

# Basic Techniques of Surface Physics (Grundlegende Methoden der Oberflächenphysik)

The investigation of solid surfaces and their modification by foreign species under controlled conditions is a primary focus of **Surface Physics**, which contributes in a decisive way to the engineering of novel functional materials at the nanoscale and to the understanding of surface and catalytic processes in general. In this laboratory experiment, the students will be introduced to two state-of-the-art experimental techniques which are widely employed to study pristine and adsorbate-covered surfaces: **Temperature Programmed Desorption (TPD)** and **Low-Energy Electron Diffraction (LEED)**. The former is used to analyze the products of thermally-activated desorption from solid surfaces and is based on mass spectrometry – a widespread analytical tool in physics and chemistry. The latter relies on the scattering of electrons by the regular array of atoms in a solid: it is intrinsically surface sensitive due to the strong interaction of electrons with matter and represents a notable demonstration of the wave-particle duality in quantum mechanics.

Taking adsorbed carbon monoxide (CO) on a Ru(0001) surface as an exemplary case, insight will be gained into the fundamental principles and principal outcome of the techniques, and into the basic instrumentation and methodology involved. Importantly, a **fundamental understanding of adsorption and desorption phenomena** and the **formation of long-range ordered superstructures on solid surfaces** will be developed in a natural fashion.

The physical content and technical basis of the experiment include:

- basics of ultra-high vacuum technology
- experience in surface preparation protocols
- computer-controlled acquisition of TPD measurements, data analysis, treatment of desorption processes from model surfaces
  - acquisition of electron diffraction patterns and determination of surface order by reciprocal-space analysis

The laboratory experiments will be conducted in an interactive way to stimulate the interest and self-confidence of the students, and to provide a comprehensive view on adsorption phenomena at surfaces.

### Tutors:

**Dr. Yiqi Zhang**

(Contacts: [yiqi.zhang@tum.de](mailto:yiqi.zhang@tum.de), Chair E20, Room 225, Tel. 089 289 12320)

**Dr. Tao Lin**

(Contacts: [tao.lin@tum.de](mailto:tao.lin@tum.de), Chair E20, ISL-TUM, Tel. 089 289 12979)

**Dr. habil. Francesco Allegretti**

(Contacts: [francesco.allegretti@ph.tum.de](mailto:francesco.allegretti@ph.tum.de), Chair E20, Room 214, Tel. 089 289 12618)