We offer the Bachelor thesis topic

Advanced electron source characterization for low energy electrons

A part of the SALVE project at Universität Ulm

Modern condensed matter physics, solid state chemistry, and materials science greatly benefit from the characterization power electron microscopes offer. Especially, nowadays aberration corrected transmission electron microscopy (TEM) provides atomic scale structural and chemical information on *e. g.* functional interfaces or nanomaterials. Nevertheless, there are still big challenges to tackle in every aspect of the technique; one of them is the damage the imaging electron beam causes in the sample to be characterized *via* several different damaging mechanisms. One way to reduce sample damage is to image with electrons that bear significantly lower energy than normally used.

In a joint project with manufacturers we developed a prototype transmission electron microscope for imaging with very low electron energies. One part of this project was to optimize the electron source for the operation at unusually low acceleration voltages. Electron sources play an important role in the imaging process because there is no ideal electron source such as an electron LASER with high spatial and temporal coherence that we need for high information transfer and a high brightness. Partially incoherent imaging electron beams introduce a dampening of the high resolution information up to the total loss in the micrograph, and at lower voltages this effect increases. High brightness is needed to gather sufficient signal for high resolution images in an acceprable time dictated by the stability of the system. For the quantitative assessment of the electron source several individual characteristics can be measured, like the virtual source size, the electron energy distribution, and the electron current. All these characteristics are dependent on the primary electron energy.

The candidate will characterize different modern electron sources and layouts available on different high end microscopes, with different characterization methods, and at various primary electron energies. The different methods themselves will be compared by the student. Finally, the electron sources and their operation parameters will be evaluated in terms of their suitability for different imaging modes.

Candidate requirements: Bachelor course in physics, basic programming skills.

Contact

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