CFEL SCIENCE

Workshop

on

Nanoscale Imaging in Materials

March 8th 2012

Flash Hall (bldg 28c) – Seminar Room

10:00	**Andrea Cavalleri** Welcome
10:15	**Jim Zuo** *(Dept. of Materials Science and Engineering, University of Illinois)* Electrons for Imaging Molecular Motions and Atomic Reactions, the Scientific Opportunity and Challenge
11:15	coffee
11:45	**Tim Salditt** *(Institut für Röntgenphysik, Universität Göttingen)* X-ray nano-imaging of biomolecular matter: a matter of contrast and a matter of resolution
12:45	lunch
14:15	**Ian Robinson** *(University College London)* Structural principles for nanoparticles: time-domain investigations
15:15	coffee
15:45	**Henry Chapman** *(DESY-CFEL Hamburg)* Femtosecond Nanocrystallography with X-ray Free-Electron Lasers
16:45	**Andrea Cavalleri** Conclusion

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Jim Zuo *(Dept. of Materials Science and Engineering, University of Illinois)*
Electrons for Imaging Molecular Motions and Atomic Reactions, the Scientific Opportunity and Challenge

Structure determination of individual molecules so far has not been possible, because the dose required for recording atomic resolution diffraction data often leads to extensive structure damage before the molecular diffraction pattern can be recorded. X-ray diffraction "snapshot" technique has been developed using femtoseconds (fs) pulses from a hard X-ray free electron laser to overcome this limit. For electrons, because of their large scattering cross section, the same diffraction power can be achieved with ~10^6 electrons. This talk will explore the limits of electron molecular diffraction, and scientific opportunity of using electrons for imaging molecular motions and atomic reactions with new developments in electron microscopy, pulsed electron sources and electron detectors.

Tim Salditt *(Institut für Röntgenphysik, Universität Göttingen)*
X-ray nano-imaging of biomolecular matter: a matter of contrast and a matter of resolution

Images of molecular functions in complex environments require a combination of high spatial resolution, quantitative contrast, and full compatibility with environmental conditions. Circumventing the fabrication constraints of zone plate, novel lens-less x-ray imaging techniques approaches have emerged, where the object function is reconstructed from the measured intensities without the need of an object lens. We present recent results on coherent x-ray tomography of bio-molecular samples and biological cells.

Ian Robinson *(University College London)*
Structural principles for nanoparticles: time-domain investigations

Recent experiments at the XPP station of LCLS showed unexpectedly abrupt early time heating behavior of single gold nanocrystals. This is explained, with the help of MD simulations, to be due to an electronic heating effect. Subsequent time evolution is consistent with acoustic "ringing" of the normal modes.

Henry Chapman *(DESY-CFEL Hamburg)*
Femtosecond Nanocrystallography with X-ray Free-Electron Lasers

X-ray pulses from free-electron lasers are of high enough intensity and of sufficiently short duration that single-shot diffraction patterns can be obtained from a sample before significant damage occurs. We have shown that this idea of "diffraction before destruction" holds to atomic resolution, and are applying it to solve the structures of proteins from samples too small or radiation sensitive for conventional measurements.