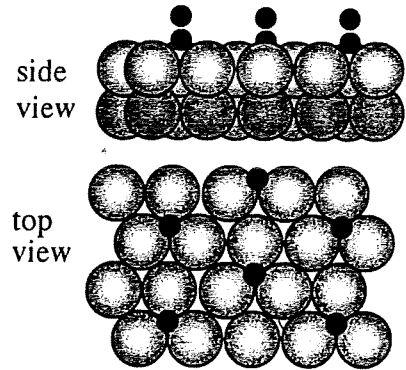


1. Explain shortly what are the following surface science techniques and why they are surface sensitive
 - a) XPS
 - b) LEISS
 - c) STM



2. On the right is shown the surface structure obtained after CO adsorption on the Pd(111) surface.
 - a) Name the structure.
 - b) What is the coverage of CO?
 - c) Sketch the LEED picture given by the system.

3. An ion scattering experiment is carried out on the surface of a polycrystalline FeAlO₃ sample, using 2000 eV ⁴He⁺ ions and a scattering angle of 90°.
 - a) Sketch the expected plot of ion yield vs. energy for the scattered ions.
 - b) If the sample were a single crystal, rather than polycrystalline, how might this affect the peak height ratios in the spectrum?

4. A tungsten SPM tip was initially characterized by thermionic emission and it produced a thermionic current of 0.38 A/cm² at a temperature of 2500 K. Following this, it was scanned over a silver surface in a KPM experiment and the current was minimized at an applied bias voltage of 0.2 V. Calculate the work function of the surface and comment on the value. The work function of Ag (111) surface is 4.6 eV.

(The constant $A = \frac{4\pi k_B^2 e}{h^3} \approx 120 A cm^{-2} K^{-2}$)

5. Water adsorbed at low temperature on a Cu(110) leads to a work function decrease. With increasing temperature the data shown in the adjacent figure was obtained: a) adsorbed species as identified by UPS, b) superstructures as observed by LEED, and c) work function change measured from, the clean surface value. Calculate the dipole moment of the adsorbed water molecule at 120K. Copper is an fcc metal with a lattice constant 3.61 Å.

