Measuring the Coherence Length of Electrons in an Electron Microscope

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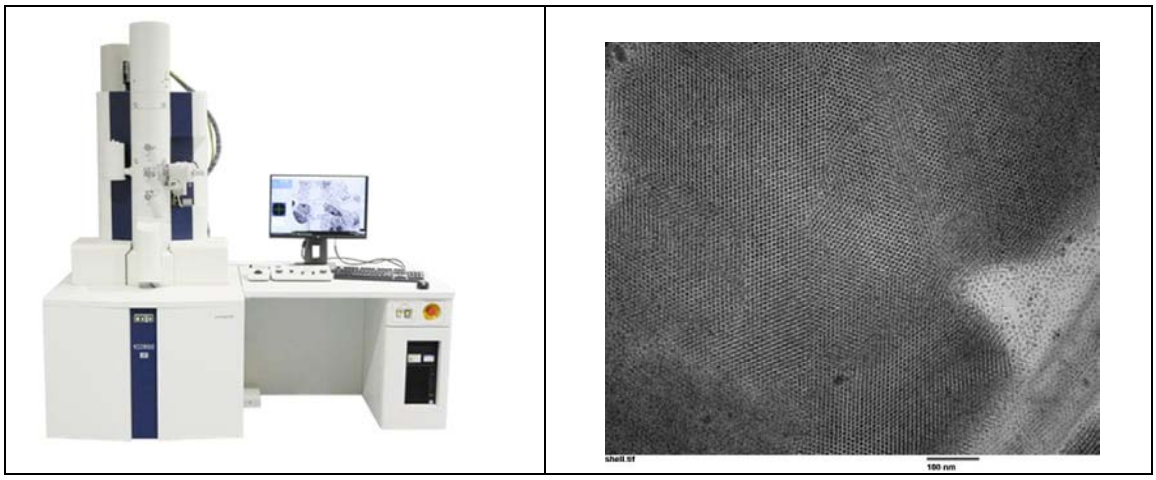
Transmission electron microscope (TEM) is a unique instrument to study nanoworld. The technique is capable of resolving the atomic structure of materials using either direct imaging or diffraction. In a TEM, electrons are emitted from an electron source that can be either a thermionic or field emission source. The spatial coherence length is a measure of the correlation between phases of an electron wave at different locations transverse to the direction of wave propagation. Coherence length is an important parameter in diffraction imaging. For coherent imaging, the coherence length of electrons should be larger than the size of the object under study.

The coherence length is directly related to the size of the electron source, which in our case is a thermionic source. The summer student will assist in measuring the coherence length of a thermionic TEM as a function of beam current and beam diameter. The outcome of this project is very important in terms of determining the correct electron source parameters, including beam diameter and current, for different sample sizes in diffraction analysis.



(Left) Picture of the TEM that will be used in this project. (right) TEM image of quantum dots.

This project is a combination of experimental and theoretical physics with the focus on the experimental part. The summer student will be involved in the following research development skills:

- Training on operating principles of TEM equipped with the high-end electron detector.
- Learning the basic knowledge of wave theory and diffraction theory.
- Analyzing the experimental data based on the theory to measure properties of the electron beam.

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