A journey in electrochemistry: From single nanoparticle to in operando electrochemistry and future opportunities

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Chemistry Seminar on Operando electrochemistry

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Abstract: Electrochemistry is an attractive field that offers a wide range of applications. In the last decade, electrochemistry has found applications to study single entity systems, from developing ultrasensitive sensors for single molecule detection to studying electron transfer reactions at individual metal nanoparticles and extract valuable kinetic information. Besides this, several research groups have coupled electrochemistry with other fields such as spectroscopy, this combination becomes a powerful tool to probe electrochemical reactions and obtained chemical information *in situ*. In this seminar, first section will explain how electrochemistry is used to study electrocatalysis at single nanoparticles and nanoparticle ensembles with ultramicroelectrode dimensions. What are the advantages of these studies and potential applications to obtain kinetic information at the single nanoparticle level. Following by a section that will cover development of *in operando* electrochemistry to study electrode-electrolyte interfaces in Li-ion batteries. This section aims to demonstrate how combining other techniques such as gravimetry and infrared spectroscopy with electrochemistry helps to understand the origin of electrolyte degradation in Li-ion. Understanding this interface from Li-ion batteries is of high importance, as these devices are widely used for energy storage and found in multiple electronic devices such as cell phones, laptops, and electric vehicles. The third and last part of this talk will explore what are the future opportunities in electrochemistry and why electrochemical interfaces are important. In this section will bring new strategies to study these interfaces by implementing in operando electrochemistry to study nanoconfined spaces and surface reactivity of electrocatalytic materials. Concluding how electrochemistry is of huge importance to study chemical problems found in energy conversion, energy storage, and electrodeposition of metals.