SYNTHESIS OF $Na_3MnPO_4CO_3$ AND $Na_4Mn_3(PO_4)_2(P_2O_7)$ AS CATHODE MATERIALS FOR AQUEOUS NA-ION BATTERIES

Gintarė Plečkaitytė[1], Jurgis Pilipavičius[1], Saulius Daugėla[2], Tomas Šalkus[2], Jurga Juodkazytė[1], Linas Vilčiauskas[1]

[1]*Center for Physical Sciences and Technology, Vilnius, Lithuania*
[2]*Institute of Applied Electrodynamics and Telecommunications, Vilnius University, Vilnius, Lithuania*
gintare.pleckaityte@ftmc.lt

In order to meet the Paris climate agreement goals of future energy requirements [1], as well as the climate neutrality by 2050 [2], the development of renewable energy sources has become more and more urgent. Although the electricity generated by wind turbines, solar panels or hydropower is clean and safe, the supply is of intermittent nature and requires large-scale storage devices in order to obtain a balance. Electrochemical energy storage has many desirable features such as pollution-free operation, high round-trip efficiency, wide range of power and energy, long cycle life and low maintenance, as well as easy integration into the grid [3]. Various novel materials have been investigated and reported as cathodes and anodes for aqueous sodium-ion batteries, however there are still several problems such poor cycle stability, low energy density or low voltage which should be acknowledged [4]. After all, Mn-based (mixed)phosphate cathodes have a lot of advantages such as widespread availability of raw materials, low cost, high safety and non-toxicity. Moreover, Mn-based framework materials distinguish themselves as good candidates for fast sodium intercalation, small lattice volume changes and high insertion potentials [5].

In this work, we synthesized different Mn-based (mixed) phosphate framework materials such as $Na_4Mn_3(PO_4)_2(P_2O_7)$ and $Na_3MnPO_4CO_3$ via solid-state or hydrothermal synthesis methods. The structure and morphology of prepared materials were characterized by X-ray diffraction (Fig. 1.), scanning electron microscopy and thermogravimetric analysis. Moreover, ionic conductivity was measured of both samples. The electrochemical properties of prepared electrodes were investigated by cyclic voltammetry at different pH values.

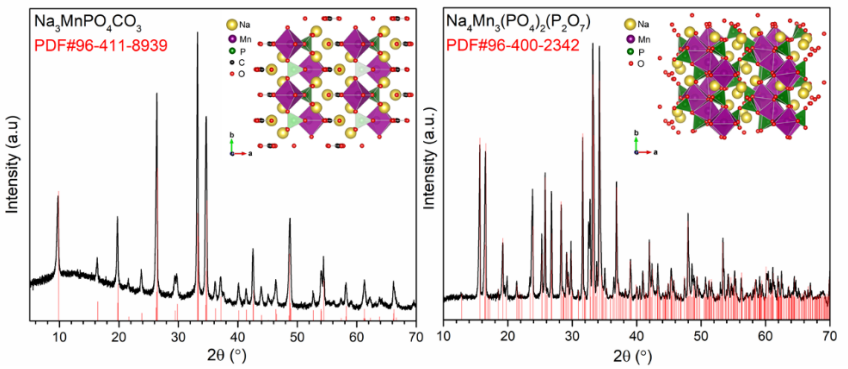

Fig. 1. X-ray diffraction patterns of $Na_4Mn_3(PO_4)_2(P_2O_7)$ and $Na_3MnPO_4CO_3$

Acknowledgements: This project has received funding from the European Regional Development Fund (Project No. 01.2.2-LMT-K-718-02-0005) under grant agreement with the Research Council of Lithuania (LMTLT).

References

1. The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
2. Implementing the SET Plan 2020 report. https://setis.ec.europa.eu/implementing-set-plan-2020-report-2020-11-23_en
3. D. Kundu, Angew Chem Int Ed Engl, 2015, 54, 3431-3448.
4. Y. Liu, Adv. Funct. Mater 2021, 2010445.
5. J. Kang, ACS Sustain. Chem. Eng. 2020, 8, 163-171.