FM 17: Highlighted Talk: Piled higher, probed deeper: X-ray insights into ferroelectric devices (Martina Müller)

Chair: Anna Grühnebohm (Ruhr-Universität Bochum), Jan Schultheiß (NTNU Trondheim)

Time: Thursday 9:30–10:00 Location: BEY/0138

Invited Talk FM 17.1 Thu 9:30 BEY/0138

Piled higher, probed deeper: X-ray insights into ferroelectric devices — •Martina Müller — Fachbereich Physik, Universität Konstanz

In ferroelectrics, the nothing is mighty: The key to shaping the ferroelectric functionalities of oxide/nitride materials and devices lies in the tunability of their oxygen/nitrogen sublattice, particularly their defect structure. While dopants and vacancies are a key aspect of emerging ferroelectricity in HfO_2 and AlScN, their detection is much more subtle than that of atomic properties. This is because the experimental observation of e.g. oxygen vacancies means the detection of something absent. This requires access to indirect signatures, which often are of very low intensity and located within a device structure - a combination of experimental conditions that are challenging to meet in practice.

This talk presents recent advances in the expertise required to detect defects and dopants related ferroelectric functionality in HfO_2 and AlScN using synchrotron radiation. Bulk-sensitive hard X-ray photoelectron spectroscopy (HAXPES) enables the non-destructive depth profiling of heterostructures, revealing spectroscopic fingerprints also in subtle core-level signatures. Performing HAXPES 'in operando' is a powerful tool for determining the band alignment and chemical state of interfaces under operating conditions of real-world ferroelectric devices.