MONASH University

Monash Centre for Electron Microscopy

Seminar

4-dimensional Scanning Transmission Electron Microscopy: disentangling materials' composition and electronic structure

Thursday, 17 June 2021

5.00 – 6.00 pm (AEST)

ZOOM – Register in advance for this meeting:

https://monash.zoom.us/meeting/register/tZwrdO-gpjsqH9ApXcZLQfOjqIlLEajZFSD

Passcode: 111111

Professor Kerstin VOLZ Heisenberg professor (full professor) for experimental physics at Philipps-Universität Marburg/Germany since 2009.

Andreas Beyer & Kerstin Volz

Materials Sciences Centre and Faculty of Physics, Philipps University Marburg, Germany

Scanning transmission electron microscopy (STEM), especially when aberration-correction is used, can be applied to investigate materials at an atomic level. When compared to image simulations, the information on the sample's structure and composition can be quantitative. Combining STEM with a fast, pixelated detector allows for the acquisition of a full diffraction pattern at each scan point. From this, four-dimensional STEM (4D-STEM) datasets are available, which can be used to generate different data, e.g., annular dark field (ADF) as well as (annular) bright field ((A)BF) images, angular resolved STEM (ARSTEM) or differential phase contrast (DPC) data.

We use a double aberration corrected JEOL 2200FS STEM, equipped with an in-column energy filter and a pnCCD detector to acquire (energy-filtered) 4D-STEM data sets.
With the example of cathode active materials for batteries, we show that light elements (e.g., Li) can be also quantified using specific (low) angular ranges of scattering. The ADF regime, however, is strongly influenced by inelastic (Plasmon) scattering. This will be elucidated using energy-filtered 4D-STEM.
In order to assess, whether 4D-STEM could also be used to measure electric fields by the shift of the electron beam, we investigated GaAs p-n-junctions, having different doping levels and hence different depletion widths and built-in electric fields. It will be shown that from center of mass tracking while scanning the electron probe across the p-n-junction, it is possible to obtain data, which reflects the characteristics of the p-n-junction.

This contribution will summarize our recent understanding on the quantitative determination of composition and electronic structure using different functional materials as examples.

The Presenter

Prof Kerstin VOLZ received her diploma in physics from Augsburg university in 1996. In 1999 she obtained her PhD from the same university. After several research visits at Osaka National Research Institute/Japan and Nagasaki Institute of Technology/Japan and a postdoctoral stay at Stanford University/USA she joined Philipps-Universität Marburg as a Junior Group leader. After a professorship at the Humboldt-Universität zu Berlin, she was appointed as a professor in Marburg. She currently serves as speaker of the Research Training Group "Functionalization of Semiconductors" as well as as the spokesperson of the Collaborative Research Center "Structure and Dynamics of internal Interfaces", both financed by the German Research foundation and is the director of the Materials Science Center in Marburg.

Honors, awards and other means of qualification:

- 2020 Member of the "Forschungsbeirat" (Steering Committee) of the UMR
- 2020 Member of the "Forschungsrat" (Research Council) of the FCMH
- 2018-2020 Dean of the department of Physics
- 2018 Member of the board of the DGE (German Society for Electron Microscopy)
- 2016 Member of the MRS medal selection committee
- 2009 Patricia Pahamy teaching award, faculty of physics, Philipps-Universität Marburg
- 2008 Heisenberg professorship of DFG
- 2001 Feodor-Lynen Fellowship of Alexander von Humboldt Stiftung
- 1996 Graduate Student Award of EMRS

Her research interests include the synthesis and quantitative transmission electron microscopy of novel functional materials.

Convener

Professor Joanne Etheridge

Director, Monash Centre for Electron Microscopy, Monash University

MICROSCOPY AUSTRALIA

Email: mcem@monash.edu **Tel:** +61 3 9905 5563