Titanate Anodes for Sodium Ion Batteries

Identification of a suitable anode material is essential for successful development of sodium ion batteries, because graphite, the most commonly used anode for lithium ion batteries, does not undergo sodium insertion reactions to any appreciable degree. Titanates are one class of materials that are of interest for these devices, based on considerations of earth abundance, low toxicity, reasonable cost, and the probability that redox reactions will take place at low voltages vs. Na^+/Na. In the Na-Ti(IV)-O system, several stepped layered and tunnel compounds that can act as hosts for sodium ions are easily synthesized and are redox-active. Tunnel compounds, although structurally robust, have low capacities for sodium due to site limitations, but may be useful in devices targeted to grid storage or other applications not requiring high energy density. Layered compounds exhibit either two-phase or solid solution behavior in electrochemical cells, depending on the exact details of the structure. Some of these are electroactive at extremely low potentials (~0.3V vs. Na^+/Na), a feature that may enable high-energy Na-ion cells to be developed. For this presentation, we will discuss the relationship between structure and the physical and electrochemical properties of selected titanate compounds of interest for use in sodium ion batteries.

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