

Atomic Force Microscope (AFM) and Tribometer in Ultra-high Vacuum

Key words

AFM, atomic force microscope, friction, wear, UHV, adhesion, nanotribology

Fields of application

Basics of friction and wear, ultra-high-vacuum conditions (UHV), nanotribology

Methodology and instrumentation

Atomic force microscopy (AFM) with temperature control -250 °C to +1200 °C, sliding tribometer

Items tested

Small samples (~ 10 mm x 1 mm), single crystals, AFM-tips

Quantities / characteristics tested

Topography with atomic resolution, friction, wear, adhesion

Uncertainty / reliability of results

Atomic resolution, friction: 2 % to 5 %, wear: 5 % to 100 % (depending on type of friction and wear)

Qualification and quality assurance

As a unique capability, this facility enables operation and sample cleaning in ultra-high vacuum.

Long-term experience in micro/nanotribology; more than 50 years of tribology research and testing.

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Further information

The apparatus is a combination of an Atomic Force Microscope (AFM) and a tribometer in an Ultra-High-Vacuum (UHV) chamber. Both are used to measure friction and wear. The AFM works with loads in the range of nano-newtons and the tribometer in the range of newtons.

The AFM is in principle a stylus profilometer, with atomic resolution in topography measurement (AFM-Mode, see Fig 1). By comparison of topographies smallest wear volumes can be evaluated. The friction between AFM-tip and sample surface can be measured if the apparatus is operated in the Lateral Force Mode (LFM, see Fig.1). The free energy of a surface or its adhesion tendency can be derived from so called force/distance curves.

The AFM can also be operated as a scanning tunneling microscope (STM) without contact to a conducting surface.

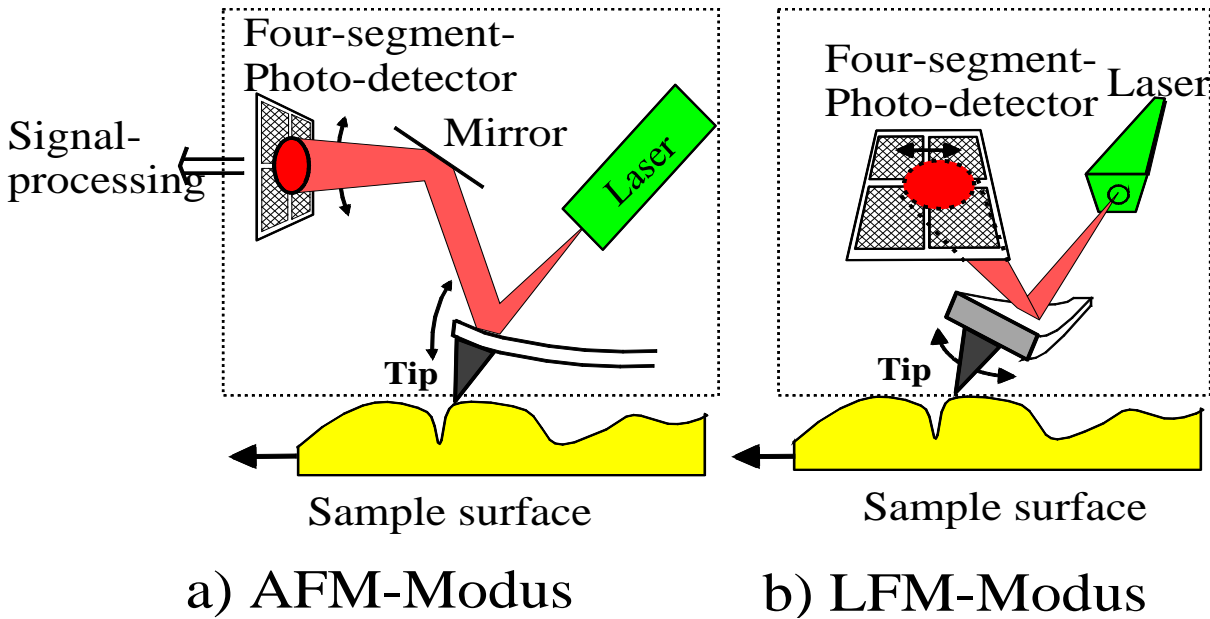
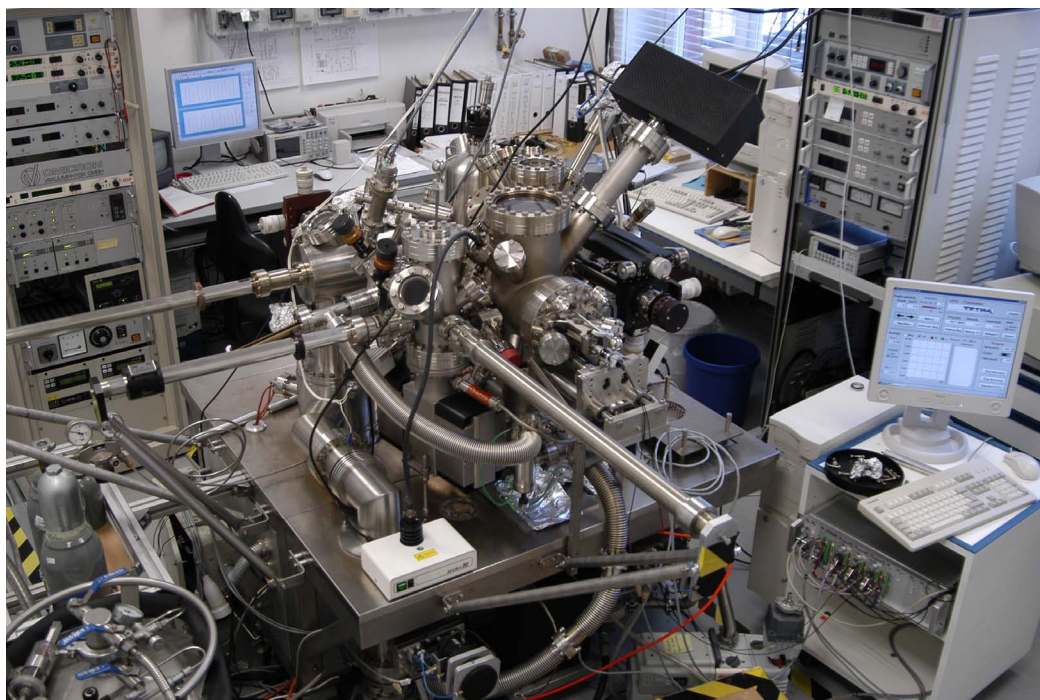


Fig. 1: Principle of an atomic force microscope (AFM)



Instruments for stressing samples by friction and measuring the friction and wear are called tribometers.

The load applied with the AFM is typically in the range of nano-newtons and that of the tribometer in this apparatus is in the range of some Newtons.

Fig. 2: UHV-chamber