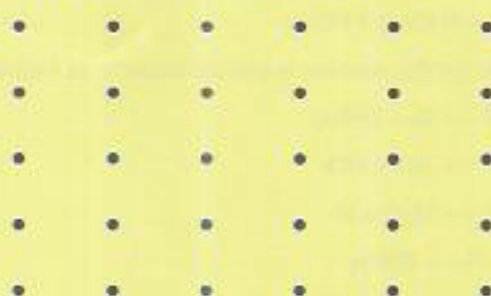


**Question 11**

(a) (8 marks) A lattice point representation of the structure of the (110) surface of a crystal of the fcc metal M is shown in Figure 3.



**Figure 3** The (110) surface of the fcc metal M.

(i) State what is meant by the term 'surface unit mesh', and sketch the unit mesh for this surface, labelling it in the conventional way.

(ii) Carbon monoxide adsorbs on this surface to produce an adsorbate structure denoted by  $M(110)(4 \times 1)\text{-CO}$ . Explain what is meant by this notation, and sketch the unit mesh of this adsorbate structure. With the aid of your sketch, determine the fractional surface coverage of CO.

(b) (2 marks) The (110) surface of this metal crystal is to be prepared for study by X-ray photoelectron spectroscopy (XPS) and electron energy loss spectroscopy (EELS). Describe how the surface should be treated for this purpose, giving your reasons.

(c) (10 marks) Explain with the help of a sketch, *but without giving experimental details*, the principles of surface studies by each of the following techniques:

(i) X-ray photoelectron spectroscopy (XPS)

(ii) Electron energy loss spectroscopy (EELS)

In each case, state the kind of information that is obtained and indicate how you would interpret the experimental results, stating any information that would be needed for this interpretation. Use the example of CO adsorption on a metal surface to illustrate your discussion of EELS.

[END OF QUESTION PAPER]