Science on Saturday Lecture
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Visualizing The Atomic World

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ABSTRACT:
"Atom-Specific Interaction Quantification by High-Resolution Atomic Force Microscopy – and What We Can Learn From It"

Entire scientific disciplines such as mechanics and chemistry are governed by the interactions between atoms and molecules. On surfaces, forces extending into the vacuum direct the behavior of many scientifically and technologically important phenomena such as corrosion, adhesion, thin film growth, nanotribology, and surface catalysis. To advance our knowledge of the fundamentals governing these subjects, it would be useful to simultaneously map electron densities and quantify force interactions between the surface of interest and a probe with atomic resolution. For example, in the case of a catalytically active surface, this would allow to study the role and effectiveness of surface defects such as vacancies, kinks, impurities, and domain boundaries as active sites. Nanotribological research, i.e., the study of the atomic origins of friction, would be aided by the availability of a method able to lateral forces with atomic specificity.

We will start this talk by shortly reviewing the operational principles of scanning tunneling microscopy (STM) and atomic force microscopy (AFM), two probe-based microscopy methods that are able to achieve atomic-resolution imaging of surfaces. Subsequently, we show with the examples of graphite, a model solid lubricant, and oxygen-terminated copper (001), a model catalyst, how much of the in-depth information discussed above, which far exceeds simple atomic imaging, can be derived from combining advanced variants of STM and AFM.