Simultaneous AFM and STM measurements using optical deflection sensor

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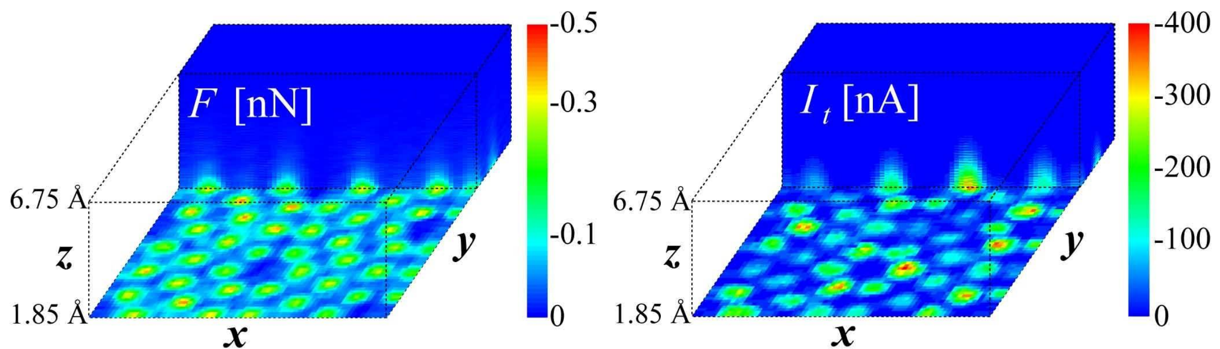
Atomic force microscopy (AFM) as well as scanning tunneling microscopy (STM) allow for the imaging of individual atoms on various surfaces and for the measurement of a variety of local physical quantities. Using conductive tips and samples, combined AFM/STM measurements on the same surface area become possible. Since AFM and STM yield complementary quantities, simultaneous measurements offer a powerful method to investigate mechanical and electronic properties on surfaces with atomic scale resolution.

We have carried out simultaneous AFM/STM measurements on the semiconducting surfaces using metal coated Si cantilevers [1-4] and W tips supported by quartz cantilevers [5-6]. Cantilever deflection sensor based on optical interferometer enables force measurements with high sensitivity and completes decoupling of the force and tunneling current signals. In this talk, simultaneous AFM/STM imaging at constant height, 3D force/current mapping, and the conversion formula [7] from the time-averaged tunneling current to the instantaneous tunneling current are presented. The relation between the chemical bonding force and the tunneling current in a semiconducting atomic-scale junction is also discussed.



3D maps of the short-range force and the instantaneous tunneling current on the Si(111)-(7×7) surface. They are converted from the maps of the frequency shift and the time-averaged tunneling current simultaneously obtained.

References

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