

University of Virginia

Department of Physics

Physics 606: How Things Work II

Lecture #21 Slides:

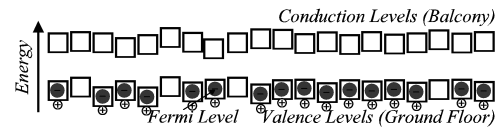
Audio Amplifiers II

Doped Semiconductors

- Pure semiconductors are insulating
 - Valence levels are filled and can't conduct
 - Conduction levels are empty and can't conduct
- Impure semiconductors can be conducting
 - Extra valence levels → valence band conduction
 - Extra electrons → conduction band conduction

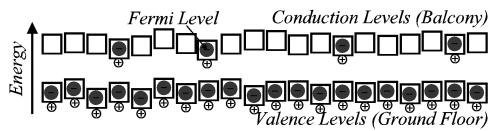
p-Type Semiconductors

- Substitute atoms with more empty orbitals
- Extra, empty valence levels
- Electrons can move through valence levels



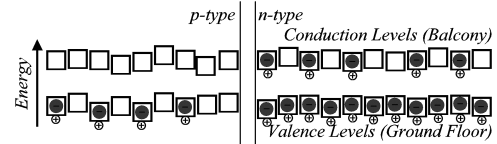
n-Type Semiconductors

- Substitute atoms with more filled orbitals
- Extra, full conduction levels
- Electrons can move through conduction levels



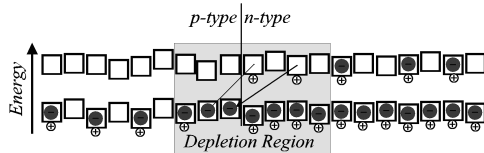
pn-Junction (before)

- Before p-type meets n-type:
 - Each material can conduct electricity
 - Each material is electrically neutral everywhere



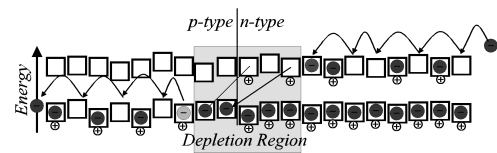
pn-Junction (after)

- After p-type meets n-type:
 - Insulating depletion region appears at junction
 - Depletion region is electrically polarized



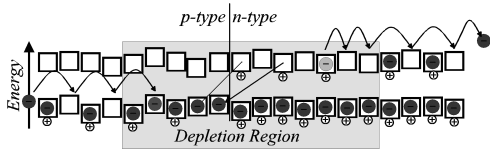
Forward Conduction

- A diode conducts when electrons arrive at the n-type end and leave at the p-type end
- Depletion region shrinks



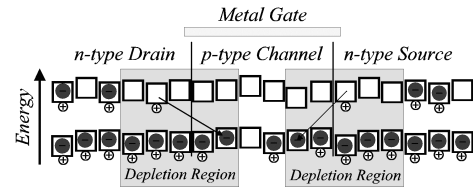
Reverse Conduction

- A diode doesn't conduct when electrons arrive at the n-type end and leave at the p-type end
- Depletion region enlarges



MOSFET Transistor Off

- Two back-to-back pn-Junctions
- Normally does not conduct electricity at all



MOSFET Transistor On

- Gate charge can change the channel type
- Entire device becomes one type and conducts

