Sol-gel routes to antimony electrodes for lithium and sodium batteries

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Antimony is of interest as a research material for use in battery anodes due to its attractive properties, such as its relatively high gravimetric capacity and the ability to insert both lithium and sodium into its structure. Relatively few synthetic routes to this material exist, with most studies characterising nanocomposites[1,2], bulk microcrystalline powders[3] or vacuum evaporated thin films[4]. While recent work has developed a colloidal synthesis to pure antimony nanoparticles[5], there is still a demand for a robust and easy route to produce antimony particles for use in battery anodes. Herein we present a one pot sol-gel synthetic route to making high-purity antimony particles. The ease of synthesis combined with the flexible nature of sol-gel techniques should allow for tailoring of the antimony particles to suit a range of requirements, such as particle size. The rate capability of one sol-gel material is presented in Figure 1, with the SEM data in the insert showing the antimony particle size in the region of 5-50 microns. The cycling data is consistent with expectations for antimony microparticles within this size distribution, with an initial capacity of 674 $mAhg^{-1}$ at C/10 (66 $mAg^{-1}Sb$) and capacities of 528, 455, 405, 345 and 272 $mAhg^{-1}$ at C/2, C, 2C, 4C and 8C respectively. We will present the synthesis and physical characterisation of a selection of antimony particles, along with a study into their electrochemical properties for both sodium and lithium insertion.

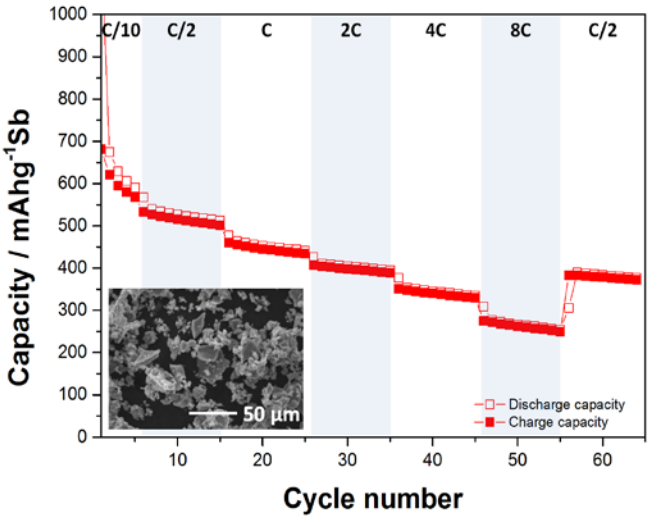

Figure 1. Cycling performance for antimony electrodes in lithium half cells (1C is taken as 660 mAg^{-1} Sb), inset SEM image of material. Antimony electrodes had the composition Sb(64%)/CB(21%)/CMC(15%), with a 1 M $LiPF_6$ in 1:1 w/w ethylene carbonate : dimethyl carbonate electrolyte.

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