$Na_{1\pm Y}Ti_{2-X}M_X(PO_4)_3$ (M = Al(III), Hf(IV), Mg(II), Zr(IV)) ISOVALENT AND ALIOVALENT SUBSTITUTION INFLUENCE ON AQUEOUS ELECTROCHEMICAL PROPERTIES AND ELECTRODE STABILITY

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It is predicted that the electricity demand will increase from 30 to 50 percent by 2050, as a consequence of the ongoing transition from fossil fuels to renewable energy. Such a transition requires coordinated and comprehensive adaptations across a range of areas that affect society as a whole and should come together with state-of-the-art technologies. Efficient energy storage is considered to be the key for the successful and entire transition to renewable energy sources. Electrochemical energy storage technologies are and will be playing an important role for achieving this desirable goal – especially for mobile devices and the transportation sector, also stationary storage. In general, all applications require high energy and power density, low cost, safety, and preferably high sustainability. These characteristics vary significantly depending on the specific needs. Aqueous Na-ion based batteries are recognized as one of the promising candidates to replace Li-ion technologies, especially for stationary energy storage applications. NASICON-structured $NaTi_2(PO_4)_3$ (NTP) phosphate framework has already attracted a lot of attention and remains the most studied negative electrode material for aqueous Na-ion batteries. The major challenges to overcome are the NTP degradation in aqueous electrolytes during prolonged cycling and self-discharge. As it was presented in our previous research [1], the electrochemical properties of carbonaceous NTP composite electrodes are strongly dependent on the synthesis route. However, elemental composition is prerequisite for material conductivity and electrochemical properties [2].

Here, we present the results of electrochemical properties and cycling stability in aqueous electrolytes where $Na_{1\pm y}Ti_{2-x}M_x(PO_4)_3$ is substituted by M = Al(III), Hf(IV), Mg(II) and Zr(IV) in isovalent and aliovalent ratios. XRD, SEM, EDX, Cyclic voltammetry and Galvanostatic charge/discharge cycling experiment results will be presented at the conference.

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References

1. S. Tutliene et al. J Electrochem Soc. 168, 060545;
2. P. Maldonado-Manso et al. Solid State Ionics 176 (17-18) p.1613-25 (2005)