Contribution ID: **40** Type: **Oral Presentation**

Structural dynamics in Li ion batteries via synchrotron non-damaging depth profiling

Wednesday, November 29, 2023 3:30 PM (30 minutes)

Phase transitions in electrodes are considered to be the major reason for ageing in lithium/Sodium ion batterie. The electrolyte decomposition, on the other hand, leads to the formation of a protective and insulating layer called the solid electrolyte interphase (SEI) [1,2] that prevents further reduction of the active material interfaces, leading to an operative electrode while its ionic conductivity allows the Li+/Na+ battery operation. [3,4] Depth profiling of the active material and SEI layer starting from the very first monolayers of the structure to a few nanometers below can improve the understanding of the formation and evolution of the battery performance. Different approaches for depth profiling of the active materials and SEI structure, such as Ar+ sputtering, have proven to induce an artificial material gradient, endangering the consolidated picture of the prevalence of inorganic components occupying regions close to the active particles and of organics occupying the external zone. [5] X-ray absorption spectroscopy (XAS), specially in soft regime, is a powerful technique to investigate the evolution of the short-range structure with a tunable probing depth in the range 3–100 nm with minimal destructive effects, preventing the degradation of the components of the active material and SEI layer upon measurement.[6,7] It is also element-specific, targeting the evolution of a desired chemical species in complex systems. X-ray photoemission spectroscopy (XPS), on the other hand, is strongly surface-sensitive and can be used to investigate the SEI superficial layer within the first few atomic monolayers. The combination of the two techniques results in a depth profiling of the active material and SEI layer without invasive structure modification providing a complete image of their structural dynamics.

[1]Peled, E. The Electrochemical Behavior of Alkali and Alkaline Earth Metals in Nonaqueous Battery Systems–The Solid Electrolyte Interphase Model J. Electrochem. Soc. 1979, 126, 2047– 2051
[2]Peled, E.; Golodnitsky, D.; Ardel, G. Advanced Model for Solid Electrolyte Interphase Electrodes in Liquid and Polymer Electrolytes J. Electrochem. Soc. 1997, 144, L208– L210
[3]Verma, P.; Maire, P.; Novak, P. A Review of the Features and Analyses of the Solid Electrolyte Interphase in Li-Ion Batteries Electrochim. Acta 2010, 55, 6332– 6341
[4]Peled, E. Lithium Batteries; Gabano, J. P, Ed.; Academic Press, 1983.
[5]urbach, D.; Zaban, A.; Gofer, Y.; Ely, Y. E.; Weissman, I.; Chusid, O.; Abramson, O. Recent Studies of the Lithium-Liquid Electrolyte Interface Electrochemical, Morphological and Spectral Studies of a Few Important Systems J. Power Sources 1995, 54, 76– 84
[6]Rezvani S. J. , Nobili F, Gunnella R, Ali M, Tossici R, Passerini S, Di Cicco A (2017). SEI Dynamics in Metal Oxide Conversion Electrodes of Li-Ion Batteries. JOURNAL OF PHYSICAL CHEMISTRY. C, vol. 121, p. 26379-26388
[7]Rezvani S. J. , Gunnella R, Witkowska A, Mueller F, Pasqualini M, Nobili F, Passerini S, Di Cicco A (2017). Is the Solid Electrolyte Interphase an Extra Charge Reservoir in Li-Ion Batteries?. ACS APPLIED MATERIALS & INTERFACES, vol. 9, p. 4570-4576,

Primary author: Dr REZVANI, Javad (university of camerino)

Presenter: Dr REZVANI, Javad (university of camerino)