Photoemission and Double photoemission with Femtosecond High-Harmonic Generation Sources

Cheng-Tien Chiang[2], Andreas Trützschler[1], Michael Huth[2], Frank O. Schumann[2], Jürgen Kirschner[2,1], and W. Widdra[1,2*]

[1] Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, Halle, Germany

[2] Max Planck Institute of Microstructure Physics, Halle, Germany

* wolf.widdra@physik.uni-halle.de

With the recent progress in high-order harmonic generation (HHG) using femtosecond lasers, laboratory photoelectron spectroscopy with an ultrafast, widely tunable vacuum-ultraviolet light source has become available. Whereas HHG-based photoemission experiments at kilohertz repetition rates have been severely limited by the space-charge effects in the past, the new development of compact HHG light sources with megahertz repetition rates allows for efficient photoemission and double photoemission experiments as is demonstrated for the Ag(001) surface [1-5].

Here we will present momentum-resolved photoemission experiments with photon energies between 14 and 40 eV that demonstrate the high performance of the setup [3,4,6]. In addition, the combination of two time-of-flight spectrometers with coincidence detection electronics opens the way for efficient and long-term stable double photoemission experiments at variable photon energies [1,6]. For the noble metal (001) surface of Ag, we present a detailed analysis of double photoemission data and will compare them with similar data for the NiO(001) surface. The electron-electron pair distribution shows a sharp sum-energy onset, which corresponds to one hole in the Ag 3d band (4.5 eV below the Fermi level) and a second excitation from the Ag sp band. Simultaneously, an intense energy sharing between the electrons in the pair is visible indicating strong electron-electron correlations [5].

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