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Davisson-Germer Prize in Atomic or Surface Physics Winner: Probing Dynamics and Structure from Within with VUV and Ultrafast X-rays[1]

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VUV and X-rays produced at synchrotron facilities or free electron lasers (FELs) have energies and intensities sufficient to access core and inner-shell electrons producing, unlike visible optical lasers, inside-out photoionization to probe matter. The element-specificity of x-ray absorption, i.e., the ability to target specific atoms within molecules and select specific shells in those atoms (by tuning with high resolution the photon energy to specific spectral regions) has been used to investigate the dynamics and structure of atoms, molecules, clusters and their ions. The new class of x-ray lasers, the intense-femtosecond FELs, has opened up new opportunities to study AMO physics with atomic spatial resolution and femtosecond temporal resolution. The understanding of physical and chemical changes at an atomic spatial scale and on the time scale of atomic motion is crucial not only for AMO physics but also for a broad range of other scientific fields. We will report on experimental investigations coupled with a quantitative understanding of dynamical effects due to VUV or x-ray exposure. We will also describe newly-built instrumentation already applied to x-ray pump-x-ray probe experiments to map out time-dependent processes to interrogate molecular dynamics in order to advance our fundamental understanding of the interaction of matter with x-rays.

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