O 76: Ultrafast Electron and spin dynamics at interfaces III

Time: Wednesday 17:30–18:30 Location: MA 005

O 76.1 Wed 17:30 MA 005

Coherent many-particle excitations in NiO ultrathin films — •Konrad Gillmeister[1] and Wolf Widdra[1,2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle, Germany — [2]Max-Planck-Institut für Mikrostrukturphysik, 06120 Halle, Germany

Strong electronic correlation in NiO causes the appearance of a charge-transfer gap (CTG). Its lower and upper edges (Hubbard bands) are formed by Ni 3*d* electrons. In this contribution we focus on the electron dynamics after exciting electrons into the upper Hubbard band.

Using time-resolved two-photon photoemission spectroscopy (2PPE) on 1–20 monolayers (ML) NiO ultrathin films on Ag(001) we find that electrons decay within 15 fs across the CTG. However, there is a second long-living contribution to the 2PPE signal which is thickness- and temperature-dependent: periodic intensity modulations in the detected time-resolved signal near the vacuum cut-off with a lifetime of ∼350 fs are found for NiO film thicknesses beyond 5 ML and temperatures below 470 K for 10 ML (560 K for 20 ML). These oscillations are exlained by intra-gap states which are indirectly but coherently addressed by an instantaneous decay of excited electrons and which are subsequently probed. A simultaneous excitation of magnons is also discussed.

O 76.2 Wed 17:45 MA 005

Time-resolved photoelectron spectroscopy with high-order harmonics: Surface photovoltage shift at SiO_2/Si(001) interfaces with nonlinear optical excitations — •Robin Kamrla[1,2], Cheng-Tien Chiang[1,2], Andreas Trützschler[1,2], Michael Huth[2], Frank Oliver Schumann[2], and Wolf Widdra[1,2] — [1]Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany — [2]Max Planck Institute of Microstructure Physics, Halle (Saale), Germany

We investigate the fluence and doping dependence of surface photovoltage shifts (SPV) at SiO_2/Si(001) interfaces. Charge carriers are excited by 300 fs laser pulses at repetition rates of 0.2 to 0.7 MHz with photon energies of $h\nu_{pump} = 1.2$ or 2.4 eV, and subsequently probed by high-order harmonics with $h\nu_{probe} = 22.6$ eV. On SiO_2/p-Si(001) we observe a SPV of 250 meV upon excitation with $h\nu_{pump} = 1.2$ eV towards higher energies, whereas on SiO_2/n-Si(001) the SPV reverses its sign and has a smaller magnitude of 140 meV. Upon excitation with $h\nu_{pump} = 2.4$ eV a maximum SPV at SiO_2/p-Si(001) of 350 meV is observed. Moreover, SPV at SiO_2/p-Si(001) shows a nonlinear fluence dependence at $h\nu_{pump} = 1.2$ eV, which significantly differs from that of $h\nu_{pump} = 2.4$ eV. In this talk the dynamics of SPV as well as its fluence dependence will be discussed.

O 76.3 Wed 18:00 MA 005

The one-step model of 2PPE in its layer-KKR formulation — •Jürgen Braun and Hubert Ebert — Dept. Chemie, LMU München, Germany

Recently a theoretical frame for the description of two-photon photoemission has been developed by the authors. The approach is based on a general formulation using the Keldysh formalism for the lesser Green function to describe the real-time evolution of the electronic degrees of freedom in the initial state after a pump pulse that drives a system out of equilibrium [1]. The fully relativistic formalism has now been generalized to angular resolution in both the initial and intermediate state by means of layer-KKR multiple scattering techniques. First examples of angular-resolved 2PPE calculations on Fe(100) will be presented. Furthermore, correlation effects will be accounted for in this spectroscopical study by means of a static self-energy $\Sigma^{DMFT}(E)$ obtained for Fe from dynamical mean-field theory.

[1] J. Braun, R. Rausch, M. Potthoff , and H. Ebert, One-step theory of two-photon photoemission, Phys. Rev. B **94**, 125128 (2016)

O 76.4 Wed 18:15 MA 005

Asymmetric electron and hole dynamics in the Rashba material BiTeI — •Sophia Ketterl[1], Marco Polverigiani[1], Vladimir Voroshnin[2], Beatrice Andres[1], Alexander Shikin[2], and Martin Weinelt[1] — [1]Freie Universität Berlin, Arnimallee 14, 14195 Berlin — [2]St. Petersburg State University, Institute of Physics, Uljanovskaya 1, 198504 St. Petersburg, Russia

Due to strong spin-orbit coupling and non-centrosymmetric crystal structure, the narrow band-gap semiconductor BiTeI hosts Rashba-split surface and bulk bands. This makes BiTeI a promising material for the generation of spin-polarized currents. It is intrinsically n-doped and exhibits additional strong band-bending at its polar surfaces, leading to partially occupied electron- and hole-like surface states for Te and I termination, respectively.

We studied the elecron and hole dynamics in the suface state and bulk conduction band on the Te-surface with time-resolved ARPES and observed a strong asymmetry for carriers close to the Fermi level. Electrons behave according to Fermi-liquid theory, while hole lifetimes decrease towards E_F. We attribute this behavior to drift currents due to the surface band bending and the influence of a plasmon decay channel as predicted by Eremeev *et al.* in *JETP Lett.* **96**, 437 (2012).