

### 17.2.7 Field emission electron spectroscopy (FES)

Field Emission is the emission of electrons from a cold cathode upon application of an intense electric field. An electric field strength of the order of  $10^9 \text{ Vm}^{-1}$  is required for the electrons to tunnel through the surface barrier. To achieve these field strengths with realistic applied voltages of a few thousand volts the emitting cathode is etched to a very sharp point. This system is the basis of Field Emission Microscopy (FEM) and, with the addition of helium gas, Field Ion Microscopy (FIM). In Field Emission Microscopy however, the information about the surface contained in the electron energy distribution is forfeited in order to retain the spatial information for microscopy. However, if electrons from only a small area of the surface are collected and energy analyzed we have an electron spectroscopy. This is usually known as Field Emission Energy Distribution Spectroscopy (FEEDS) or Field Emission Spectroscopy (FES).

#### **Field Emission Energy Distribution spectroscopy (FEEDS)**

The sample is a single crystal, etched to a sharp tip ( $\approx 10^{-7}$  m in radius). The crystal is at a potential of several kilovolts to an earthed phosphor screen with a small probe hole in it for electrons from a selected spot to pass through. The region of the surface to be analyzed is selected by deflection plates near the cathode. Electrons passing through the probe hole are decelerated by an electron lens system into an electron energy analyzer.

Electric field: strength:  $\approx 10^9 \text{ Vm}^{-1}$ ; applied voltage: 5-10 kV; sample area: 10-100 nm.

Detected: electrons ( $\approx 2 \text{ keV}$ ); angle of exit: forward with a wide spread.

Spectrum: electron current vs. analyzer energy.