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Designing ZIF67 Derivatives Using Ammonia-Based Fluorine Complex as Structure-Directing Agent for Energy Storage Applications

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Abstract : The morphology of electroactive material is highly related to energy storage ability. Structure-directing agent (SDA) can design electroactive materials with favorable surface properties. Zeolitic imidazolate framework 67 (ZIF67) is one of the potential electroactive materials for energy storage devices. The SDA concept is less applied to designing ZIF67 derivatives in previous studies. An in-situ technique with ammonium fluoride (NH_4F) as SDA is proposed to produce a ZIF67 derivative with highly improved energy storage ability. Attracted by the effective in-situ technique, the NH_4F, ammonium bifluoride (NH_4HF_2), and ammonium tetrafluoroborate (NH_4BF_4) are first used as SDA to synthesize ZIF67 derivatives in one-step solution process as electroactive material of energy storage devices. The mechanisms of forming ZIF67 derivatives synthesized with different SDAs are discussed to explain the SDA effects on physical and electrochemical properties. The largest specific capacitance (CF) of 1527.0 Fg^{-1} and the capacity of 296.9 $mAhg^{-1}$ are obtained for the ZIF67 derivative prepared using NH_4BF_4 as SDA. The energy storage device composed of the optimal ZIF67 derivative and carbon electrodes presents a maximum energy density of 15.1 $Whkg^{-1}$ at the power density of 857 Wkg^{-1}. The CF retention of 90% and Coulombic efficiency larger than 98% are also obtained after 5000 cycles.

Keywords : ammonium bifluoride, ammonium tetrafluoroborate, energy storage device, one-step solution process, structure-directing agent, zeolitic imidazolate framework 67
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