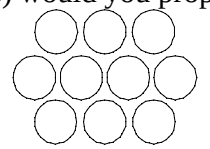
Quiz 4 XRD 4/20/01

a) **Sketch** (in any reasonable way) the 3d structure of copper (A1) and
show [110]. (A1 is the conventional structural designation).

b) **Sketch** the structure of NaCl (B1)
How many atoms does this structure have per unit cell?
Is this a primitive cell?

c) If you saw the following crystallographic plane in a TEM image
what possible crystal structure(s) would you propose?



Which planes in this (these) crystal structure(s) would this correspond to?
How could you verify the actual 3-d crystal structure in the TEM?

d) **Sketch** a BCC structure (A2) in a 3d real space lattice and
in a reciprocal space lattice.
How are the two lattices related? i.e. what relates $\mathbf{b}_1$ to $\mathbf{a}_1$, $\mathbf{a}_2$ $\mathbf{a}_3$?
How does the reciprocal space lattice relate to the Miller indicies of a plane?
Is the real space symmetry reflected in the reciprocal space lattice?

e) **Sketch** the diamond cubic structure (A4).
Why is this structure of interest to the semiconductor industry?

Answers: Quiz 4 XRD 4/20/01

a)

b) 8 atoms per cell
No it is not a primitive cell

c) Either HCP or FCC.
In HCP this is the (001) plane and in FCC the (111) plane.
You would need another projection to determine if it was HCP or FCC. A normal projection to that shown would have an ABAB sequence in HCP and an ABCABC sequence in FCC.

d)

$\mathbf{b}_1 = \mathbf{a}_2 x \mathbf{a}_3 / V$ etc. $\mathbf{b}_1$ is in the same direction as $\mathbf{a}_1$. Points in the reciprocal lattice correspond to Miller indicies of groups of planes. Real space symmetry is maintained in reciprocal space.

e)

This is the structure of silicon and germanium which are the main materials used in the semiconductor industry.