Sb Nanocrystals Embedded in SiOC Ceramic Materials as a High-Capacity and Long-life Anode for Sodium-ion Batteries

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Recently, sodium-ion batteries (SIBs) have attracted significant attention due to low cost an d greater abundance of sodium compared with lithium. Among all proposed anode materials for SIBs, antimony (Sb) recently has gained intensive attention as a potential anode materials for SIBs owing to its high theoritical Na-storage capacity of 660 mA h g^{-1} by forming Na_3Sb alloy. Despite of these advantage of Sb, such an alloying reaction is inevitably accompanied by huge volume expansion and sluggish kinetics during repeatd Na^+ insertion and extraction, which leads to poor cyclability. To solve these obstacles, many efforts have been devoted to fabricating nanosized Sb/Carbon composite structures, which can effectively accommodate volume expansion of Sb. However, fabrication nanosized Sb crystals uniformly embedded in a C matrix by a one-setp synthesis method still remains a challenge.

Herein, we synthesized the Sb nanocrystals embedded in SiOC composite (Sb/SiOC) via a facile and direct one-pot pyrolysis method. We fabricated Sb/SiOC composite by using advantage of the superior self-dispersion properties of antimony acetate powders in silicone oil. The obtained Sb/SiOC composite shows homogeneous distribution of Sb nanocrystals in the armorphous SiOC matrix which not only provides buffuring matrix for effective release of mechanical strain during repeated cycle but also inhibits the agglomeration of Sb crystals. Because of these properties of SiOC matrix, Sb/SiOC composite electrode exhibit exellent sodium storage capacity and highly stable cycling performance.

Owing to the facile synthesis and superior electrochemical performance of the Sb/SiOC, it is a promising anode candidate for high-performance and stable SIBs for use in energy storage systems.