On electrochemical activity of $Zn_2(EDTA)(H_2O)$ in aqueous sodium-ion based electrolytes

Alena Starodubtseva[1*], Ivan Trussov[1,2], Alina Galeyeva[1], Andrey Kurbatov[1]
[1] *al-Farabi Kazakh National University, Almaty, 050040, Kazakhstan*
[2] *Skolkovo Institute of Science and Technology, Moscow, 121205, Russian Federation*
*E-mail: alena.a.rubanova@gmail.com

Metal-organic frameworks (MOFs) are a class of compounds consisting of metal ions or clusters coordinated to organic ligands to form one-, two-, or three-dimensional structures. Due to their high porosity and excellent adsorption and catalytic activity, as well as the ability to simultaneously implement different charge accumulation mechanisms (ions de/intercalation and adsorption/desorption), they can be considered as electrode materials for metal-ion batteries. However, a significant drawback is that most MOFs have low conductivity, and the obtaining of conducting MOFs is a costly, time-consuming and technically difficult process.

In this work, we present a method for synthesis of $Zn_2(EDTA)(H_2O)$ MOF composite and investigation of its electrochemical activity in aqueous sodium-ion based electrolytes. The structure of the synthesized substance was confirmed by X-ray diffraction analysis with subsequent Rietveld refinement method as well as by IR spectroscopy. Scanning electron microscopy has showed the porous structure of investigated material. Thermogravimetric analysis data indicates considerable stability of the material up to 500 °C and confirming stable bonding of coordination water with the zinc ion in the structure. Electrochemical characteristics of the studied MOF in 1-10M NaOH alkaline electrolytes as well as in $NaClO_4$ saturated aqueous electrolyte were evaluated by cyclic voltammetry and galvanostatic cycling. It was found that the studied compound does not give a satisfactory electrochemical response in aqueous electrolytes due to the strong degradation of the electrode material, which is associated with the high solubility of this MOF. The main driving force for dissolution is the replacement of carboxylate linkers by hydroxide ion\water, which competitively bind to zinc ions in the organic framework. Thus, this material is not suitable for use as an intercalation electrode material for sodium-ion batteries based on aqueous electrolytes. This conclusion is in a direct conflict with the work of Sangeetha S. Patel et al, published in the journal of Inorganic and Organometallic Polymers and Materials in 2020.

The obtained results have an importance by two reasons: 1) we have better understanding of behavior of EDTA based MOFs in aqueous electrolytes; 2) once again we understand that every piece of scientific knowledge must be cross-checked by various researchers.

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