Overview of in-situ and operando characterization at the micro/nano-scale with electron microscopy and synchrotron methods

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SEMINAIRE

Understanding industrial scale chemical and physical processes necessary for developing new materials requires detailed characterization in realistic conditions of growth and operations. Such characterization requires structural and chemical information at multiple length-scales providing realistic sampling of the structure and the changes occurring in materials during their synthesis or operation.
In-situ electron microscopy has evolved, over the last few decades, from the initial investigation of dislocations movement during mechanical deformation in high-voltage electron microscopes to solid-gas interactions in environmental transmission electron microscopes to understand the surface structure of catalysts in gaseous environments and the growth of nanostructures from molecular beams. Liquid-cell electron microscopy techniques were developed in more recent years to investigate solid-liquid interactions and electrochemical processes for understanding electrocatalysts' operations and the degradation of energy storage materials. These electron microscopy techniques have provided detailed nanometer to atomic scale information on the mechanisms of deformation in metals, on ledge and interface displacements during nanowires growth, on electrodeposition and dissolution processes, on movement of ferroelectric domains and the formation of dendrites during electrochemical cycling of lithium ion batteries, amongst many examples.
At the same time, synchrotron-based methods have provided, also over the last few decades, very precise spectroscopic, diffraction and imaging information on materials exposed to realistic operating conditions, including high-pressure experiments simulating geological processes occurring in the Earth core. While many of the synchrotron techniques enable experiments that probe samples from mm to micrometer scale, other methods, taking advantage of advanced X-ray optics components and ptychography reconstruction techniques, today enable to reach the few 100's nm to sub 10 nm probes.
Despite the impressive capabilities of electron microscopy and synchrotron methods on their own right, it is imperative to correlate information from multiple techniques. Average information does not provide the necessary details to fully understand the evolution of materials, while very focused information does not ensure the true representation of complex microstructures or phenomena, especially when the operating conditions are not exactly comparable.
In this presentation, after an overview of in-situ and operando characterization techniques in electron microscopy and synchrotron methods, examples of work will show the value of the combination of multiple characterization methods to provide a more comprehensive understanding of materials and their evolution as they are used in operating conditions.

Formalités d'entrée : accès libre dans l'amphi du pavillon d'Accueil.
Si la manifestation a lieu dans le Grand Amphi SOLEIL du Bâtiment Central merci de vous munir d'une piece d'identité (à échanger à l'accueil contre un badge d'accès).

Attention la capacité maximum dans l'amphitheatre est de 90 personnes

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