Ultrafast Transmission Electron Microscopy

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In the past decades, great effort has been made to improve the spatial resolution of Transmission Electron Microscopes (TEM). More recently, researchers have begun to focus on in-situ experiments for imaging a variety of dynamic processes inside the TEM. Many in-situ processes occur at very short time scales, often less than few microseconds. Studies on such processes are limited by the minimum acquisition time of the modern TEM cameras (~few millesconds) that miss salient details of the sample dynamics, e.g., defect processes, phase transformations, or nucleation phenomena. For these studies, a much higher temporal resolution is required and can be obtained using short pulse electron beams. Recent improvements in the quality of pulsed electron beams for TEM offer new opportunities for the study and understanding of sub-microsecond phenomena. The electron emission is correlated in time with the transient states in the TEM sample using pump-probe techniques which can have sub-ps temporal resolution using femtosecond laser illumination.

These pulsed electron imaging studies can be carried out in two different operating modes:

- Single shot mode, required for studying irreversible processes.

- Stroboscopic mode allows imaging and spectroscopy of reversible processes.

In this poster, the specifications of a new Ultrafast Dynamical Transmission Electron Microscope (UDTEM) installed at the IPCMS Laboratory (Strasbourg, France) are shown.