

› Allgemeines Physikalisches Kolloquium

› Donnerstag, 07.06.2018 um 16 Uhr c.t.

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“New Developments in Ultrafast Electron Imaging and Spectroscopy”

Novel methods in time-resolved electron microscopy, diffraction and spectroscopy promise unprecedented insight into the dynamics of structural, electronic and magnetic processes on the nanoscale. A key to the realization of such technologies is the generation of high-quality beams of ultrashort electron pulses. In this talk, our recent development of imaging and spectroscopy using localized electron emitters will be discussed. Specifically, two approaches employing high-coherence electron pulses from nanotips will be presented, namely Ultrafast Low-Energy Electron Diffraction (ULEED) and Ultrafast Transmission Electron Microscopy (UTEM). ULEED allows for the study of structural dynamics with high temporal resolution and ultimate surface sensitivity [1-2], while UTEM combines femtosecond [3-6] and even attosecond [7] resolution with the imaging and spectroscopy capabilities of an electron microscope.

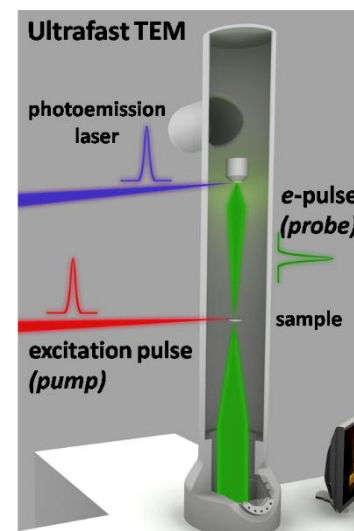
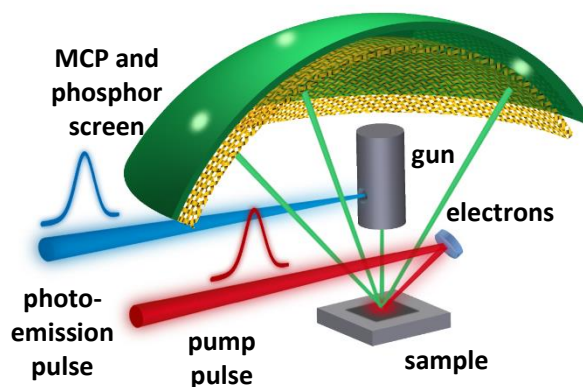


Figure: Two complementary approaches to the study of ultrafast dynamics in solids, at surfaces and nanostructures: Ultrafast Low-energy electron diffraction (ULEED, left) probes structural dynamics at surfaces with electron pulses at kinetic energies of 20-200 eV. Ultrafast transmission electron microscopy (UTEM, right) allows for ultrafast imaging, diffraction and spectroscopy of thin films and nanostructures using high-energy electron pulses (100-200 keV).

References

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- [2] S. Vogelgesang et al., "Phase ordering of charge density waves traced by ultrafast low-energy electron diffraction", *Nat. Phys.* 14, 184–190 (2018).
- [3] A. Feist et al., "Ultrafast transmission electron microscopy using a laser-driven field emitter: Femtosecond resolution with a high coherence electron beam", *Ultramicroscopy* 176, 63 (2017).
- [4] A. Feist et al., "Nanoscale diffractive probing of strain dynamics in ultrafast transmission electron microscopy", *Struct. Dyn.* 5, 014302 (2018).
- [5] A. Feist, K. E. Echternkamp, J. Schauss, S. V. Yalunin, S. Schäfer, and C. Ropers, "Quantum coherent optical phase modulation in an ultrafast transmission electron microscope", *Nature* 521, 200 (2015).
- [6] K. E. Echternkamp, A. Feist, S. Schäfer, and C. Ropers, "Ramsey-type phase control of free electron beams", *Nature Phys.* 12, 1000 (2016).
- [7] K. E. Priebe, C. Rathje, S. V. Yalunin, T. Hohage, A. Feist, S. Schäfer, and C. Ropers, "Attosecond Electron Pulse Trains and Quantum State Reconstruction in Ultrafast Transmission Electron Microscopy", *Nat. Phot.* 11, 793 (2017).