Metal Oxides and Lithium Alloys as Anode Materials for Lithium-Ion Batteries

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Abstract

Metal oxides such as TiO(sub2), Li(sub4)Ti(sub5)O(sub12), SnO(sub2), SnO, M(sub2)SnO(sub4) (M=ZnM=Zn, Co, Mn, Mg), TMO (TM=MnTM=Mn, Fe, Co, Ni, or Cu), TM(sub3)O(sub4) (TM=CoTM=Co, Fe, or Mn), and lithium alloys Li–Sn, Li–Si are among the next-generation anode materials for lithium–ion batteries with high prospect of replacing graphite. Most of these anode materials have higher specific capacities between the range of 600-1000 mA h g(sup-1) compared with 340 mA h g(sup-1) of graphite. These high-capacity anode materials normally face poor cycle performance due to severe volume change during the discharge/charge reactions which leads to crack and pulverization. To overcome these limitations, two commonly adopted strategies are nano-engineering and coating with carbon. In this chapter, we have discussed the metal oxides and lithium alloy anodes in three sections, with emphasis on their electrochemical reaction mechanisms with lithium. We have also presented a brief historical review based on the development of the metal oxides and lithium alloys as anode materials for lithium–ion battery, highlighted ongoing research strategies, and discussed the challenges that remain regarding the synthesis, characterization, and electrochemical performance of the materials.