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Surface Photovoltage in the Vicinity of Individual Plasmon Excited Nanoparticles

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The investigation of photophysical processes of heterogeneous systems largely relies on local probing techniques [1]. For plasmon assisted electron-hole generation a key property is the size of the region that is affected by enhanced charge carrier density which is accessible via the local surface photovoltage (SPV). Here, we present SPV studies (see Figure 1) of single resonantly excited Ag clusters [2] on clean Si(100)-(2x1) measured by energy-resolved two-photon photoemission electron microscopy (2PPE-PEEM). Analysis of the distance dependence from the particles reveals an enhanced plasmon induced charge carrier density at the location of the nanoparticles. This observation is corroborated by comparing spatially averaged SPV for different particle densities. We envision opportunities in the context of plasmon enhanced solar cells, particularly regarding the choice of optimal particle concentrations. In addition, coupling phenomena based on the enhanced near-field of metallic nanoparticles open perspectives in heterogeneous systems, e.g. for site-specific generation of excitons in molecular nanostructures.

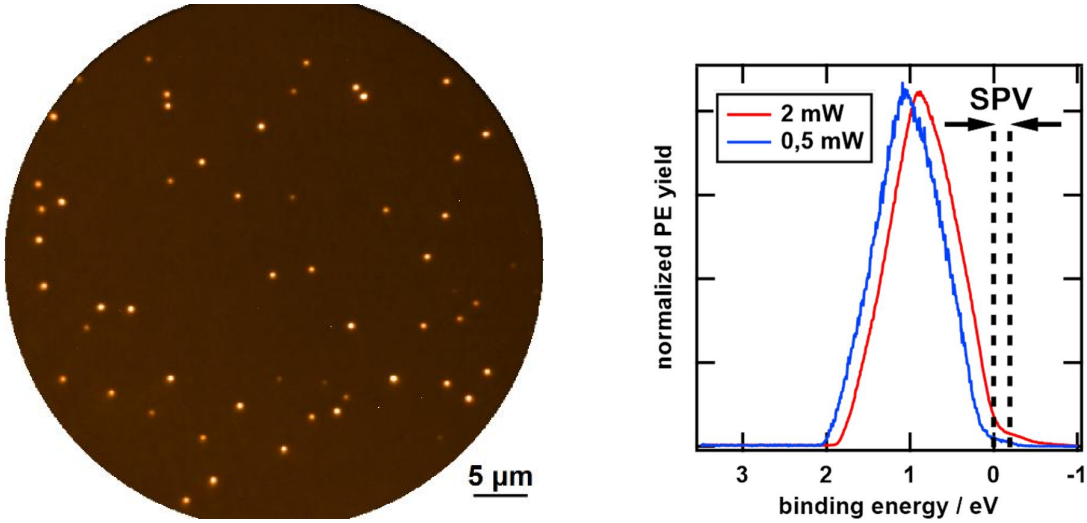

Figure 1. PEEM image of Ag clusters on clean silicon at illumination with a 380 nm femtosecond laser (left). Spatially averaged photoelectron spectra for two different laser intensities (right). The SPV affects the kinetic energy of emitted electrons and is extracted from the energy shift.

References

[1] K. Sell et al., Phys. Stat. Sol. (b) **247**, 1087 (2010).
[2] K. Oldenburg et al., J. Phys. Chem. C **123**, 1379 (2019).