第 20 回研究科セミナー（ナノマテリアル・デバイス研究領域）

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Ultrafast Photoelectron Spectroscopy and Microscopy on Nanofemto Scale

講演者： University of Pittsburgh Professor, Hrvoje Petek

日　　時：令和 6 年 10 月 15 日（火）10:00～11:30

場　　所：マテリアルサイエンス講義棟　1 階　小ホール

講演要旨：

I will discuss our recent studies of ultrafast light-induced phenomena at plain and molecule-modified silver surfaces. Light can interact with matter by exciting dipole transitions or driving PHz electron currents. Nonlinear photoelectron spectroscopy and microscopy experiments communicate outcomes to both responses at different field strengths and on different time scales.Light travels at 300 nanometers per femtosecond, and nothing is faster than that. Its focusing is limited by diffraction to ～0.5 λ, where λ is its wavelength. I will show how we take movies of the structured vortex fields with spatial resolution below its diffraction limit as light propagates at a metal-vacuum interface as a light-matter surface plasmon polariton wave. We accomplish this by photoemission electron microscopy where we image the nonlinear two-photon electron emission that polaritons emit in their wake in response to excitation by two identical femtosecond pulses,[1,2] Light can also drive coherent electron currents at metal-molecule-vacuum interfaces.While one might think that molecular conjugated frameworks could carry such currents, I will show that instead the charge transfer occurs through a coherent non-Markovian process on <2 fs time scale through a molecule-dressed vacuum. Finally, when we look in a silver mirror, its free electrons screen the forward field propagation enabling us to see a coherent mirror replica of ourselves. But if the field is sufficiently strong, the screening charge may not emit the reflection field, but the field itself can drive the nonlinear photoelectron emission vanishing the reflection on attosecond time scale as modified photoelectron signal. I will show how photoelectron microscopy and spectroscopy illuminate the free electron responses in silver on the nanofemto scale.

[1] M. Dabrowski, Y. Dai, and H. Petek, Chem. Rev. 120, 6247 (2020).
[2] Y. Dai,*et al.*, Nature 588, 616 (2020).

講演者略歴：

1980 B. S. in Chemistry, Massachusetts Institute of Technology
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