Polycrystalline TiO2(B) Nanosheet Films Deposited via Langmuir-Blodgett Method

LAURA BIEDERMANN, PAUL KOTULA, THOMAS BEECHEM, Sandia National Laboratories, ANTHONY DYLLA, KEITH STEVENSON, U. of Texas at Austin, CALVIN CHAN, Sandia National Laboratories — As an energy storage material, TiO2 offers higher Li⁺ capacities and smaller volume changes with lithiation than graphite electrodes. In particular, the bronze phase, TiO2(B) has a higher lithiation capacity (1.0 Li⁺/Ti) and faster lithiation kinetics due to its larger lattice parameters than other TiO2 polymorphs. Direct observation of lithiation will require TiO2(B) monolayers, such as those prepared via Langmuir-Blodgett deposition of the nanosheets (NS). Optical microscopy of the TiO2(B)-NS Langmuir monolayer at the air/water interface shows that these nanosheets assemble into large (>1 mm) islands. These elastic TiO2(B)-NS monolayers are deposited on diverse substrates for further characterization. Electron diffraction in both transmission electron microscopy (TEM) and low-energy electron microscopy (LEEM) of these films confirm that their polycrystalline structure is predominately composed of TiO2(B) nanocrystals, ~10s nm across. Discrimination of monolayer and bilayer TiO2(B) is evident in LEEM. Thermal stability of these nanosheets is investigated via in-situ TEM and ex-situ Raman spectroscopy. This monolayer TiO2(B) deposition will allow future observations of lithiation and phase changes.

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