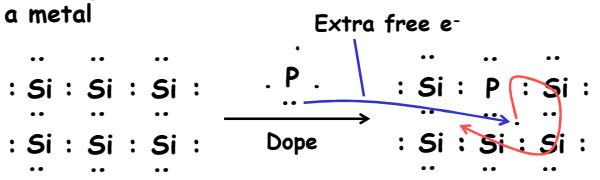
Semiconductor Doping

Doping of Semiconductors

- Semiconductors are not intrinsically conductive
- To make them conductive, replace silicon atoms in the lattice with dopant atoms that have valence bands with fewer or more e^-'s than the 4 of Si
- If more e^-'s, then the dopant is a donor: P, As
  - The extra e^- is effectively released from the bonded atoms to join a cloud of free e^-'s, free to move like e^-'s in a metal



  - The larger the # of donor atoms, the larger the # of free e^-'s → the higher the conductivity

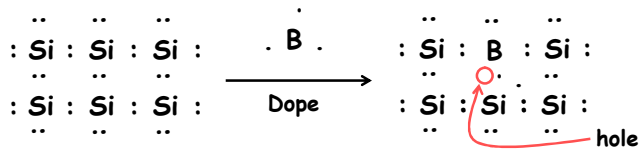
Doping of Semiconductors (cont.)

- Conductivity Equation:

$$\sigma = q\mu_n n + q\mu_p p$$

σ: conductivity; q: charge magnitude on an electron; μ_n: electron mobility; n: electron density; μ_p: hole mobility; p: hole density

- If fewer e^-'s, then the dopant is an acceptor: B



  - Lack of an e^- = hole = h^+
  - When e^-'s move into h^+'s, the h^+'s effectively move in the opposite direction → a h^+ is a mobile (+) charge carrier