

Chemical and Electrochemical Properties of Supersaturated Vanadium Sulfate Electrolytes for High Energy Storage Density Applications

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Extended Abstract

Supersaturated electrolytes, particularly those prepared without chemical stabilizers, have only recently attracted attention because their intrinsic thermodynamic instability has traditionally limited their use. Our recent investigations into supersaturated vanadium electrolytes, specifically Vanadium (IV) Sulfate (VOSO_4) and Vanadium (V) Sulfate ($[\text{VO}_2]_2\text{SO}_4$), which serve as metal salt solutions in all-vanadium flow batteries, show that these solutions can remain stable for hours to days. Further analysis has revealed the presence of multiple molecular species with distinct chemical and electrochemical behaviors, including at least two electrochemically active forms and one inactive form of V(IV). We find that the final composition of V(IV) electrolytes is strongly influenced by the preparation method, resulting in significant differences in their bulk chemical and electrochemical characteristics. Possible structures for V(V) species have also been proposed. In this presentation, we will outline our latest results, including measurements of electrochemical kinetics in these non-standard electrolytes and the observed ratios of active to inactive species produced by various preparation techniques aimed at maximizing active-species concentration. We will also discuss the implications of this work for high-energy-density solid/liquid storage technologies and demonstrate the operation of a supersaturated V–H₂ flow battery, highlighting the feasibility of using supersaturated electrolytes to increase flow-battery energy density.