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Atomic Force Microscopy for the characterization of the topography and properties of surfaces

In this lecture the principles of Atomic Force Microscopy (AFM), an advanced and versatile tool for the investigation of topography and different properties of surfaces, will be reviewed. This technique is based on the interaction of a sharp tip of nanometric size with the surface of a sample. The different types of tip-surface interactions will be first described and used to introduce the functioning of the technique. The experimental setup of an AFM microscope will be presented, together with contact and non-contact imaging methods for the determination of sample topography. Additionally, non-topographic imaging modes used to measure electrical, magnetic, chemical and other surface properties will be reviewed.

Micromechanics of surfaces by Atomic Force Microscopy

The mechanical response of materials and surfaces can be traditionally measured by macroscopic techniques such as rheology and tribology. An alternative is the use of Atomic Force Microscopy (AFM): By indenting the tip of the microscope into the surface, either continuously or in an oscillatory fashion, the force that the surface opposes to the applied deformation can be measured. Conventional techniques use the force measurement to determine the Young modulus of the surface/material, i.e. the surface hardness. However, recent developments based on Fourier analysis, allow the determination of the frequency dependent viscoelastic properties of the surface/material, as in rheology. Different from rheology though, the viscoelastic moduli can be determined on a local scale determined by the tip size, providing complementary information to this macroscopic technique.