UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

PCAM Physics and Chemistry of Advanced Materials EUROPEAN DOCTORATE

Ph.D. Course in Materials Science and Nanotechnology

University of Milano-Bicocca, Department of Materials Science, via Cozzi 55, 20125 Milano

September 10, 2018 – 11.30 a.m.

Seminar room - Department of Materials Science U5

Candace K. Chan

School for Engineering of Matter, Transport and Energy, Arizona State University, USA

Nanostructured Garnets: Synthesis, Structure, and Electrochemical Properties as Solid Electrolytes for Solid-State Li Batteries

Lithium lanthanum zirconate ($Li_7La_3Zr_2O_{12}$, LLZO) is a promising ceramic solid electrolyte for all-solid-state lithium batteries with improved safety characteristics. However, the different phases of LLZO, namely tetragonal and cubic, differ in lithium ionic conductivity by several orders of magnitude, with extrinsic dopants often required to stabilize the high conductivity cubic phase. Here we show that cubic LLZO can be stabilized at room temperature in nanostructured particles without the use of extrinsic dopants. Different methods for preparing nanostructured LLZO, including electrospinning, templating onto cellulosic fibers, sol-gel, and molten salt based methods will be discussed. Using nanostructured LLZO over bulk LLZO can be beneficial in terms of ionic conductivity, cycle life, and mechanical strength. Detailed structural characterization are performed to understand the LLZO formation processes and phase transformations and correlate with impedance data in LLZO-based ceramic electrolytes. LLZO nanomaterials can also be used as ceramic fillers in solid polymer electrolytes. Very small loadings of LLZO are used to improve the ionic conductivity of the polymer by 3 orders of magnitude, with the maximum conductivity observed with 5 wt% of LLZO exceeding 10^{-4} S/cm at room temperature. Solid state nuclear magnetic resonance spectroscopy is used to study the preferred lithium diffusion pathways in these composite polymer electrolytes.

PhD students and all interested in the seminar are kindly invited to participate.

The PhD Coordinator

Prof. Marco Bernasconi