USING ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY TO INVESTIGATE ALKALI-METAL ION ABSORPTION INTO GLUCOSE DERIVED HARD CARBON BATTERY ANODES

Ronald Väli, Alar Jänes, Enn Lust

Institute of Chemistry, University of Tartu, Ravila 14a, 50411 Tartu, Estonia
ronald.vali@ut.ee

Sodium and potassium-ion batteries have attracted great deal of attention due to sodium's abundance and lower price compared to lithium and cobalt. A major obstacle that prevents sodium-ion batteries going to a mass-scale is the negative electrode (anode during discharge). Graphite is currently the safest negative electrode material for lithium-ion batteries, but does not intercalate sodium reversibly, because sodium ions prefer prismatic or octahedral coordination sites [1].

Our previous work [2] focused on the synthesis and electrochemical characterization of glucose-derived hard carbon negative electrodes for sodium-ion batteries. The results inspired us to conduct a more detailed impedance study of the electrode processes.

Hard carbons have shown to absorb/insert and desorb/de-insert sodium reversibly [2,3]. However, the exact mechanism is difficult to understand without detailed studies, which apply different physical and electrochemical methods. Therefore, electrochemical impedance analysis with equivalent circuit fitting was conducted to analyse surface processes at various potentials. ICP-MS, SEM-EDS and TOF-SIMS confirmed alkali-metal absorption in the carbon structure.

Acknowledgements

This research was supported by the EU through the European Regional Development Fund TK141 "Advanced materials and high-technology devices for energy recuperation systems", Estonian target research project IUT20–13 and personal research grant PUT55. The authors thank Dr. Kalle Kirsimäe for ICP-MS analysis. Mr. Väli thanks Estonian Students Fund in USA and University of Tartu foundation for financial support.

References

1. J. Qian, X. Wu, Y. Cao, X. Ai, H. Yang, 2013, *Angew. Chem. Int. Ed.*, 52, 4633.
2. R. Väli, A. Jänes, T. Thomberg, E. Lust, 2016, *J. Electrochem. Soc.*, 163, A1619.
3. S. J. R. Prabakar, J. Jeong, M. Pyo, 2015, *Electrochim. Acta*, 161, 23.

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks