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Influence of Using Metallic Na on the Interfacial and Transport Properties of Na-Ion Batteries

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Abstract

$Na_2Ti_3O_7$ is a promising negative electrode for rechargeable Na-ion batteries; however, its good properties in terms of insertion voltage and specific capacity are hampered by the poor capacity retention reported in the past. The interfacial and ionic/electronic properties are key factors to understanding the electrochemical performance of $Na_2Ti_3O_7$. Therefore, its study is of utmost importance. In addition, although rather unexplored, the use of metallic Na in half-cell studies is another important issue due to the fact that side-reactions will be induced when metallic Na is in contact with the electrolyte. Hence, in this work the interfacial and transport properties of full Na-ion cells have been investigated and compared with half-cells upon electrochemical cycling by means of X-ray photoelectron spectroscopy (conventional XPS and Auger parameter analysis) and electrochemical impedance spectroscopy. The half-cell has been assembled with C-coated $Na_2Ti_3O_7$ against metallic Na whilst the full-cell uses C-coated $Na_2Ti_3O_7$ as negative electrode and $NaFePO_4$ as positive electrode, delivering 112 $Wh/kg_{anode+cathode}$ in the 2nd cycle. When comparing both types of cells, it has been found that the interfacial properties, the OCV (open circuit voltage) and the electrode–electrolyte interphase behavior are more stable in the full-cell than in the half-cell. The electronic transition from insulator to conductor previously observed in a half-cell for $Na_2Ti_3O_7$ has also been detected in the full-cell impedance analysis. View Full-Text

Keywords: $Na_2Ti_3O_7$; metallic sodium; $NaFePO_4$; full-cell; X-ray photoelectron spectroscopy; solid electrolyte interphase; electrochemical impedance spectroscopy; electronic transition

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