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INMA Impulso

Leveraging x-ray coherence to probe the complexity of realistic interfaces at the nanoscale

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The advent of the world's first coherent hard X-ray sources in France (ESRF) and the USA (APS) represents an unprecedented opportunity to conduct operando (i.e., in situ and time-dependent) studies on the structure and behavior of surfaces, interfaces, and single crystalline grains in reactive environments. In this talk, I will start by explaining the basis of coherent diffraction imaging (CDI) to extract information at the nanoscale about the structure, morphology, defects and strain fields of realistic systems such as 3D crystalline grains or amorphous films. Then, I will introduce two new approaches which push forward the capabilities of CDI to observe the microscopic dynamics underlying growth and dissolution at mineral-water interfaces with coherent x-rays. In the first study coherent X-ray reflectivity was used to reveal the morphology and the active sites for growth and dissolution of a an otavite ($CdCO_3$) thin film grown on a dolomite substrate. The second study shows a novel approach to extract structural information from a coherent diffraction pattern based on the re-interpretation of the Patterson Function as an auto-hologram and a mathematical graph. These two studies form the initial basis of a research program aiming to develop advanced coherent x-ray imaging methodologies to characterize the dynamic and chemical behavior of crystalline grains at the nanoscale and under realistic environments (e.g. mineral matrices, multilayered compounds, liquid solutions, etc.). .

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