Post-doc researcher in the field of TEM

At imec our slogan is 'Embracing a better life' and the way we do this is via nanoelectronics. Our chips are used for high-tech solutions that contribute to more efficient health care, safer transport, more sustainable energy, and more. A better world starts with the technology behind it and that technology is created in our cleanroom. In the electron microscopy group at imec we combine service and research. In the service we support the learning cycles by applying a variety of morphological, structural, and chemical methods. While in our research activities we are evaluating and/or developing new methods to characterize the increasing complex devices and materials used in our pilot line. As a postdoc researcher, you will push the boundaries of our research activities.

Imec is intensively investigating the emerging memory technologies for high speed, low energy consumption solutions compatible with the latest requirements in CMOS technology. Key for these technologies are ferroelectric materials. [1] Traditional ferroelectric materials suffer from lack of thickness scaling and compatibility with CMOS processing. However, recently, thin binary oxides and III-nitride compounds have emerged as an attractive alternative due to CMOS compatibility and precise thickness control through atomic layer deposition.[2][3][4] The ferroelectric response of these materials can be very complex and is affected by doping, extrinsic strain, electrode materials, and phase transformation. Also, the application of repeated electric fields may reduce the ferroelectric performance, leading to polarization reversal failure, i.e., ferroelectric degradation [5] due to domain pinning and microcracks formation. [6] To employ these materials in memory devices it is important to directly probe and characterize these effects. Scanning Transmission Electron Microscopy (STEM) is the most promising technique to fulfil the analytical requirements for these investigations due to the nanoscale range of these properties. [7]
The goal of this position is to advance both the acquisition and data processing of phase and orientation mapping of ferroelectric materials by advanced TEM characterization methods such as precession electron diffraction (PED), differential phase-contrast (DPC) analysis and in-situ TEM.

Your mission

During the postdoc the researcher will have the opportunity to work with Imec transmission electron microscopes on materials and structures that are being developed for future semiconductor device technologies.
The research will concentrate on:

- Visualization of the microstructural evolution and the nanoscale ferroelectric domain switching behavior under electric fields by in-situ and ex-situ TEM.
- Correlate these measurements with other physical analysis such as XRD.
- Quantify the charge distribution at domain walls during cyclic electric loading by field mapping STEM techniques (such as differential phase contrast, and 4D-STEM) corroborated by other physical analysis.
- Gain deeper insight into the sources of ferroelectric degradation by correlating electrical characteristics with physical characterization of individual transistors.
- Develop a model to explain the physical behavior of the studied materials.
- Report and publish results in leading scientific journals and conferences.

Your profile

A candidate with a unique profile in terms of TEM expertise, material knowledge and data analysis:

- PhD in the field of Material Science, Engineering, Physics or related disciplines.
- Proved experience in advanced Transmission electron microscopy and data analysis.
- Experience with the Nanomegas Astar phase mapping system.
- Skill in FIB specimen preparation will be appreciated but is not an essential prerequisite.
- Knowledge of the physics of ferroelectrics and/or microelectronics devices is a definite plus.
- Experience on in-situ TEM a plus.

Our offer

At Imec, we offer you the opportunity to join one of the world's premier research centers in nanotechnology at its headquarters in Leuven, Belgium. With your talent, passion, and expertise, you'll become part of a team that makes the impossible possible. Together, we shape the technology that will determine the society of tomorrow. We are proud of our open, multicultural, and informal working environment with ample possibilities to take initiative and show responsibility. We commit to supporting and guiding you in this process, not only with words but also with tangible actions. Through imec. Academy, 'our corporate university', we actively invest in your development to further your technical and

personal growth. We are aware that your valuable contribution makes imec a top player in its field. Your energy and commitment are therefore appreciated by means of a competitive salary with many fringe benefits.

References:

[1] T. Mitsui, "Ferroelectrics and antiferroelectrics," in Springer Handbook of Condensed Matter and Materials Data, edited by W. Martienssen and H. Warlimont (Springer, Heidelberg), 2005, 903– 938
[2] R. Batra et al. "Search for Ferroelectric Binary Oxides: Chemical and Structural Space Exploration Guided by Group Theory and Computations" Chem. Mater. 2020, 32, 9, 3823–3832
[3] A. Zubair, Tunneling and Ferroelectric based Transistors for Energy Efficient Electronics. Ph.D Thesis, MIT, 2019, 190-205
[4] X. Liu, "Aluminum scandium nitride-based metal–ferroelectric–metal diode memory devices with high on/off ratios"Appl. Phys. Lett.118, 2021, 202901
[5] Lupascu, D. C. Fatigue in Ferroelectric Ceramics and Related Issues (Springer Science & Business Media, 2013).
[6] Q. Huang et al. "Direct Observation Of Nanoscale Dynamics Of Ferroelectric Degradation "Nature Communications" 2021
[7] M. Popovici, "High performance La-doped HZO based ferroelectric capacitors by interfacial engineering" IEDM 2022, 6.4.1-6.4.4

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