Atomic Scale STM Imaging of Carbon Nanotubes: Possibilities and Limitations

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Ever since its invention in 1982, the scanning tunneling microscopy (STM) continues to be a very versatile tool in surface science and technology. The high-resolution power of STM combined with its remarkable advances in manipulation techniques have allowed scientists to fabricate artificial atomic scale structures, to study quantum phenomena or to probe physical and chemical properties of matter at single atomic and molecular level. STM has also played a crucial role in carbon nanotube (CNT) research as it provided direct microscopic evidence for the interplay between structural parameters and electronic properties, intramolecular junctions and defects, interlayer interaction, cross-junction interaction, electron-phonon interactions and chemical attachment. However, mechanical and electronic interactions of substrate-CNT system complicate the STM results and limit the resolution in space and energy. These limitations pose great challenges to directly measure diameters and chiralities, to visualize the atomic arrangements at local defects and to probe the intrinsic physical properties. In this talk I will address these issues and show how we can reduce the unwanted interactions in order to extract the relevant information while allowing other techniques, such as transport and TEM or Raman spectroscopy, to be performed on the same CNT for complementary characterization.