Halide-free Water-in-Salt Electrolytes Enabling Symmetric Aqueous Sodium-Ion Batteries

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Abstract: The “water-in-salt” electrolyte (WiSE) containing sodium acetate (8 m) and potassium acetate (32 m) is extensively investigated via classical Molecular Dynamics (MD) simulations, unveiling clear interactions between cations, anion and water. The WiSE is then used as electrolyte in symmetric aqueous sodium-ion batteries, featuring NASICON-type Na\textsubscript{2}VTi(PO\textsubscript{4})\textsubscript{3}/C (NVTP/C) as active material at both the positive and the negative electrode. \textit{In situ} X-ray diffraction (XRD) measurements resolve the structural evolution of NVTP/C during the highly reversible sodium de/intercalation and Differential Electrochemical Mass Spectrometry (DEMS) confirms the remarkable stability of the highly concentrated electrolyte. Symmetric cells employing two NVTP/C electrodes and a green, acetate-based aqueous electrolyte show an average discharge voltage of 1.13 V with stable cycling performance and a coulombic efficiency above 99\% at 1C and 99.9\% at 10C over 500 cycles.

Keywords: Water-in-Salt electrolyte, WiSE, acetate, aqueous sodium-ion batteries, NASICON

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