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Investigation of Different Electrolyte Salts Effect on ZnO/MWCNT Anode Capacity in LIBs

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Abstract : Rechargeable lithium ion batteries (LIBs) have been considered as one of the most attractive energy storage choices for laptop computers, electric vehicles and cellular phones owing to their high energy and power density. Compared with conventional carbonaceous materials, transition metal oxides (TMOs) have attracted great interests and stand out among versatile novel anode materials due to their high theoretical specific capacity, wide availability and good safety performance. ZnO, as an anode material for LIBs, has a high theoretical capacity of 978 mAh g-1, much higher than that of the conventional graphite anode (~370 mAhg-1). However, several major problems such as poor cycleability, resulting from the severe volume expansion and contraction during the alloying-dealloying cycles with Li+ ions and the associated charge transfer process, the pulverization and the agglomeration of individual particles, which drastically reduces the total entrance/exit sites available for Li+ ions still hinder the practical use of ZnO powders as an anode material for LIBs. Therefore, a great deal of effort has been devoted to overcome these problems, and many methods have been developed. In most of these methods, it is claimed that carbon nanotubes (CNTs) will radically improve the performance of batteries, because their unique structure may especially enhance the kinetic properties of the electrodes and result in an extremely high specific charge compared with the theoretical limits of graphitic carbon. Due to outstanding properties of CNTs, MWCNT buckypaper substrate is considered a buffer material to prevent mechanical disintegration of anode material during the battery applications. As the bridge connecting the positive and negative electrodes, the electrolyte plays a critical role affecting the overall electrochemical performance of the cell including rate, capacity, durability and safety. Commercial electrolytes for Li-ion batteries normally consist of certain lithium salts and mixed organic linear and cyclic carbonate solvents. Most commonly, LiPF6 is attributed to its remarkable features including high solubility, good ionic conductivity, high dissociation constant and satisfactory electrochemical stability for commercial fabrication. Besides LiPF6, LiBF4 is well known as a conducting salt for LIBs. LiBF4 shows a better temperature stability in organic carbonate based solutions and less moisture sensitivity compared to LiPF6. In this work, free standing zinc oxide (ZnO) and multiwalled carbon nanotube (MWCNT) nanocomposite materials were prepared by a sol gel technique giving a high capacity anode material for lithium ion batteries. Electrolyte solutions (including 1 m Li+ ion) were prepared with different Li salts in glove box. For this purpose, LiPF6 and LiBF4 salts and also mixed of these salts were solved in EC:DMC solvents (1:1, w/w). CR2016 cells were assembled by using these prepared electrolyte solutions, the ZnO/MWCNT buckypaper nanocomposites as working electrodes, metallic lithium as cathode and polypropylene (PP) as separator. For investigating the effect of different Li salts on the electrochemical performance of ZnO/MWCNT nanocomposite anode material electrochemical tests were performed at room temperature.

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