

## APPENDIX B

### More on Tunneling

If a metal probe tip terminating in a single atom is placed sufficiently close to an electrically conductive sample and a small voltage is applied between the probe and sample, then electron tunneling may occur between the tip and substrate. The net flow of electrons can be measured as a tunneling current, which is proportional to the transmission probability. When the probe above the sample is moved horizontally, any bumps on the surface will change the tip-to-surface separation, because of changes in the overlap between the tip atom and the surface atoms. Changes in the separation distance of as small as 0.01 nm result in measurable changes in the tunneling current, because of the exponential relationship between the separation and the transmission probability. Thus, when the tip is directly over a surface atom, the tunneling current will be higher than when the tip is between two atoms. Higher currents mean that the substance being investigated has a higher surface height at that position and shorter tunneling distance. Measurement of the tunneling current obtained from scanning (rastering) consequently generates the topographic map of the surface with atomic resolution.