Attosecond electron dynamics on surfaces and layered systems

Reinhard Kienberger*

*Fakultät für Physik, E11, Technische Universität München, James Franck Straße, 85748 Garching

Synopsis

The generation of single isolated attosecond pulses in the extreme ultraviolet (XUV) together with fully synchronized few-cycle infrared (IR) laser pulses allowed to trace electronic processes on the attosecond timescales. The pump/probe technique was used to investigate electron dynamics on surfaces and layered systems with unprecedented resolution.

The attosecond streaking method [1] is the most established technique in attosecond science. Photoelectrons generated by laser based attosecond extreme ultraviolet pulses (XUV), are exposed to a dressing electric field from well synchronized laser pulses. The energy shift experienced by the photoelectrons by the dressing field is dependent on the delay between the XUV pulse and the dressing field and makes it possible to measure the respective delay in photoemission between electrons of different type (core electrons vs. conduction band electrons). The information gained in such experiments on tungsten [2] triggered many theoretical activities leading to different explanations on the physical reason of the delay. Attosecond streaking experiments have been performed on different solids [3], leading to different delays – also depending on the excitation photon energy.

A systematic investigation of photon-energy-dependent (E_Ph = 95 eV…145 eV) delay times measured in tungsten at different crystal orientations giving insight into possible effects responsible for the delay is presented and will be discussed.

Further, we show measurements of time-resolved transport of different types of electrons through a defined number of adlayers on a bulk material on an attosecond timescale (Fig 1) [4]. While the linear behavior in delay between the different types of electrons can be explained by transport effects the delay of conduction band electrons is more complex and not fully understood.

References


E-mail: reinhard.kienberger@tum.de