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Raman spectroscopy and TERS applied to energy storage and conversion materials

The quest for facile, non-destructive chemical analysis techniques that can provide microscopic insights into the phase evolution of materials has been the driving force for many successes in the research community within the last decades. Despite this progress, some of the most powerful techniques, such as current isotopic ion exchange methods, in situ TEM, and a collection of synchrotron radiation-based techniques, are quite complex, limiting easy access to crucial data for creating high-performance devices for energy harvesting and storage. Raman spectroscopy is a widely used optical technique able to provide quantitative chemical and structural information about the material under investigation in a fast, non-destructive manner.

In this work, we show two different applications of Raman spectroscopy to the evaluation of materials in the field of energy. In a first case of study, we present our recent advances in the utilization of Tip-Enhanced Raman Spectroscopy (TERS) for the study of the distribution of species in the surface of Li-ion battery cathodes. We show the high potential of TERS for studying phase evolution at grain boundaries thanks to the combination of the chemical sensitivity of Raman spectroscopy with high spatial resolution of scanning probe microscopy (SPM). In a second application, we show a novel implementation of Raman spectroscopy for the study of the oxygen diffusion in mixed-ionic-electronic (MIEC) electrodes for Solid Oxide Cells (SOCs). In this case, the sensitivity of the technique to the atomic mass of the involved species is exploited for studying the oxygen incorporation on thin films using O18 isotope as tracer.

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