CCMX-ScopeM Advanced Course
2018

Quantitative Transmission Electron Microscopy: Experiments and Simulations

Robin Schäublin
ETH Zürich

Abstract

TEM gives beautiful images about microstructures but also actual quantitative information, which allows grounding our understanding of their physical properties, for example to determine the cause of the failure of a ferritic steel.

1. Theory module

Background to a quantitative analysis using TEM will be given, with a focus on crystal defects, including dislocations, dislocation loops, stacking faults, grain boundaries, cavities and secondary phase precipitates in metals and rocks. Diffraction contrast and phase contrast will be reviewed in this context. TEM image simulation techniques, i.e. multislice, many-beam and Bloch wave method, will be presented, including the ancillary simulation tools such as elasticity of the continuum and molecular dynamics to describe the specimen.

2. Experimental module

Hands-on experience will be given on a TEM, with an insight into the actual quantitative analysis of a dislocation in a metal. The Burgers vector as well as the dislocation line direction will be identified, allowing distinguishing its character, screw, edge or mixed. This will allow attendees to experience TEM imaging in real space, using diffraction contrast, as well as in reciprocal space, with the diffraction pattern, for the crystallographic information needed for the analysis. It will show that despite the apparent complexity of the concepts involved the methodology can be rapidly assimilated.

3. Simulation module

Integrated in the workflow of a defect analysis in situ at the TEM, rapid image simulations based on platform independent applications allow for a seamless quantification. Hands on experience will allow attendees to perform by themselves a simple analysis of a defect in a metal, starting from an experimental picture, with the TEM image simulation application CUFOUR based on diffraction contrast. It will allow them grasping the power and ease of the method as well as giving leads to their own research.

Contact details

ETH Zurich - ScopeM
Vladimir-Prelog-Weg 1-5/10, 8093 Zürich,
Switzerland E-mail:
robin.schaeublin@scopem.ethz.ch