Diodes

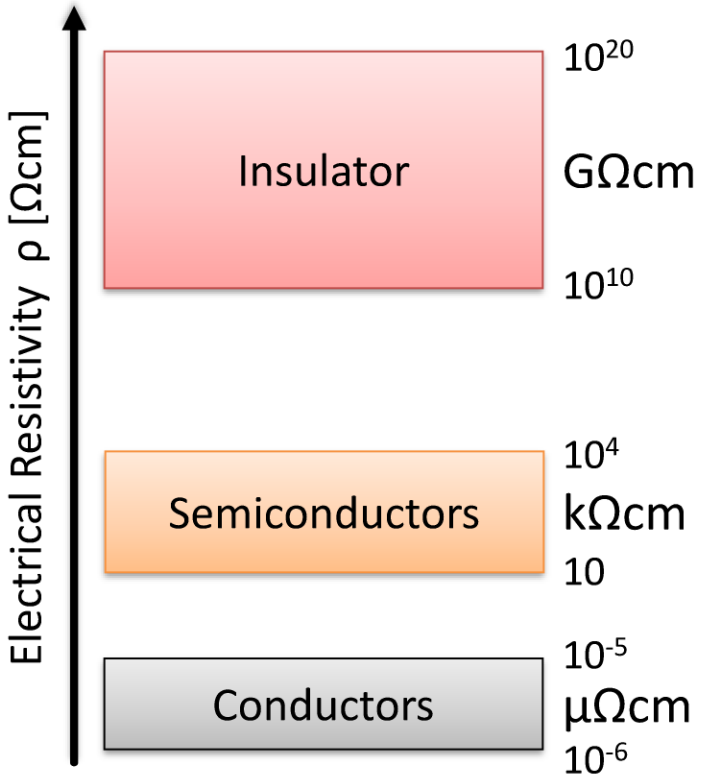
Networks and Embedded Software

Module 3.1.1

by Wolfgang Neff

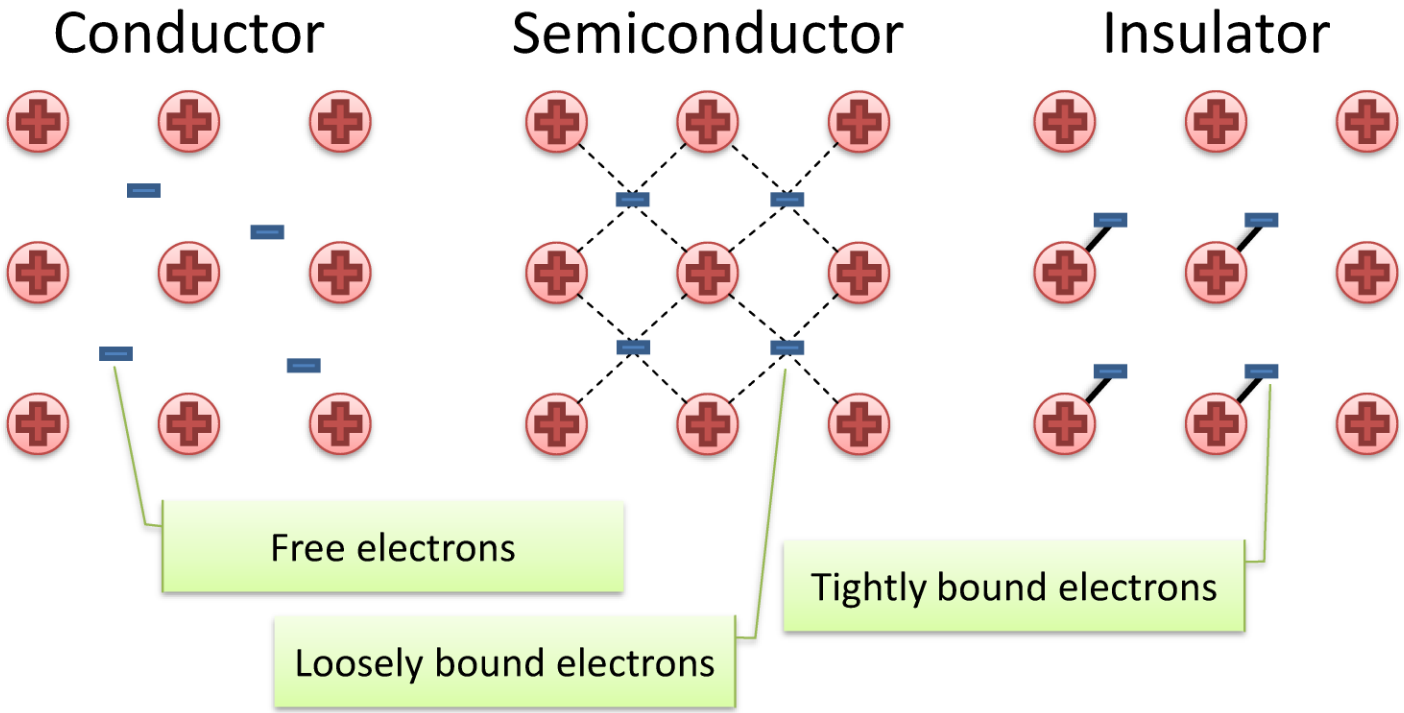
Semiconductors (1)

- Classification
  - Conductor
    - Silver, copper
    - High conductivity
  - Insulator
    - Porcelain, plastics
    - High resistivity
  - Semiconductor
    - Silicon, germanium



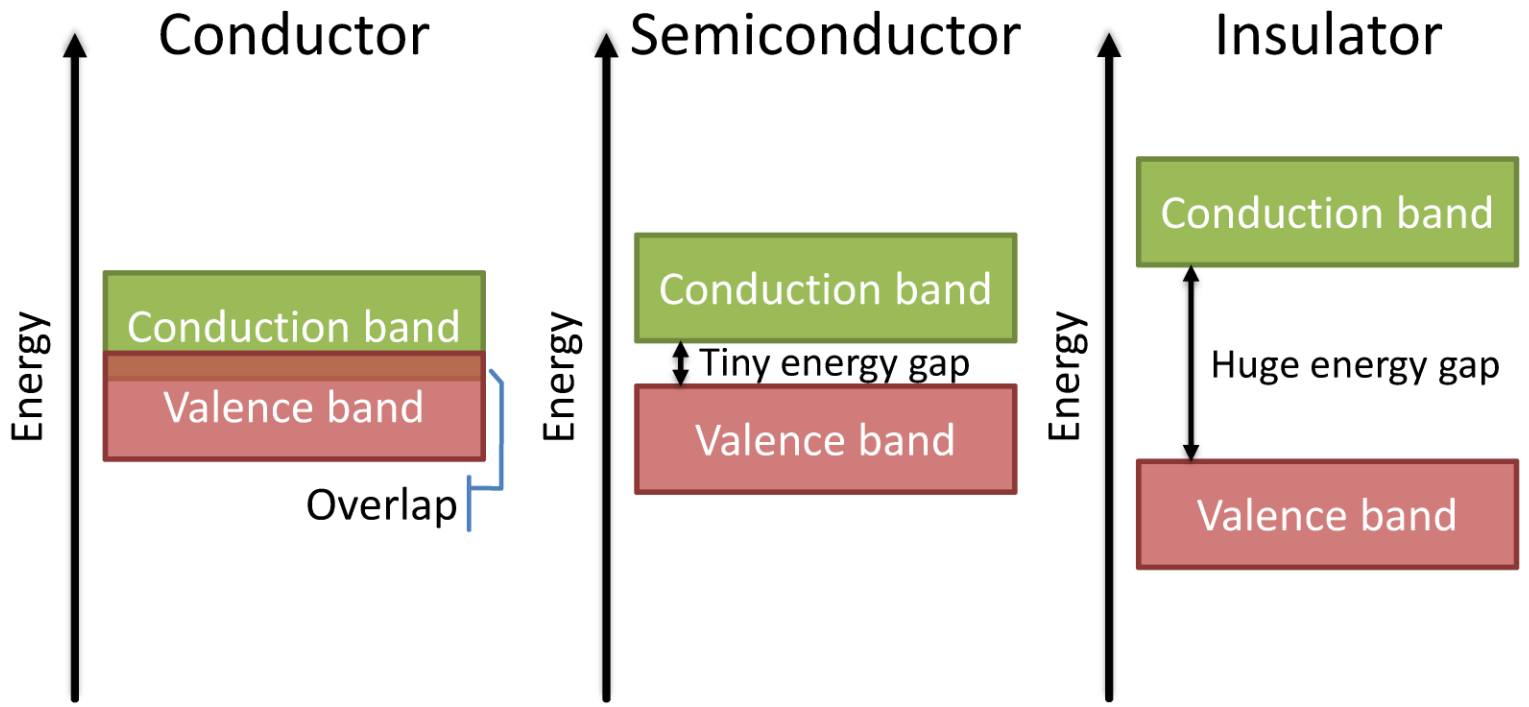
Semiconductors (2)

- Conductivity (simple model)



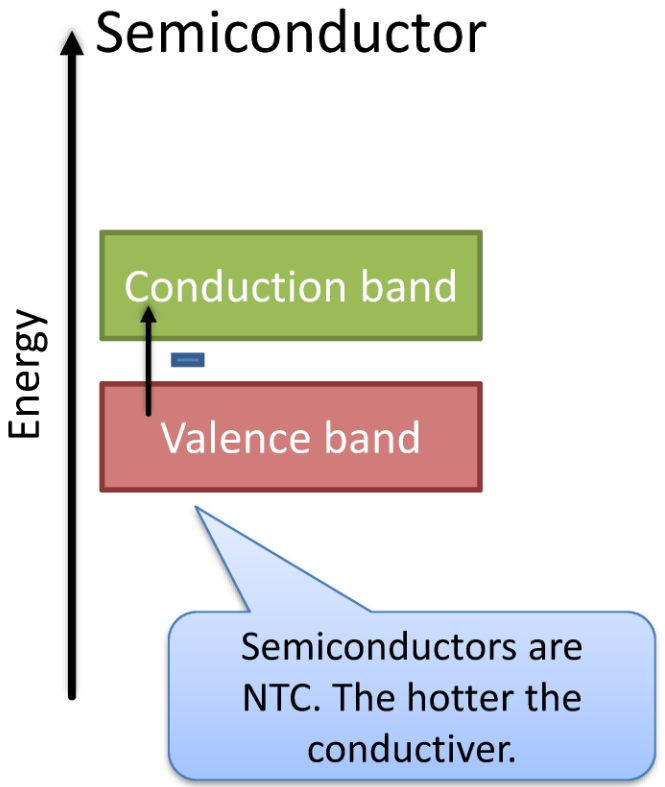
Semiconductors (3)

- Conductivity (band model)



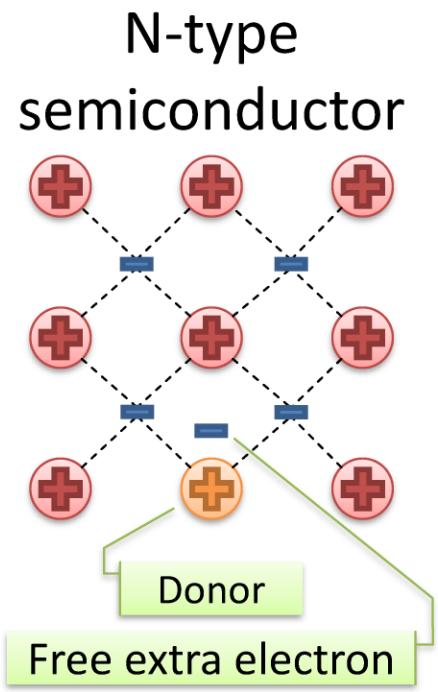
Semiconductors (4)

- Intrinsic conduction
  - Semiconductors are insulators
  - Electrons can cross the energy gap
  - Heat can provide this energy.
  - Conductivity depends on temperature



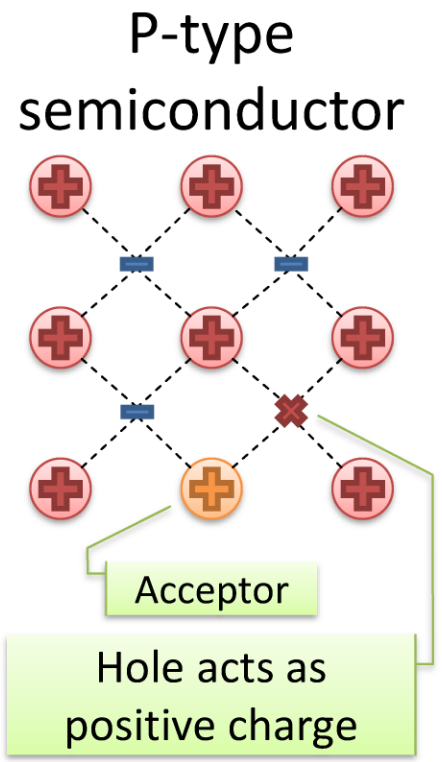
Doping (1)

- Donors
  - Some atoms replaced by donors
  - Extra electrons
  - Better conductivity
  - N-type doping



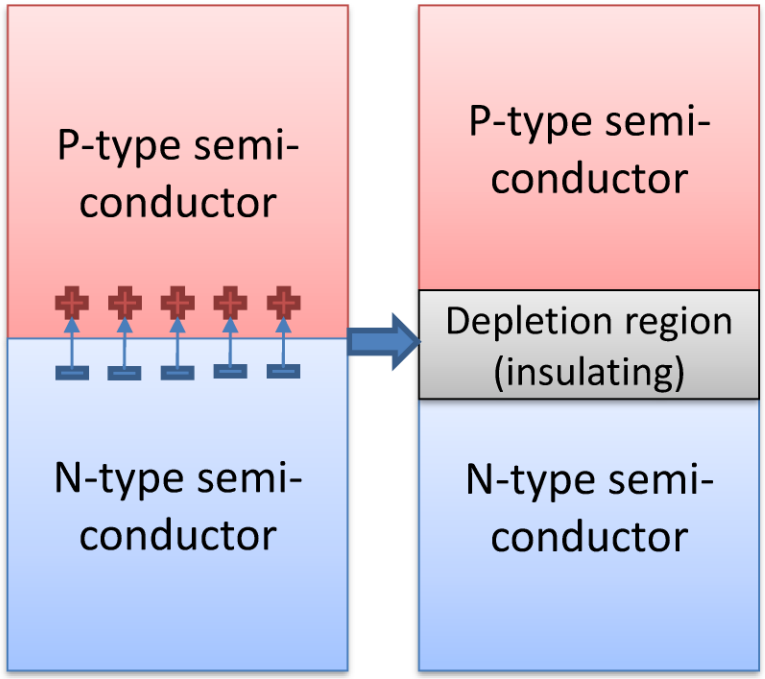
Doping (2)

- Acceptors
  - Some atoms replaced by acceptors
  - Lack of electrons
  - Better conductivity
  - P-type doping



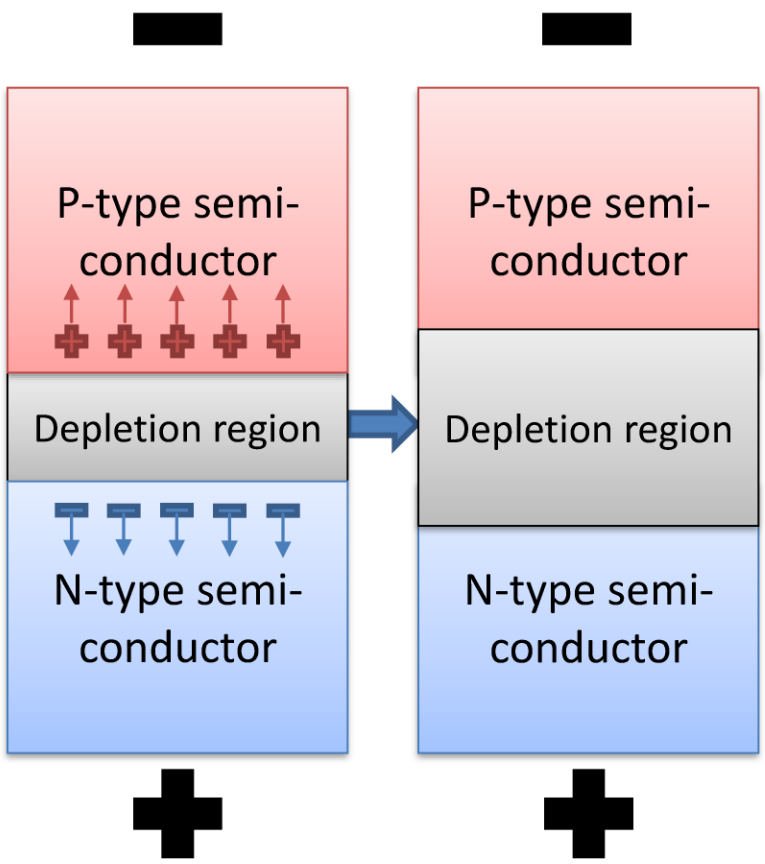
Doping (3)

- P–n junction
  - Electrons migrate into holes
  - No free charges in depletion zone
  - Depletion zone is insulating



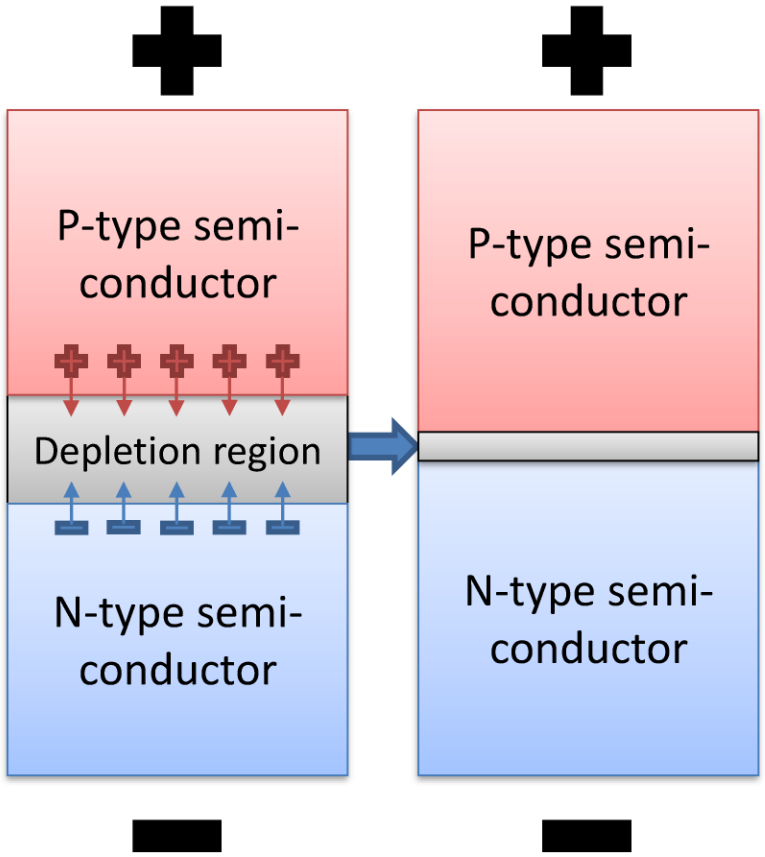
Doping (4)

- P–n junction (continued)
- Power supply
  - P-type side: –
  - N-type side: +
- Depletion zone larger
- Insulation remains



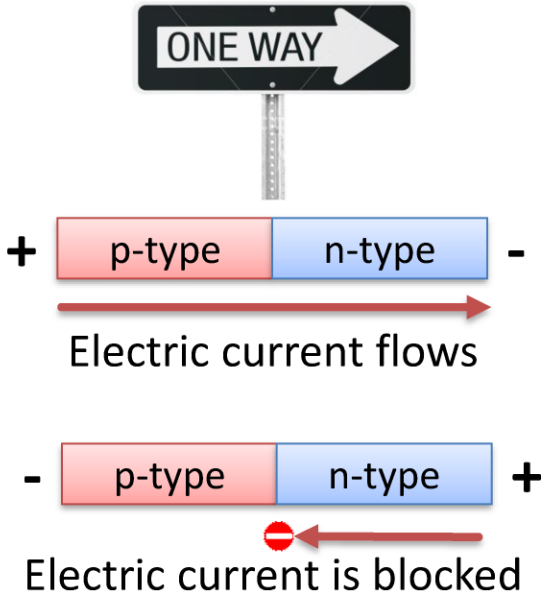
Doping (5)

- P–n junction (finished)
- Power supply
  - P-type side: +
  - N-type side: -
- Depletion zone smaller
- Insulation diminishes



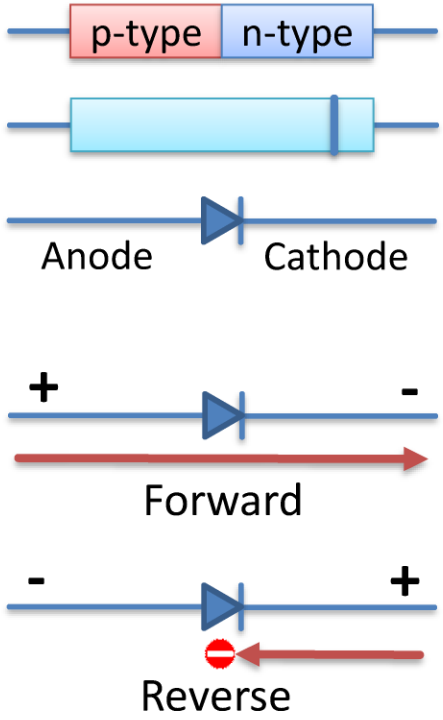
Diodes (1)

- P–n junctions are diodes
  - Flow Control Valve
    - One-Way Road
  - Forward
    - P-type: +, n-type: -
    - Current flows
  - Reverse
    - P-type: -, n-type: +
    - Current gets blocked



Diodes (2)

- Example: 1N4148
  - Maximum forward current
    - I_F = 300 mA
  - Maximum reverse voltage
    - V_R = 100 V
  - Reverse Leakage
    - I_R = 0.025 µA (V_R = 20 V)
    - I_R = 5.0 µA (V_R = 70 V)



Diodes (3)

- Applications
  - Reverse voltage protection
  - Rectifier