Probing electrons and light in nanomaterials using the photoelectric effect

T. Ohta,[1] A. Boehm,[1] S. D. Gennaro,[1] C. F. Doiron,[1] A. Kim,[1] K. Thürmer,[2] J. D. Sugar,[2] C. D. Spataru,[2] J. J. Fonseca,[3] J. T. Robinson,[3] T. E. Beechem,[4] M. B. Sinclair,[1] I. Brener,[1] R. Sarma[1]

[1] Sandia National Laboratories, Albuquerque, NM 87185
[2] Sandia National Laboratories, Livermore, CA 94550
[3] US Naval Research Laboratory, Washington, DC 20375
[4] Purdue University, West Lafayette, IN 47907

The photoelectric effect is sensitive to both the occupied electronic density of states and the electromagnetic field distribution. Thus, capturing the energy, yield, and spatial origin of photoelectrons from the sample enables us to examine local electronic properties and light-matter interactions concurrently. In this talk, we will describe two case studies using photoelectron emission microscopy (PEEM), revealing the spatial variations of Schottky barrier height between WS_2 and Au, and the local electromagnetic near-field profiles of Si metasurfaces. We will discuss the impact of crystallographic facets of Au grains as well as how the attractive interaction of Au with WS_2 can modify the crystallographic alignment among WS_2 layers. For near-field imaging, we will demonstrate the sensitivity of photoemission yield to the light absorptivity in visible to near infrared range, and evaluate the field profiles around Si meta atoms at the sub-(photon) wavelength scale on and off resonance excitation. Altogether we will discuss the potential of photoelectron imaging to examine the intertwined light-matter coupled phenomena abundant in two-dimensional and quantum materials.

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[+] Author for correspondence: tohta@sandia.gov