HIGH REVERSIBLE LITHIUM STORAGE PROPERTIES IN MNS ELECTRODE VIA AN INTERCALATION-CUM-CONVERSION REACTION

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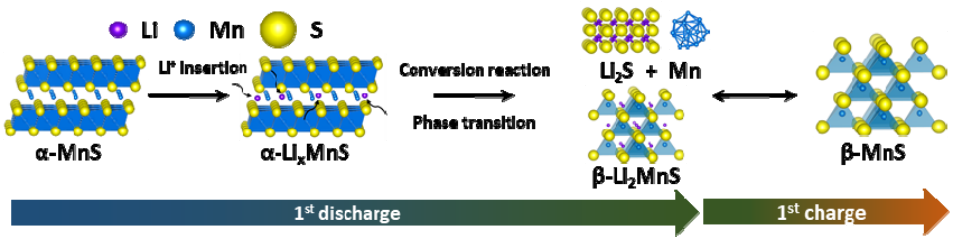
Transition-metal sulfides are of significant interest as rechargeable battery anodes due to their low cost, eco-friendliness, and high theoretical capacities.[1-2] However, the structural change due to the volume change during the electrochemical reaction and the capacity decrease due to the dissolution of polysulfide remain as problems.[3,4] Herein, a simple one-pot polyol refluxing method is used for fabricating a manganese sulfide (MnS) electrode composited with nitrogen and sulfur co-doped carbon (MnS@NS-C) for high-power lithium-ion batteries. This composite electrode is a carbon-coated nanostructure, exhibits unique spherical particle morphology with optimized average partical size ($300 < x < 500$nm) and porous features. Owing to its nanostructure, porous nature, and an electrically conducting carbon coating network co-doped with heteroatoms, the composite electrode overcomes the strong structural variations and polysulfide dissolution to afford high practical storage capacities, long-term cycle stability, and outstanding rate capability. The MnS@NS-C electrode demonstrated high reversible lithium storage capacities of 999 mAh g^{-1} at 0.1 A g^{-1}, the highest reversible capacity of 761 mAh g^{-1} at 2 A g^{-1} for over 300 cycles, and average rate capacities of 453 mAh g^{-1} at 10 A g^{-1}. In-situ X-ray diffraction investigations indicated a uniquely combined intercalation-cum-conversion reaction mechanism leading to β-$Li_{2(1-x)}MnS$, Li_2S, and Mn discharge products. The results of this study can provide deep insights into understanding reaction mechanism and motivate further study of transition-metal sulfides for prospective high-energy battery applications.



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