



Contribution ID: 53

Type: Poster

Novel TiO₂ Nanoparticles Decorated Graphene Electrodes for Lithium-Ion Batteries Investigated with Operando X-ray Diffraction

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

Commercially available lithium-ion batteries (LIBs) show limitations for future large-scale applications, due to still low energy density, safety, slow charge/discharge rate and limited cycle-life. Battery recycling is also still an open problem, mostly bound to the use of toxic heavy metals. TiO₂ is an abundant, low-cost and environmentally friendly electrode material, attractive for large scale energy-storage. However, TiO₂ electrodes suffer from low electrical conductivity. Graphene can embed TiO₂ nanoparticles, forming a conductive nanocomposite anode material for Li-ion batteries, with improved Li-ion and electron transport. Here, novel gram-scale graphene-based electrodes decorated with titanium dioxide (TiO₂) anatase were investigated as anodes for LIBs.

Graphene employed for this work was obtained in large (grams) scale, through a thermal exfoliation of graphite oxide (TEGO) under dynamic vacuum. We managed to decorate TEGO with TiO₂ anatase nanocrystals via a novel facile solvothermal synthesis employing titanium tetraisopropoxide as TiO₂ precursor. Different stoichiometries of TiO₂:TEGO have been synthesized, characterized with powder XRD, Raman and TEM; the electrochemical behavior was studied in half-cell configuration (CR2032 coin cells) via galvanostatic chronopotentiometry. The structural evolution of TiO₂ nanocrystals was followed by means of operando synchrotron powder x-ray diffraction.

We found that graphene plays an important role, both as a substrate, favouring the almost pure TiO₂ anatase nanocrystal growth, and as an efficient charge collector, thanks to its high electrical conductivity, contrasting the insulating nature of TiO₂ and thus improving specific capacity of the electrode. In particular, electrodes with 99:1 TiO₂:TEGO composition proved to be the most promising ones, showing a stable and reversible capacity of above 180 mAh/g at C/5 and high charge/discharge capability.

Primary authors: MORENGHI, Alberto (Università degli Studi di Parma); SCARAVONATI, Silvio (Nanocarbon Laboratory, Università degli Studi di Parma, INSTM, GISEL); Mr VEZZONI, Vincenzo (Università degli studi di Parma)

Session Classification: Happy Hour and Poster Session