COMPARISON OF CARBON AND METAL OXIDE ANODE MATERIALS FOR RECHARGEABLE LI-ION CELLS

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Carbon is widely used as an anode material in Li-ion rechargeable batteries. Recent developments suggest that certain metals oxides can also be used as anode materials in Li-ion cells. At JPL, we are currently investigating the use of tin oxides (SnO and SnO_2) as anodes. Preliminary results revealed that the initial amount of Li that can react with 1 mole of SnO and SnO_2 is 6.25 and 8.2 moles, respectively. This leads to the following possible reactions: 6.4 Li + SnO=Li_2O + $Li_{4.4}Sn$ and 8.4 Li + SnO_2 =2Li_2O + $Li_{4.4}Sn$. As a result, it seems that Li insertion into tin oxides forms Li-Sn alloys surrounded by Li_2O. The irreversible Li capacities are 2.2 moles of Li per mole of SnO and 5.3 moles per mole of Sn02. Consequently, SnO (4 moles of Li per mole of SnO) has a higher reversible specific capacity than SnO_2 (3 moles of Li per mole of SnO_2). Preliminary data reveals that SnO has a reversible capacity exceeding 600 mAh/g at potentials between O and 0.6 volts versus Li. This is twice the capacity obtained with carbon anodes (300 mAh/g). Some potential reasons for the large irreversible Li loss in SnO and SnO_2 are: 1) the formation of Li_2O and 2) the loss of some of the anode material as a result of the volume change when Li reacts with the Sn. The irreversible Li capacity of tin oxide anode materials was found to be insensitive to electrolyte composition but is highly dependent on electrolyte type. In the case of Li-ion cells containing carbon anode materials, the irreversible capacity during the first cycle is due to electrolyte decomposition, which results in the formation of a film on the carbon surface. This irreversible capacity is highly dependent on the electrolyte type and composition, In this paper, the Li reaction mechanism, effect of electrolyte type and composition, effect of particle size, effect of binder amount on the lithium capacity, and cycle life performance of tin oxide and carbon anode materials will be compared and discussed in depth.