Type of presentation: Invited

IT-8-IN-5754 Time-Resolved Imaging of Surface Plasmon Polaritons by Photoemission Microscopy: The Next Generation

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Observing surface plasmon polaritons (SPPs) in a photoemission electron microscope (PEEM) is possible via a two photon photoemission (2PPE) process, if ultra-short laser pulses of a suitable wavelength are directed onto a surface with plasmonic structures. In the past, we used a grazing incidence angle of 65-74° of the laser light relative to the surface normal for PEEM-based SPP imaging. The resulting SPP contrast was in this case described as a Moiré-pattern [1,2]. Properties of the SPP, however, can only be inferred indirectly from the Moiré pattern in grazing incidence geometry. For instance, SPPs propagating in different directions across the surface produce Moiré-patterns with a different fringe-spacing. A “normal incidence” geometry – harder to achieve due to the geometrical restrictions of the available PEEMs – is overall better suited for SPP imaging. The cylindrical symmetry caused by the incidence of the laser pulses normal to the surface results in the same imaging conditions for all SPPs, independent of their propagation direction. Also, the spacing of the Moiré fringes resembles the SPP wavelength, and in this respect normal incidence 2PPE PEEM provides a direct conceptual visualization of the SPP phase fronts in time and space. In time-resolved experiments under normal incidence conditions the direct observation of isolated SPP wave packets is then possible. Normal incidence 2PPE PEEM offers the possibility to study SPP reflection, transient SPP interference, and SPP focusing in time and space.

[1] L.I. Chelaru, F.-J. Meyer zu Heringdorf, Surface Science 601 (2007) 4541
[2] N.M. Buckanie, P. Kirschbaum, S. Sindermann, F.-J. Meyer zu Heringdorf, Ultramicroscopy 130 (2013) 49

Acknowledgement: Financial support by the German Research Foundation (DFG) through programs "SFB616: Energy Dissipation at surfaces" and "SPP1391: Ultrafast Nanooptics" is gratefully acknowledged.