Heat Treatment Effect on Microstrain and Electrochemical Performance of Nano-sized FeS₂ Cathode for Thermal Batteries

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Iron pyrite (FeS₂) is the most widely used material for cathodes in thermal batteries, attributed to its high specific energy density and natural abundance as well as low cost. In this study, nano-sized FeS₂ powders were synthesized by high-energy milling to improve electrochemical performance Li(Si)/FeS₂ thermal battery, and their particle sizes, microstrain, and thermal stabilities were investigated by particle size analysis (PSA), X-ray diffraction (XRD), and thermogravimetric analysis (TGA). Electrochemical performance was evaluated by single-cell discharge tests. The average particle size decreased from 107 μm to 261 nm after 10 h of dry milling, resulting in microstrain on FeS₂. This microstrain led to the thermal instability of the FeS₂ powder, causing an increase of the open-circuit voltage of Li(Si)/FeS₂ single cells. The voltage was stabilized from 2.45 V to 1.93 V, and thermal instability was mitigated by the heat treatment of the FeS₂ powder up to 400°C. The electrochemical performance of the single cells fabricated with nano-sized FeS₂ thermally annealed at 400°C improved by 57% as compared with that of untreated ones at a cut-off voltage of 1.4 V.

Keywords: Thermal battery, Iron pyrite, Microstrain, Heat treatment, Electrochemical performance

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