Accepted Manuscript

Electrochemical impedance spectroscopy on the capacitance of ionic liquid–acetonitrile electrolytes

Qian Zhang, Xiaohong Liu, Li Yin, Panhu Chen, Yonglong Wang, Tianying Yan

PII: S0013-4686(18)30561-9

DOI: 10.1016/j.electacta.2018.03.059

Reference: EA 31425

To appear in: *Electrochimica Acta*

Received Date: 13 September 2017

Revised Date: 9 March 2018

Accepted Date: 10 March 2018

Please cite this article as: Q. Zhang, X. Liu, L. Yin, P. Chen, Y. Wang, T. Yan, Electrochemical impedance spectroscopy on the capacitance of ionic liquid–acetonitrile electrolytes, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.03.059.

Electrochemical Impedance Spectroscopy on the Capacitance of Ionic Liquid–Acetonitrile Electrolytes

Qian Zhang, Xiaohong Liu, Li Yin, Panhu Chen, Yonglong Wang, Tianying Yan*

Institute of New Energy Material Chemistry, School of Materials Science and Engineering, National Institute for Advanced Materials, Collaborative Innovation Center of Chemical Science and Engineering (Tianjin), Nankai University, Tianjin 300350, China

*Correspondence author: tyan@nankai.edu.cn

Abstract: The effects of acetonitrile on the electric double layer (EDL) capacitance of ionic liquid (IL) 1-butyl-3-methyl-imidazolium hexafluorphosphate with platinum electrode are studied by electrochemical impedance spectroscopy at -1.0 – 2.0 V *versus* silver wire pseudo-reference electrode. For neat IL as well as its mixtures with different acetonitrile contents up to 95 mol%, two capacitance processes are detected, i.e., a fast Debye relaxation and a slow Havriliak-Negami relaxation. The fast Debye relaxation of sub-millisecond time scale for neat IL, and shorter by an order of magnitude at 95 mol% of acetonitrile, is attributed to the EDL charging/discharging processes. The origin of the slow Havriliak-Negami capacitive process is not resolved, but its contribution on the EDL capacitance is not considered. Upon adding acetonitrile into ionic liquid, the EDL capacitance curve switches from bell-shaped for neat IL to camel-shaped with 50 mol% and 95 mol% acetonitrile, and the EDL capacitance increases significantly at higher cathodic and anodic polarizations.