Effects of Binders on Electrochemical Na^+ Storage Properties of Tin Oxide Nanocomposite: The Effective Way to Reach High Performance

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Selection of a suitable electrode binder is essential for the enhanced electrochemical performance of Na-ion battery anodes, which undergo enormous volume expansion during cycling. Herein, sodiation/desodiation properties of tin oxide nanocomposite anode with various kinds of binders, such as polyvinylidene difluoride (PVdF), sodium carboxymethylcellulose (CMC), sodium polyacrylate (Na-PAA), and mixed CMC/Na-PAA are investigated. Our study shows that the CMC/Na-PAA binder exhibits improved electrochemical performance in terms of initial coulombic efficiency, capacity, rate capability, and cyclic stability, compared with those using other binders. In addition, the CMC/Na-PAA binder lowers charge transfer resistance and increases the sodium diffusion coefficient. These enhanced electrochemical properties mainly result from the strong binding ability of CMC/Na-PAA with tin oxide nanoparticles, the strong adhesive strength of binder with the current collector, and the high-quality polymer layer which reduces the electrolyte decomposition and suppresses the pulverization of the electrode upon cycling. The CMC/Na-PAA binder with the advantages of low cost, eco-friendliness, green aqueous fabrication process will play a vital role in the development of greener Na-ion batteries.