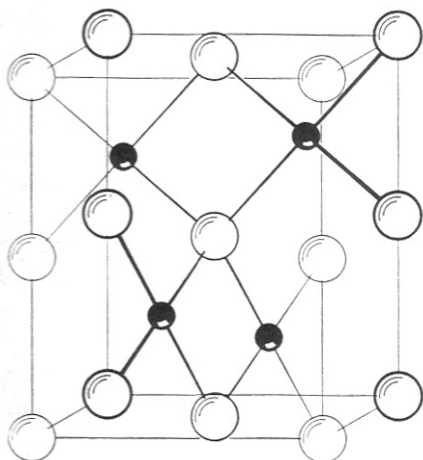
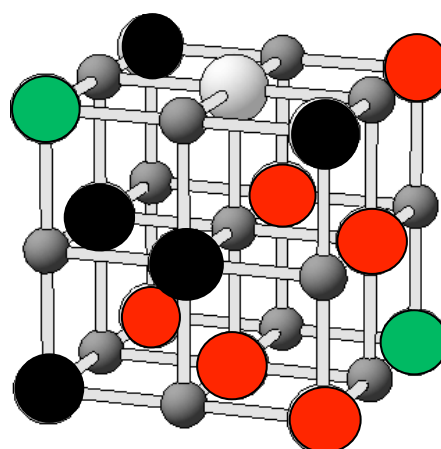


Marks
8

- PdO is used as a hydrogenation catalyst and it crystallizes with the tetragonal structure shown below. NiO has a variety of uses and crystallizes with the rocksalt structure. The large spheres represent the oxygen atoms and the smaller spheres represent palladium or nickel atoms.



palladium(II) oxide, PdO



nickel(II) oxide, NiO

Show the structure on the left is consistent with the formula PdO.

In the unit cell there are:

4 Pd atoms

1 O atom in the centre

$2 \times \frac{1}{2} = 1$ O atom at the top and bottom faces

$4 \times \frac{1}{4} = 1$ O atom at the equatorial edges

$8 \times \frac{1}{8} = 1$ O atom at the corners

This gives unit cell formula of Pd₄O₄ and thus empirical formula of PdO.

What is the coordination number about each metal atom?

Pd: **4**

Ni: **6**

The radius of the Pd²⁺ ion is 86 pm, that of the Ni²⁺ ion is 69 pm. Give a reason why the larger ion has a smaller coordination number.

Pd²⁺ (*d*⁸) prefers square planar coordination and thus has a lower coordination number than Ni²⁺. The ionic model would predict that the larger Pd²⁺ ion would have a higher coordination than Ni²⁺. The preference of Pd²⁺ for square planar coordination overrides this.

Does either structure contain a close-packed arrangement of O²⁻ ions?

PdO: YES / NO

NiO: YES / NO

If YES, indicate the layers on the unit cell(s) above. See coloured layers above