

MULTINUCLEAR NMR STUDY OF THE $\text{Na}_{2.5}\text{V}_{1.5}\text{Ti}_{0.5}(\text{PO}_4)_3$ AQUEOUS ELECTROCHEMICAL DEGRADATION

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Transition towards sustainable and renewable energy requires development of energy storage technologies such as Na-ion based batteries. Promising sodium ion batteries (SIB) are aqueous NASICON (Na Super Ionic CONductor) based batteries. NASICON materials feature a stable three-dimensional crystal structure, high ionic conductivity, thermal stability, and a wide range of redox potentials [1-3]. NASICON can be used as anodes, cathodes, solid electrolytes, or electrode coating materials in battery development. To efficiently and successfully use these technologies, it is necessary to understand the chemical processes that limit the effective usage time of the batteries. Solid-state Nuclear Magnetic Resonance spectroscopy can provide invaluable insights on the processes taking part in the solid-liquid interphases on the electrode. In addition, high-resolution (liquids) NMR is a powerful method to detect dissolved species in the electrolyte, thus giving insights on the solubility of the active electrode materials.

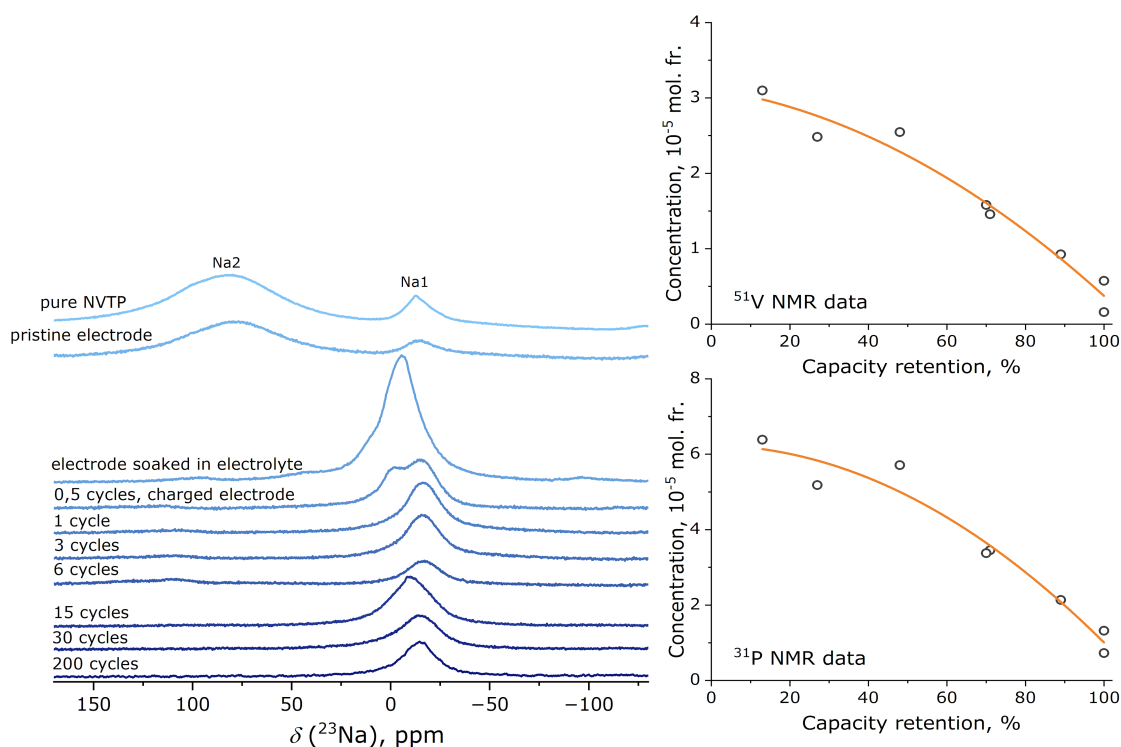


Fig. 1. Left - evolution of ^{23}Na MAS NMR spectra during the GCD cycling. Right - calculated amount of vanadium and phosphate ions dissolved in the electrolyte solution upon GCD cycling.

In this study, we use multinuclear ^{31}P , ^{23}Na , ^{15}V , and ^{13}C *ex situ* solid state NMR of NVTP-based electrodes as well as ^{31}P and ^{15}V *ex situ* high resolution NMR of the electrolytes to analyze the degradation of the electrode material and the formation of the interphasial layers in aqueous electrolytes during electrochemical cycling. The obtained results provide some insights regarding the degradation products and processes in NVTP during its aqueous electrochemical operation.

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