Progress in Magnon EELS simulations

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Background incl. Aims

Magnons, the quanta of spin waves, play a pivotal role in various solid-state phenomena, including memory and information processing [1]. Understanding their behavior at the nanoscale is crucial for advancing magnetic technologies. Electron energy loss spectroscopy (EELS) holds promise for probing these excitations with high spatial resolution [2, 3], potentially enabling the exploration of magnon dispersions down to the atomic scale. However, experiments face substantial challenges due to the overlap in excitation energy ranges between phonons and magnons, with phonon signals typically overshadowing magnon signals significantly [3]. Hence, elucidating optimal conditions for discerning magnon EELS signals remains crucial.

In this work, we present our progress in simulating inelastic electron scattering signals of magnons in Scanning Transmission Electron Microscopy, discussing the feasibility of Magnon EELS detection.

Methods
We implement a new methodology [4] to compute magnon EELS from Pauli-multislice simulations. In particular, this methodology integrates state-of-the-art simulation techniques to model magnon spectra, including the Frozen Magnon Multislice Method with absorptive-potential-based phonon scattering [3].

Results
We present findings suggesting the potential for detecting statistically significant magnon signals by selecting combinations of temperature and sample thickness [3]. Additionally, we show the capabilities of our methodology by presenting angle-resolved magnon EELS simulations.

Conclusion
Our simulations suggest the existence of feasible conditions to differentiate magnon inelastic signals from phonon signals. Also, we show the potential of our developed methodology to simulate angle-resolved magnon EELS signals.

Keywords:

Magnons Phonons EELS Multislice

Reference:

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