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CHARACTERIZATION OF CATHODE MATERIALS USING X-RAY ABSORPTION SPECTROSCOPY AND X-RAY FLUORESCENCE AT ELETTRA-SINCROTRONE TRIESTE

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Abstract

Accelerating the transitions to low carbon economy calls for rigorous and relevant research in various disciplines including, among others, energy storage and conversion which are essential to face increasing sustainability challenges in tackling global warming and energy security. Indeed, the renewable energies request the use of efficient electric energy storage systems to maximize the profit and benefit of all the energy generated. In this context, much effort is being made to design safe, lightweight, small and environmentally friendly batteries, with a high-energy density and long run and lifetimes, sometimes in an all-in-one solution. I will present the activity of the XAFS and XRF beamlines at Elettra- Sincrotrone Trieste in the field of energy storage materials highlighting the role of analytical tools such as x-ray absorption and x-ray fluorescence for the characterization of the different parts of an electrochemical cell and in particular the cathode materials. The studies performed at the XAFS beamlines are in operando conditions, i.e. the cathode are investigated during the actual operation of the battery. In these studies x-ray absorption spectroscopy provides information on the electronic and local structure of the electrochemically active elements at different points of the charge/discharge cycle, clarifying the role of the metallic ions that constitute the cathode materials during the electrochemical reaction. At the XRF beamline instead we have used x-ray fluorescence microscopy to visualize spatial heterogeneities of the active material within the cathode to be possibly correlated with the capacity fading over time after multiple operating cycles. The examples shown concerns both Li-ion and post-Li-ion batteries such as Li-S and Na-ion batteries and highlight the role and complementarity of advanced analytical tools based of synchrotron radiation.

About

Dr Giuliana Aquilanti is head of beamlines XAFS and XRF at Italian synchrotron in Trieste (Elettra). She received her PhD in Physics at the University Joseph Fourier (Grenoble, France). The research carried out over the last 20 years concerns the development and application of x-ray techniques (mainly x-ray absorption spectroscopy) for the study of matter and was carried out at the European Synchrotron in Grenoble (ESRF) and at Elettra. Her research activity is devoted to two main themes: (a) structural characterization of advanced materials for energy storage, and (b) structural characterization of matter under extreme pressure and temperature conditions. She is coordinating the scientific activity of the XAFS and XRF beamlines staff, as well as supervising fellows within different programs of ICTP, IAEA and IUCr. She was involved in different research projects funded by EU, IAEA and CERIC-ERIC. She is member and of the XAFS commission of the IUCr and part of the peer review committee of synchrotron Soleil. She is co-author of more than 170 articles.

Primary author(s) : Dr. AQUILANTI, Giuliana (Head of XRF Beamlines. ELETTRA-Sincrotrone Trieste)

Presenter(s) : Dr. AQUILANTI, Giuliana (Head of XRF Beamlines. ELETTRA-Sincrotrone Trieste)

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