Application of coherent high-order harmonic emission in time-resolved imaging and photoemission

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The process of high-order harmonic generation make it possible to upconvert laser light from the near infrared into the deep-UV, EUV, and soft x-ray regions of the spectrum.[1] This upconversion process preserves both the very short pulse duration and full spatial coherence of the femtosecond laser driving pulse, and in some cases the generated x-ray beams can have much shorter, even attosecond, pulse duration.

In this talk, I will present new applications of high-order harmonic generation in time-resolved photoemission from surfaces, in acoustic metrology, and in coherent lensless imaging. I will also discuss progress in enhancing the flux of harmonic generation using phase matching techniques, as well as in developing very high repetition rate laser sources, Highlights of this work include:

1. The use of ultrashort-pulse EUV for time-resolved photoemission, including monitoring the dynamics of surface chemical reactions.[2]
2. The first demonstration of the laser-assisted photoelectric effect in photoemission from a surface. This process makes it possible to monitor the time at which photoelectrons are ejected from a surface, potentially with attosecond time-scale resolution.[3]
3. The monitoring of surface acoustic dynamics with sub-angstrom displacement resolution, using coherent reflection and holographic imaging.[4, 5]
4. Holography and lensless imaging using coherent EUV light from high-harmonic generation.[6]

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