High brightness ultrafast Transmission Electron Microscope based on a laser-driven cold field emission source: development and application to nanospectroscopy

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The first Ultrafast Transmission Electron Microscopes (UTEM) have provided a unique insight into the physics of nano-objects with both sub-picosecond temporal resolution and nanometer scale spatial resolution [1,2]. We will report on the development of the first ultrafast cold-field electron source and its use for Ultrafast Transmission Electron Microscopy [3,4]. We have modified a cold field emission source to integrate laser optics in the immediate vicinity of the [310] oriented W nanotip to minimize the size of the laser focal spot on the tip apex, minimize the size of the emission region and therefore maximize the brightness of the source [4]. Light injection and collection from within the objective lens are achieved with a high numerical aperture by means of an optical set-up involving a parabolic mirror and a dedicated detection system.

The potential of this high-brightness ultrafast CFEG-TEM for ultrafast electron microscopy and holography will be illustrated. The spectro-temporal properties of this CFEG-UTEM will be characterized in electron-photon cross-correlation experiments based on the detection of energy gains. Finally, the potential of this instrument for the investigation of the optical excitations in nanoscale systems will be discussed.

References:

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