in situ infrared absorption spectroscopy for the study of thin film graphite electrodes has been developed [1] and is applied for the study of the graphite │1-ethyl-3-methylimidazolium tetrafluoroborate ($EMImBF_4$) ionic liquid interface as a model supercapacitor and graphite │polydicyanamide interface as a dielectric capacitor. The infrared absorption results show that, unlike previous theoretical considerations of the electrical double layer between semimetals and electrolytes, the strong interaction between the electronic and ionic part of the electrical double layer is of fundamental importance for the description of semimetal interfaces. Together with the data provided by *in situ* electroreflectance technique of the electronic and energetic structure of the graphite electrode and differential capacitance-potential dependence of the graphite │$EMImBF_4$ system [1,2], it is demonstrated that the screening of excess surface charge by the ionic liquid is strongly correlated with the potential dependent electronic properties of the electrode surface states, thus limiting the amount of charge stored.

Acknowledgements

This work was supported by the Estonian Ministry of Education and Research (projects no. IUT 20-13, PUT1033 and PUT1107) and Estonian Centres of Excellence project TK141.

References

[1] O. Oll, T. Romann, E. Lust, An infrared study of the few-layer graphene | ionic liquid interface: Reintroduction of in situ electroreflectance spectroscopy, Electrochem. Commun. 46 (2014) 22–25.

[2] O. Oll, T. Romann, C. Siimenson, E. Lust, Influence of chemical composition of electrode material on the differential capacitance characteristics of the ionic liquid|electrode interface, Electrochem. Commun. 82 (2017) 39–42.

[3] T. Romann, O. Oll, P. Pikma, K. Kirsimäe, E. Lust, 4–10 V capacitors with graphene-based electrodes and ionic liquid electrolyte, J. Power Sources. 280 (2015) 606–611.