Ivan T. LUCAS[1]

Antonin Gajan[1, 3], Constance Lecourt[1], Timothée Lang[1], Patricia Abellan[2], Laure Fillaud[1], Julien Demeaux[3]

[1] Sorbonne Université, CNRS, Laboratoire LISE, 75000 Paris, France
[2] Nantes Université, CNRS, Institut des Matériaux de Nantes IMN, 44322 Nantes, France
[3] Saft, Corporate Research, 33074, Bordeaux, France

ivan.lucas@sorbonne-universite.fr

Interfacial Instability in Operating Lithium-Ion Batteries Unraveled by SHINERS

The fundamental understanding of the electrode/electrolyte interfacial processes in lithium-sodium ion batteries (LIBs) and of their dynamics upon cycling is of prime importance for the development of new generation electrode materials. Operando analyses using the utmost sensitive techniques are required to produce an accurate depiction of the underlying processes at the origin of the battery performance decay. If enhanced Raman Spectroscopy through the use of signal nano-amplifiers (SHINs) shows the required sensitivity [1,2,3,4], its implementation in operando conditions and particularly on functional materials in contact with organic electrolytes remains challenging. Through extensive optimization of SHINERS conditions for operando diagnosis of LIB materials, including the design of near-infrared active amplifiers and the control of the photon dose, the dynamics of interfacial composition upon cycling of various electrode materials in LIB coin-cells can be extracted. Interfacial instability unraveled on both negative (Solid Electrolyte Interphase: SEI) and positive (Cathode Electrolyte interface: CEI) electrodes can be tamed through fine tuning of the electrolyte composition.

References

[1] S. Hy, Felix; Y.-H. Chen, J. Liu, J. Rick, B.-J. Hwang "*In Situ Surface Enhanced Raman Spectroscopic Studies of Solid Electrolyte Interphase Formation in Lithium Ion Battery Electrodes*", J. Power Sources, 256 (2014) 324

[2] L. Cabo-Fernandez, D. Bresser, F. Braga, S. Passerini, L. J. Hardwick, "*In-Situ Electrochemical SHINERS Investigation of SEI Composition on Carbon-Coated $Zn_{0.9}Fe_{0.1}O$ Anode for Lithium-Ion Batteries*". Batter. Supercaps, 2 (2019) 168

[3] C.-Y. Li, Y. Yu, C. Wang, Y. Zhang, S.-Y. Zheng, J.-F. Li, F. Maglia, R. Jung, Z.-Q. Tian, Y. Shao-Horn, "*Surface Changes of $LiNi_xMn_yCo_{1-x-y}O_2$ in Li-Ion Batteries Using in Situ Surface-Enhanced Raman Spectroscopy*". J. Phys. Chem. C, 124 (2020) 4024

[4] A. Gajan, C. Lecourt, B.E. Torres Bautista, L. Fillaud, J. Demeaux, I.T. Lucas, "*Solid Electrolyte Interphase Instability in Operating Lithium-Ion Batteries Unraveled by Enhanced-Raman Spectroscopy*" ACS Energy Lett., 6 (2021) 1757

Figures

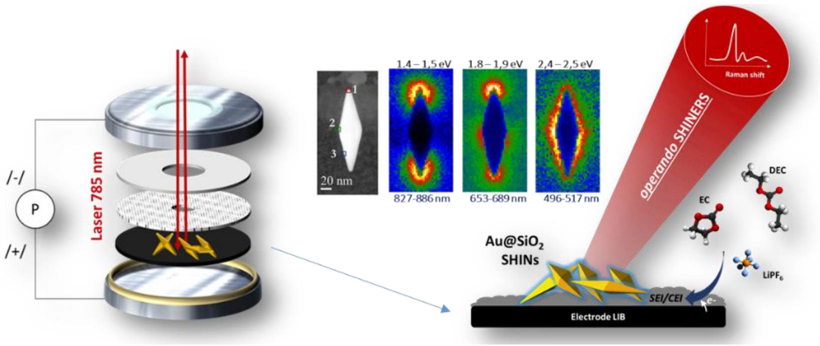

Figure 1: Operando SHINERS - Coin-cell Li-ion battery with SHIN-decorated electrode for operando diagnosis. SEI/CEI passive layer formation can be tracked operando using anisotropic SHINs ($Au@SiO_2$ core-shell bipyramid nanoparticles) combined with near-infrared Raman probe.