Elements  
Macro  
Morphology  
Structure  
Subject  
  
It should be noticed that Ti3C2Tx presents a lower capacitance in Na2SO4 electrolyte than that in Li2SO4 electrolyte , which is ascribed to more difficult diffusion of the sodium ions than that of lithium ions .   
  
Due to the different energy-storage mechanisms of anode and cathode , the MnO2// Ti3C2Tx hybrid battery does not exhibit an ideal rectangular shape and a pair of redox peak is observed around and 1.6 V , corresponding to the insertion/extraction of sodium ions into/out of the MnO2 .   
  
After 2500 cycles , the capacity of the device become slightly higher , due to the side reaction in the device .   
  
However , the monoclinic structured NaxMnFe ( CN ) 6 suffers from poor cycling performance with a capacity retention of only 47 % after 100 cycles ( Figure 4 c ) .   
  
In contrast , the M-MnHCF-60 electrode shows inferior rate capacities .   
  
The multiple structural transformations is responsible for the large lattice distortions and mechanical stress during cycling , which is account for poor cycling performance of M-MnHCF electrodes .   
  
It is revealed that the monoclinic phase ( M-MnHCF-60 ) undergoes undesirable multiple two-phase reactions ( monoclinic - cubic - tetragonal ) during the repeated charge-discharge process , leading to poor cycling stability of 38 % capacity retention .   
  
The reason was earlier reported to be the presence of excess oxygen in the form of metal oxides present on the MWCNT surface , leading to the accelerated combustion of graphene layers .   
  
All the electrodes show a clear difference between the 1st and 2nd cycle charge capacities , due to some well known interfacial reactions between the active materials and the electrolyte .   
  
The large irreversible capacity decay for the bare TiO2 is due to poor intrinsic conductivity , the formation of the surface insulating layer , and possible volume changes .   
  
On the other h , MWCNTs help TiO2 strongly anchor to their surface , and reduce the chances of developing an insulating layer .   
  
The specific capacity of TiO2 significantly fades from 143.8 mA h g-1 at 0.1C to only 19.1 mA h g-1 at 20C , and can not rise to its average level when the testing current returns to 0.1C .   
  
Mn2+ may not be useful for battery cycling as it makes the SEI layer unstable , but we did not encounter such a capacity fading issue , and also , Mn2+-ions are vulnerable to further oxidization to higher oxidation states due to fast Li interchange kinetics .   
  
It is worth mentioning that with increased Mn-doping , the electrochemical performance increases up to 5 % of Mn , but then drops for 7 % Mn-doped samples .   
  
One of the contributors could be the larger surface area achieved for 7 % Mn-doped samples , which results in decreased cycle performance because of large SEI formation , which hinders the effective permeation of electrolyte , and hence increases the charge transfer resistance , resulting in unstable cyclic performance .   
  
In comparison with the Li-cell , a lower potential range was chosen for sodium cells to achieve better capacity .   
  
In the first galvanostatic charge/discharge cycle in Fig . 7a , a typically extended plateau at about 0.17 V , which seems endless and is limited by the imposed time , is due to the irreversible SEI formation on the surface of TiO2 , and is not observed for Li-cells with TiO2 electrodes .   
  
No other voltage plateau is apparent , except for a shoulder in the charging curve beyond 2.4 V , which is in accordance with the theoretical limits .   
  
The rapid decrease of capacity in the initial few cycles is due to SEI formation , along with the irreversible capture of Na+ on the surface , and within the TiO2 matrix .   
  
Achieving good rate capability is a substantial challenge for SIBs , due to the apparent volume changes upon insertion of large Na+-ions in the host matrix .   
  
The slow decline of charge capacity with increasing current rates for 5 % Mn-TiO2/MWCNT electrode confirms that Mn-doping along with MWCNT network imparts remarkable rate performance .   
  
In particular , when the current density is decreased to 0.1C , the nanocomposite electrode after high rates can still demonstrate capacity as high as 117.2 mA h g-1 , while bare TiO2 shows a very low capacity of 58.7 mA h g-1 , possibly due to irreversible structural changes .   
  
This weak performance of TiO2 at higher current rates shows the inferior rate capability of the bare TiO2 electrode .   
  
Due to the smaller ionic radii of Li+ , it can be accommodated in the interlayer spacing of ( 001 ) and ( 110 ) planes of TiO2 ; however , only ( 001 ) planes with a relatively large spacing of 0.56 nm can accommodate the bigger Na+-ions , leading to lower electrochemical capacities for sodium-cells .   
  
For bare TiO2 , this volume expansion results in rapid structural deterioration , while for nanocomposite electrode , the MWCNTs act as a buffer to circumvent these changes .