Symposium I

Frontiers of imaging and spectroscopy in transmission electron microscopy

By highlighting the recent advances in scanning/transmission electron microscopy as a multidimensional tool on the atomic scale this symposium aims at fostering collaborative research between the electron microscopy and materials science communities. Current topics will be highlighted in keynote presentations given by leading invited experts.

Scope:

Characterization lies at the heart of materials science research. The discovery of new properties, the design and engineering of materials, the quantification of defects, and the understanding of material physics and chemistry each require robust methods to measure structure and properties over length scales from the macroscopic to the atomic. Transmission electron microscopy (TEM) is one of the most powerful characterization tools employed by material scientists, in large part due to its unmatched spatial resolution and flexibility. With the implementation of aberration corrector, the spatial resolution of electron microscope has been drastically improved. These developments were followed by faster, more sensitive direct electron (CMOS or hybrid) detectors, In-Situ and operando capability, monochromated electron sources for electron spectroscopy. As the result of these transformational discoveries, we are now able to study materials with unprecedented resolution, sensitivity and precision.

Indeed, recent advances in TEM have significantly enhanced spatial and energy resolutions, pushing them to levels better than 50 pm and 5 meV, respectively. The advent of aberration-corrected TEM has played a crucial role in achieving these remarkable resolutions. This technology has not only improved imaging quality but has also paved the way for a plethora of in-situ experiments, novel imaging techniques, and multi-dimensional data acquisitions at atomic scales. Moreover, the integration of faster or more sensitive detectors with cutting-edge data analytics and machine learning techniques has further revolutionized the field. These advances are particularly significant for studying beam-sensitive materials and liquids, allowing researchers to probe them with unprecedented precision and detail. By combining high-resolution imaging with advanced data analysis methods, scientists can extract valuable insights into the structural and dynamic properties of solid materials and liquids, even under challenging experimental conditions. Overall, these developments represent a paradigm shift in the capabilities of TEM, enabling researchers to explore new frontiers in nanoscience and materials research with unparalleled resolution and sensitivity.

In this symposium, we will discuss a broad array of cutting-edge topics of transmission electron microscopy, cryogenic techniques, in-situ/operando TEM, and multi-dimensional spectroscopy/ imaging. We also welcome contributions in computer-aided data acquisition, image analysis and big data processing, including based on artificial intelligence algorithms (machine and deep learning, neural networks, etc). The goal of this symposium is to bring together scientists from the microscopy community and materials science community to foster new collaborative research and accelerate the developments of novel functional materials and devices.

Hot topics to be covered by the symposium:

- Transmission Electron Microscopy
- New Detectors and TEM Instrumentation
- 4D-STEM
- Cryo-TEM
- Analytical (S)TEM
- In-Situ and operando TEM
- Vibrational Electron Energy-Loss Spectroscopy
- Imaging and spectroscopy: from soft matter to functional materials
- Sample preparation techniques
- Machine Learning and Data Analytics
- Theory and Modeling of Materials

- Ultrafast Electron Microscopy
- Quantitative TEM Analysis of Materials

Invited speakers

Prof. Zhen Chen, Institute of Physics, Beijing China*: Multi-slice Ptychrogphy*

Dr. Martien Den Hertog, Institut Néel, Grenoble, France : *Characterizing electrical properties of semiconducting materials at nm length scales by 4D Transmission Electron Microscopy*

Dr. Martin Hÿtch, CEMES-CNRS, Toulouse, France: *Measuring charge at interfaces in nanocapacitors by in-situ biasing electron holography*

Prof. Oliver Jaco, Nelson Mandela University, South Africa: *Atomic-Scale Imaging of Hydrogen-Induced Platelet Defects in Proton-Bombarded n-Type GaAs Using Probe-Cs-Corrected STEM*

Dr. Mathieu Kociak, Université Paris Sud, France : *Novel ns-resolved nano-optical spectroscopies with in the scanning transmission electron microscope*

Prof. Slawomir Kret, IFPAN, Warsaw, Poland: *Investigation of Residual Strain and Relaxation in Nanowires Based on Semiconductor Compounds via TEM Techniques*

Dr. Daesung Park, Technische Universität Braunschweig, Germany: *Robust analysis tool for position averaged convergent beam electron diffraction patterns and quantitative scanning transmission electron microscopy using a foundation model*

Prof. Quentin Ramasse, SuperSTEM Laboratory, Daresbury, UK: *High-resolution EELS (vibrational spectroscopy and beyond)*

Prof Ana Sanchez, University of Warwik, UK: *Imaging and EBIC in heterostructures*

Dr. Marco Schowalter, Universtät Bremen: *Scanning precession nano beam electron diffraction strain mapping on kappa-(InGa)2O3/Ga2O3 layers*

Dr Julita Smalc-Koziorowska, UNIPRESS, Warsaw, Poland: *Revealing defects in nitride semiconductor structures in TEM*

Prof. Milos Vittori, University of Ljubljana, Slovenia: *Characterization of crustacean biomaterials using analytical transmission electron microscopy*

Dr: Thomas Walther, Sheffield University: *Measurement of surface segregation and interdiffusion in the Ga(As,Bi) semiconductor alloy system*

Prof. Zhujun Wang, Shanghai Technical University, China*: Insitu in SEM*

Dr Dan Zhou, IKZ, Berlin Germany: *In Situ TEM on Off-Stoichiometric $SrTiO_3$ and Ga_2O_3*

Tentative list of scientific committee members

Prof. Peter A. van Aken, Max Planck Institute for Solid State Research
Prof. Miran Čeh, Jozef Stefan Institute, Ljubljana, Slovenia
Prof. Angus Kirkland, Department of Materials, University of Oxford, UK
Prof. Gerald Kothleitner, Graz Technical University, Graz, Austria
Prof. Quentin Ramasse, SuperSTEM Laboratory, Daresbury, UK
Prof. Odile Stephan, Universite Paris Sud, France

Publication of the proceedings

Selected manuscripts will be published in Top level Journals; discussions are in progress with Elsevier and Wiley