Exploring Novel Capabilities of the Scanning Tunneling Microscope*

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The scanning tunneling microscope (STM) invented by Binnig and Rohrer twenty-five years ago has made a major breakthrough in surface science and also laid the foundations of the current nanotechnology. The purpose of the present paper is to demonstrate that the STM can have many more capabilities by modifying it in several points. The demonstration is made by taking the following four examples from our recent work.

1) The development of multiprobe STMs has made it possible to measure the electrical conductivity of various nanostructures; all the probes can be used to observe STM images, but their main role is to be used as nanoscale electrodes that form electrical contacts with a selected nanostructure for conductivity measurement.

2) By measuring the linear and circular polarizations of photons emitted from the tunneling gap of the STM, we can obtain information on the orbital and spin angular momenta, respectively, of local surface electronic states of a sample.

3) Using the probe tip of the STM, we can trigger chain polymerization at any point in certain self-assembled molecular layers and can also control local polymerization and depolymerization reversibly in thin films of C60 molecules.

4) When the tunneling gap of the STM is illuminated with a synchrotron-radiation X-ray with continuously changing photon energy, a part the observed STM image changes its contrast when photon energy exceeds a certain value. From this critical photon energy, which corresponds to an absorption edge, the element in that part can be identified.

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