Investigation of Lateral forces in Si(111)-7×7 surface using small oscillation amplitude nc-AFM with tunnel current feedback

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Lateral forces play an important role in friction studies as well as atomic manipulation. Giessibl *et al*. has shown lateral force images exhibiting atomic scale resolution [1], however it is speculated that even smaller amplitudes can demonstrate true atomic resolution images as well as lateral stiffness measurement of ad atoms.

We present the design and performance of an nc-AFM which is capable of measuring lateral forces simultaneously with tunneling current. The microscope (Fig.1) employs a sensitive fiber interferometer for high resolution force measurements [2,3]. Home-made tungsten cantilevers with typical stiffness of about 150 N/m is dithered in lateral directions respect to the sample with sub-Ångstrom oscillation amplitudes (A_0 =0.25 Å) at a frequency, well below the resonance frequency and the changes in lateral oscillation amplitudes are recorded using a lock-in amplifier. In addition, the microscope can simultaneously be operated as STM. By changing the tunneling current and bringing the tip closer to the surface, we investigate the lateral forces during STM imaging. The lateral force images will be presented as a function of tunnel current (relative tip-sample distance) on Si(111) (7×7) surface.

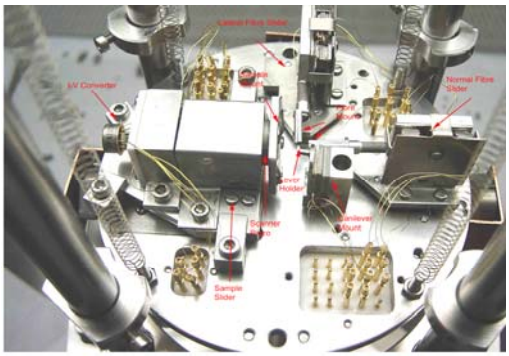

Figure. 1 Photograph of the AFM

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[2] D. Rugar, H. J. Mamin, and P.Guethner, Appl. Phys. Lett., 55, 2588 (1989)

[3] A. Oral, R. A. Grimble, H. O. Ozer, and J. B. Pethica , Rev. Sci. Inst. 74(8) 3656 (2003)