東京大学大学院工学系研究科　総合研究機構

結晶界面工学研究室

Crystal Interface Laboratory, The University of Tokyo

Crystal Interface Lab. Seminar Series

In-situ Dynamic Transmission Electron Microscopy (DTEM)

by

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The need to be able to observe dynamic phenomena in materials systems with both high spatial (~1nm or better) and high temporal (~1μs or faster) resolution has led to the development of a dynamic transmission electron microscope (DTEM). The high temporal resolution is achieved in the DTEM by using a short pulse laser to create the pulse of electrons through photo-emission (here the duration of the electron pulse is approximately the same as the duration of the laser pulse). This pulse of electrons is propagated down the microscope column in the same way as in a conventional high-resolution TEM. The only difference is that the spatial resolution is limited by the electron-electron interactions in the pulse (a typical 10ns pulse contains ~10^8 electrons). To synchronize this pulse of electrons with a particular dynamic event, a second laser is used to "drive" the sample a defined time interval prior to the arrival of the laser pulse. The important aspect of this dynamic DTEM modification is that one pulse of electrons is used to form the whole image, allowing irreversible transitions and cumulative phenomena such as nucleation and growth, to be studied directly in the microscope. The use of the drive laser for fast heating of the specimen presents differences and several advantages over conventional resistive heating *in-situ* TEM – such as the ability to drive the sample into non-equilibrium states. So far, the drive laser has been used for *in-situ* processing of nanoscale materials, rapid and high temperature phase transformations, controlled thermal activation of materials. In this presentation, a summary of the development of in-situ stages for both the existing DTEM at LLNL and a new aberration corrected DTEM at UC-Davis will be described. Particular attention will be paid to the potential for gas stages to study catalytic processes and liquid stages to study biological specimens in their live hydrated states. The potential improvements in spatial and temporal resolution that can be expected through the implementation of upgrades to the lasers, electron optics and detectors used in the new DTEM will also be discussed along with the correlation of dynamic results with conventional high resolution imaging and spectroscopic methods in TEM.

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(工学部総合研究機構　9 号館 1 階　大会議室)

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