Rational design graphitic carbon coated mesoporous TiO2 hollow spheres anode for high performance sodium ion batteries

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Sodium-ion batteries (SIBs) have received remarkable attention, and been regarded as a potential alternative for LIBs because of their cost effectiveness and the geographical distribution of sodium.[1, 2] Sodium ranks the 4th most abundant metal element on earth, and has a comparable redox potential with lithium. Among the various anode materials for SIBs, TiO_2 shows more superior electrochemical characteristics because its low sodium ion interaction voltage and volume zero-strain features during sodiation/desodiation process. However, the low ionic and electrical conductivity intrinsic seriously deteriorate its sodium insertion/extraction reactions, resulting in poor rate properties and long term cycling performance as anode material for sodium ion batteries.[3, 4] In our research, we developed a rational design graphitic carbon coated mesoporous TiO_2 hollow spheres nanostructure (donated as HT@GC) to improve the sodium storage performance of TiO_2. In this unique structure, the nanosized TO_2 particles (around 10 nm) are uniformed coated by ultrathin graphitic carbon layers with a thickness less than 2 nm, which can significantly improve the electronic conductivity of TiO_2 particles. Besides, this well-defined HT@GC hollow spheres with a high specific surface area 226. 5 m^2 g^{-1}, a large pore size 3.6 nm, which can effective enhance the sodium ions diffusion dynamics. When tested as an anode material for SIBs, the HT@GC can achieve a high revisable capacity around 260 mAh g^{-1} after 150 cycles at a cycling current density of 67 mA g^{-1}, and present a superior high rate performance and exhibit a capacity of 170 mAh g^{-1} at 5 C rate (1.675 A g^{-1}), even at 10 C rate (3.35 A g^{-1}) it can still obtain an reversible capacity retained around 150 mAh g^{-1} over 600 cycles.

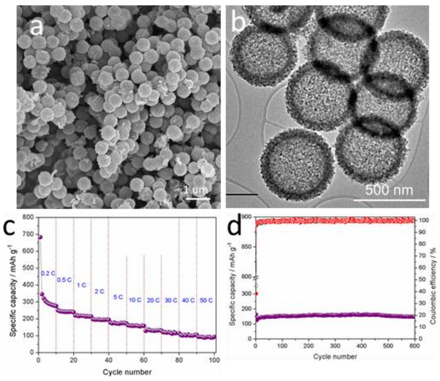

Figure 1 SEM (a) and TEM (b) images of HT@GC. (c) Rate capability of HT@GC. (d) Cycling performance of HT@GC at 10 C rate.

References:

1. D. Kundu, E. Talaie, V. Duffort and L. F. Nazar, *Angewandte Chemie International Edition*, 2015, **54**, 3431-3448.
2. W. Luo, F. Shen, C. Bommier, H. Zhu, X. Ji and L. Hu, *Accounts of chemical research*, 2016.
3. N. Yabuuchi, K. Kubota, M. Dahbi and S. Komaba, *Chem. Rev.*, 2014, **114**, 11636-11682.
4. J. Ni, S. Fu, C. Wu, J. Maier, Y. Yu and L. Li, *Advanced Materials*, 2016.