Construction of an NC-AFM Combined with a Field Ion Microscope

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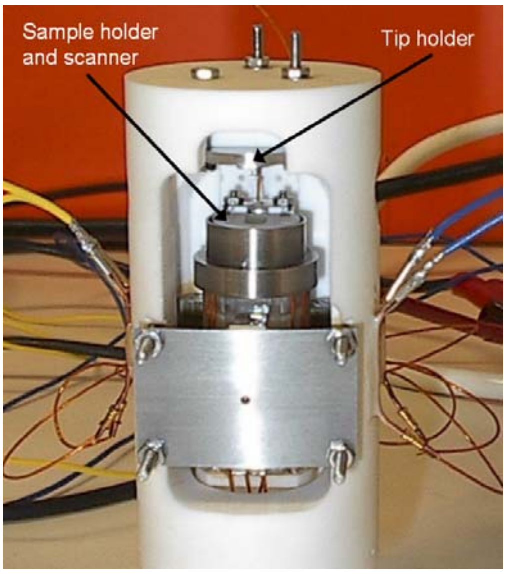
In recent years, the atomic force microscope (AFM) has been established as a tool for the imaging of surfaces with atomic resolution. However, a reliable interpretation of the observed atomic-scale contrast is often difficult since the exact configuration of the tip is usually unknown. Meaningful comparisons with theoretical simulations would require knowledge of the *exact* position and identity of all atoms at the tip apex. A method that allows to determine the position of the tip atoms with atomic precision is the field ion microscope (FIM).

We build an AFM for operation at low temperatures and under ultra high vacuum (UHV) conditions based on a design that has been previously published [1]. This type of design was chosen since it features a monolithic microscope body made from Macor; the resulting very high mechanical stiffness facilitates the decoupling of external vibrations. Significant changes in the design were nevertheless necessary since the original design uses silicon cantilevers as the force sensors, which are not suited as FIM specimens. Therefore, we implemented a tuning fork as force sensor [2], allowing us to choose an appropriate material such as tungsten as tip material while maintaining atomic-scale resolution capabilities.



It has been shown before that the combination of an AFM operated in static contact mode with a FIM allows the correlation of interatomic forces with the atomic-scale tip configuration [3]. The dynamic mode of operation using the tuning fork technique is expected to greatly enhance the force sensitivity of such measurements. Ultimately, the combination of clean experimentation in ultrahigh vacuum, high stability and low drift at low temperatures, high sensitivity to short-range forces of the tuning fork sensor, and detailed tip structure characterization by FIM will enable in-depth investigations on how the NC-AFM contrast mechanism is affected by the exact geometry of the last atoms of the probing tip.

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