DS 12 Lecture of the Gaede Prize Laureate

Time: Tuesday 14:00–14:45 Room: TRE Phys

Prize Talk DS 12.1 Tue 14:00 TRE Phys

Understanding Scanning Tunneling Microscopy Experiments on Transition-Metal Structures — •Stefan Heinze — Institut für Angewandte Physik, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg

Scanning tunneling microscopy (STM) is one of the most important techniques to characterize nanostructures on surfaces with a resolution down to the atomic scale. However, the interpretation of such measurements is not trivial, especially on the atomic scale, due to contributions to the tunneling current from various sources such as structural, electronic, chemical, and magnetic properties. Successful interpretation approaches, e.g. the Tersoff-Hamann model, rely on an accurate description of the electronic structure of the sample. Hence, the combination with modern density functional theory (DFT) calculations has proven a powerful tool for the understanding of STM experiments.

Here, the theory of STM is applied to structures on transition-metal surfaces and a transparent method is introduced to correlate bandstructure features with STM measurements. With this approach surprising effects such as bias-dependent corrugation reversal, imaging of buried nanostructures, and even the detection of small spectroscopic signals due to spin-orbit coupling can be explained based on the electronic structure. Further, the theory of spin-polarized STM (SP-STM) is presented and the potential of SP-STM to unravel complex, e.g. non-collinear, magnetic structures on the atomic scale is demonstrated. A particular striking example is the verification of a two-dimensional antiferromagnetic structure in a monolayer of Fe, the prototypical ferromagnet, on W(001).