Contribution ID: **57** Type: **Poster**

Sn/Ti oxide from Ti3Al(1-x)SnxC2 MAX Phases (x=0.4, 0.7, 1) as Negative Electrode for Lithium Ion Batteries: three Sides of a Coin

Wednesday, November 29, 2023 5:50 PM (2h 10m)

Batteries are electrochemical devices that have characterized society and its development in recent decades. Moreover, to improve the use of renewable energy sources and electric vehicles, and with the continuous growth of the demand for portable electronics, the demand for batteries that can meet global needs has increased. Currently, the most widely used type of them is the lithium-ion battery (LIB), which is reliable and provides satisfying electrochemical performances[1]. However, the most used anode in this system is the graphite anode (theoretical capacity of 370 mAh g-1), which suffers from aging and becomes unsafe with high currents. So, it is important to investigate other types of materials as possible and promise anode that could give better properties. MAX phase (where M is a transition metal cation, A is a metallic or metalloid element and X is C, N or B) are a class of 3D materials, with layered hexagonal crystal structure (space group P63/mmc) consisting of several layers of MX, alternated with layers of pure A-elements along the c cell parameter[2]. One of the most common of this class of materials is the Ti3AlC2 MAX phase. However, it shows poor energy storage performances as active electrode (capacity of 60 mAh g-1).
One compound well-known as active material is titanium oxide (TiO2). This has been shown to be a well-established and particularly stable material for applications in ion batteries. However, it has a lower capacity than graphite[3].
One interesting material as electrode is tin oxide (SnO2): this is a very promising material due to its high specific capacity, but it suffers from poor stability due to the high volume change it undergoes during charge and discharge cycles[4].
A possible strategy to improve the long-term stability of this oxide is to use the stable titanium oxide with it: is reported that by adding it, making a solid solution of Sn/Ti oxide, the total system achieves less volume change during cycling and so gains a stability improvement.
Here, a promising strategy to obtain a new active electrode material based on the MAX-phase system, combined with titanium/tin oxide to improve its specific capacity, is proposed. First, MAX-phase Ti3Al(1-x)SnxC2 are obtained via spark plasma sintering, with x equal to 0.4, 0.7 and 1. After that, the material is oxidized by a thermal treatment in air to obtain a nanostructured layer based on tin oxide and titanium oxide. To better understand their structure and composition, these materials are investigated by morphological and structural analysis, like x-ray diffraction (XRD), scanning electron microscopy (SEM), and Raman spectroscopy. Then, their electrochemical properties are studied, versus lithium in coin cell setup and versus a working positive electrode in pouch cell setup, demonstrating their possible availment as promising negative electrode in LIB.

Primary author: VALLANA, Nicholas

Session Classification: Happy Hour and Poster Session