

# ***High-Resolution Transmission Electron Microscopy (HREM/HRTEM) Workshop***

**THE NEXT WORKSHOP WILL TAKE PLACE ON:** Workshop will be organised when sufficient interest is registered. Contact Dr Martin Saunders - [martin@cmm.uwa.edu.au](mailto:martin@cmm.uwa.edu.au) - to register your interest.

## **WHO SHOULD ATTEND THIS COURSE?**

Researchers, PhD and Hons students in the physical sciences with TEM experience wishing to obtain images of crystalline materials with atomic resolution as part of their research project at the UWA Centre for Microscopy, Characterisation and Analysis (CMCA), or other facilities.

## **COURSE OUTLINE:**

The principles and applications of high-resolution TEM will be reviewed through an initial lecture. Practical training on the microscope will introduce attendees to the alignment procedures and relevant software (Digital Micrograph) for obtaining high-resolution TEM images with a digital camera at CMCA. Basic image analysis and interpretation will be included in the workshop. There will be opportunities for attendees to discuss the use of high-resolution TEM in their research project with a member of Centre staff.

## **WHAT YOU SHOULD KNOW BEFORE THE COURSE?**

It will be assumed that attendees have a basic knowledge of crystal structures and crystallography. Attendees are expected to be familiar with the basic operation of a TEM and the TEM aspects of their own research project before attending the course. You must have completed the TEM training course before you can attend the HREM workshop. It is also recommended that you gain some experience operating a TEM before attending the workshop.

## **WHAT WILL YOU LEARN ON THIS COURSE?**

Attendees will learn how to obtain and interpret high-resolution TEM data, including –

- How to set up and align the microscope for high-resolution imaging;
- How to adjust the objective stigmation and image focus using Fourier Transforms of high-resolution images;
- How to obtain images at atomic resolution;
- Basic image interpretation (e.g. is the sample crystalline or amorphous?);
- Basic image analysis (measuring planar spacings and interplanar angles);
- Introduction to image simulation;
- Sample requirements for high-resolution TEM (but not sample preparation methods).

## **WHAT IS NOT INCLUDED IN THIS COURSE?**

Basic information on TEM operation is covered in the TEM training course and is not included in this workshop. Crystallography and information related to the understanding of crystal structures is not included in this workshop (and it will be assumed that attendees already have a basic understanding of these topics). Detailed information on the theory of high-resolution imaging and image simulation is not included in the workshop.

## **TEACHING MATERIALS:**

Copies of lecture notes and supporting documentation will be made available in electronic form before the course. Attendees are expected to be familiar with the basic principles and applications of high-resolution TEM before attending the course. Many TEM-related books including high-resolution TEM information can be found in the UWA library. The following are recommended –

- D. Shindo, K. Hiraga (1998) High-resolution electron microscopy for materials science, Springer.
- J.C.H. Spence (2003) High-resolution electron microscopy, Oxford University Press.

Attendees are recommended to download and read the following review article (and any of the included references) before attending the workshop –

- J. C. H. Spence, The future of atomic resolution electron microscopy for materials science, Materials Science and Engineering: R: Reports, V26, Issues 1-2, 26 Oct 1999, Pages 1-49. See: <http://www.sciencedirect.com/science/article/B6TXH-3XRY70W-1/2/ee49c7f79e98caf7c9e740c7bf59bf7d>

The library also houses a set of DVD recordings of microscopy workshops run by the Microscopy Society of America.

### **RELATED TRAINING OPPORTUNITIES:**

Other TEM-related workshops currently include –

- TEM training course (for basic TEM operation);
- Electron diffraction (for crystal structure analysis);
- Energy-filtered TEM (EFTEM) (for element distribution imaging);
- Electron energy-loss spectroscopy (for local composition and chemistry);
- X-ray microanalysis by TEM (for compositional analysis);
- Scanning TEM imaging (including BF and HAADF imaging);
- Sample preparation for the physical sciences (appointments can also be made with Dr Martin Saunders – [martin@cmm.uwa.edu.au](mailto:martin@cmm.uwa.edu.au) Dr Alexandra Suvorova – [suvorova@cmm.uwa.edu.au](mailto:suvorova@cmm.uwa.edu.au) to discuss your specific requirements).

Appointments to discuss individual projects, project planning, etc. can be made directly with Centre staff (Physical Sciences – Dr Martin Saunders).

### **HOW DO I REGISTER AND WHAT DOES IT COST?**

Places on the HREM workshop are available to researchers/students with a demonstrated need to use high-resolution TEM in their research. You can apply to attend the next workshop by completing the online registration form.

Places are limited and preference will be given to registered CMM Users. Your place will be confirmed in advance of the next scheduled workshop.

To find out about becoming a CMM User contact the CMM Manager, Jeanette Hatch (e-mail: [admin@cmm.uwa.edu.au](mailto:admin@cmm.uwa.edu.au) or phone: 6488 2770).

The workshop is free to all current registered users. All other non-registered participants will be allocated a place only if maximum numbers are not reached, and a cost of \$220 (inc. GST) will apply. Any enrollee who fails to cancel their attendance more than 24h in advance will be charged a \$55 (inc. GST) no show fee.