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Promising cathode material for sodium-ion batteries: Prussian White modified with polyaniline

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Developing efficient cathode materials is very important task for the wide distribution of the electrochemical devices, in particular sodium-ion batteries (SIB). One of the perspective cathode materials for SIB is an iron (III) hexacyanoferrate (II) (Prussian White, PW) currently being produced by Altris AB, Sweden [1]. It is one of Prussian Blue Analogues AxM'[M(CN)6]1-y·zH2O (where A is an alkaline metal and M and M'are transition metal cations), the promising cathode materials for SIB due to their open framework structure and low-temperature synthesis. One of the main problems of PW-based cathodes in SIB is the degradation processes on the surface of the active material caused by humidity [2]. There is a hypothesis that the organic coating on the active material would lead to an improving of the rate capability and capacity retention. Our aim was to evaluate the effect of polyaniline (PANI) coating on the electrochemical properties of PW. In the literature, there are controversial information about this kind of modification. For example, authors of [3] have demonstrated the positive effect of PANI on the characteristics of PBAs in processes of lithium storage and overall water splitting.
In our work, the commercial PW (Fennac) was coated with PANI via chemical oxidative polymerization according to the methodology from [3]. It is important to note that the synthesis of polyaniline occurred in the presence of PW. Thus, the material was not a simple mixture of PW and PANI. Scanning electron microscopy showed that PANI was uniformly coated on the surface of PW nanocubes. Using thermogravimetric analysis and X-ray diffraction, it was revealed, that PANI promotes the formation of the cubic phase and shifts the temperature of transition from cubic to rhombohedral phase to higher temperature. The electrochemical cell assembled with PW@PANI as an active cathode material demonstrates the less capacity fall during long performance compared with the cell with the pure PW.

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[1] W. Brant et al. Method of producing a sodium iron(II)-hexacyanoferrate(II) material // United States Patent application publication. No: 2019/0270649 A1, Sep.5 2019.
[2] D. O. Ojwang et al. Moisture-driven degradation pathways in prussian white cathode material for sodium-ion batteries // ACS Applied Materials & Interfaces (2021) V. 13, No: 8, PP. 10054–10063
[3] L. Zhang et al. Multifunctional Prussian blue analogous@polyaniline core–shell nanocubes for lithium storage and overall water splitting // RSC Advances (2017) V. 7, PP. 50812–50821

Primary authors: IVANSHINA, Olga (Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research); KORNEEVA, Ekaterina (G.N. Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia / National University of Science and Technology NUST-MISiS, Moscow, Russia); Mr SUMNIKOV, Sergey; VASIN, Roman (JINR); Dr SAMOYLOVA, Nataliya (Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research)

Presenter: IVANSHINA, Olga (Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research)

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