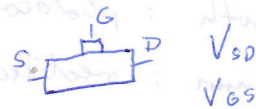


physics, bme.ha/...

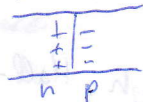
Physics of Semiconductors

Semiconductors (SC): material whose conductivity can be effected

- by: - temperature
- doping (intentional/unintentional)
- external voltage (drain, bias voltage)



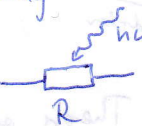
- another semiconductor nearby
 - o diffusion, charge transfer



depletion layer → charge diffusion junction

- light, photoconductivity

(sensors, photovoltaic eff.)



- magnetism (spintronics, magnetic semiconductors)
 - Mn ; GaAs

SC materials

o IV. group: Si, Ge, (Sn), C
 allotropes: diamond, graphite, graphene, nanotubes, fullerenes

Bulk semiconductor

- o IV. group Compounds: SiC
- o III-V group Compounds: GaAs, AlP, InSb
- o II-VI group Comp.: ZnS, ZnSe, ZnO, PbS₂, FeSe₂

Low dimensional semiconductors: 1D: C nanotubes, nanowires GaAs
 2D: graphene, transition metal dichalcogenide
 MoS_2 , $MoSe$

Molecular SC: Buckytube

Diamond: SC or Insulator?

$$E_g = 6 \text{ eV} \rightarrow \text{SC}$$

$$\text{Si}_3\text{N}_4 \Rightarrow 4 \text{ eV} \rightarrow \text{Insulator}$$

B: C \rightarrow Superconductor
4% 96%

Early History of SCs: Fundamental effects

1833 Faraday: AgS heated \rightarrow R decreases

1839 Becquerel: photovoltaic effect

1873 Smith: photoconductivity Se (light \rightarrow R decreases)

1874 Brann: rectification (eggs and digits) in metal-sulfides

Schuster: CuO rectification

1878 Hall-effect

1900 Baedeker: inverse sign Hall-effect in CuI

$$R_H = \frac{1}{n \cdot e}$$

n = number of e-c
 cm^{-3} \rightarrow charge carriers

1910 Weiss: Hall semiconductor

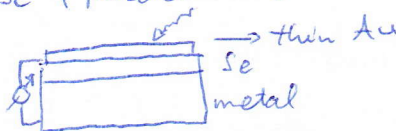
1928-1938 Quantum Theory of Semiconductors
Bloch, Schottky, Matt

1940 Bardeen: ~~Bardeen~~ non-reproducing laboratory results are due to about $< 1 \text{ ppm}$ unintentional doping

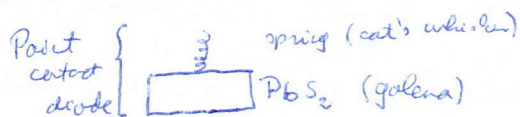
Technology:

1880: Bell voice transfer Se (piezoelectricity)

1883: Fritts: first solar cell



1904: J.C. Bose sensitive radio detector (rectifying device)



1906 Pound: LED

1920 several people \rightarrow CuO + Se: rectifier AC \rightarrow DC

1922 Loser ZnO: amplifier