Low loss EELS database for TMDs

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Background and aim

By means of electron energy-loss spectroscopy (EELS), the chemical composition of solids can be analyzed, as well as their dielectric properties. If EELS is performed in a transmission electron microscope (TEM), this information can be obtained from very small sample regions, using the high spatial resolution of the TEM.

In low-loss experimental EELS spectra ($\Delta E \leq 50eV$, the measured peaks are dominantly caused by interband transitions or plasmon excitations, but also other contributions like retardation and surface effects contribute to the acquired spectra [1-3]. Retardation effects including Cherenkov losses and guided light modes arise when the speed of the probing electron is larger than the speed of light in the sample, while surface plasmons and interface plasmons can be excited when the electron probe is near the surface or interface[1,3-9].

The aim of this work is to simulate the effects of surface and relativistic losses on the EELS spectra as a function of sample thickness for various transition metal dichalcogenides (TMDs). The simulation study will be performed in the framework of the local relativistic dielectric formalism[6], based on the method developed by Bolton and Chen[5]. The results will be used to introduce an EELS database for TMDs, which are a promising material for a new class of electronic devices[10].

Workplan

- Literature research: Basics of electron energy-loss spectroscopy (EELS)[1] and details of surface and relativistic effects on EELS spectra[3-9]
- Simulation of EELS spectra for various TMDs (Matlab/Phyton)
- Detailed analysis of specific contributions (Relativistic effects, surface plasmons,…) to EELS signal for the individual materials
- Comparison of simulated spectra with experimental data (optional)

Requirements

- Good understanding in physics
- Basic programming skills
- Strong motivation to work in our team.

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