Antimony Oxychloride/Graphene Aerogel Composite as Anode Material for Sodium and Lithium Ion Batteries

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Due to limited lithium resources on earth's crust, several other battery chemistries have been explored and introduced as a potential alternative to lithium ion battery (LIB).[1] Sodium, being abundant element in earth's crust with similar electrochemical properties to that of lithium, has turned out to be a wise choice among other alternatives. The real challenge in implementation of SIBs lies in developing efficient electrode materials with higher energy and power density with long cycle life for various applications in portable electronics, transport sector, etc.[2]Antimony-based materials (Sb,Sb_2O_3) that possess high theoretical capacities (660 mAh/g for Sb)undergo conversion and alloying reactions with sodium that involves multiple electron transfer and have attracted great attention in recent years. [3]
Here we demonstrate that pure-phase antimony oxychloride ($Sb_4O_5Cl_2$) microstructures, prepared *via* hydrothermal technique, exhibit promising electrochemical performances as potential electrode for both sodium and lithium-ion batteries. Lithium ion intercalation into MOCl (M=Fe,V,Cr,Ti) was first reported by Whittingham,[4] and recently, other metal oxychlorides such as vanadium oxychloride[5] and bismuth oxychloride[6] have been explored as electrode material for sodium and lithium ion batteries. $Sb_4O_5Cl_2$ exhibits excellent Na-ion storage performance by delivering a high initial reversible capacity of 830 mAh g-1. Further, we prepared $Sb_4O_5Cl_2$-graphene aerogel composite electrode ($Sb_4O_5Cl_2$-GA) *via* low temperature self assembly process, which showed much improved rate capability by retaining a stable capacity of over 200 mAh g-1 at 2 A g-1 (~3 C; 1 C corresponding to 450 mA g-1). $Sb_4O_5Cl_2$ microstructures, which are uniformly anchored on the graphene aerogel matrix result in interconnected networks which facilitate better charge transfer and effective buffering to alleviate the structural variation of $Sb_4O_5Cl_2$ during cycling. Further, we demonstrate that $Sb_4O_5Cl_2$-GA delivers excellent performance as anode material for lithium ion batteries, with a reversible capacity of 600 mAh g-1 obtained over 50 cycles, at a current rate of 50 mA g-1

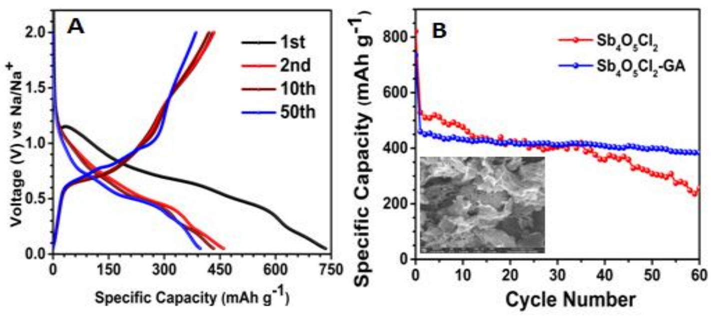

Figure 1. (A) Galvanostatic charge/discharge curves for $Sb_4O_5Cl_2$-GA electrode cycled at a rate of 30 mAg^{-1}vs Na. (B) Cycling plot for $Sb_4O_5Cl_2$-GA electrode *vs.* Na for 60 cycles at a current density of 30 mAg^{-1}.SEM image of the composite material is shown as inset.

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