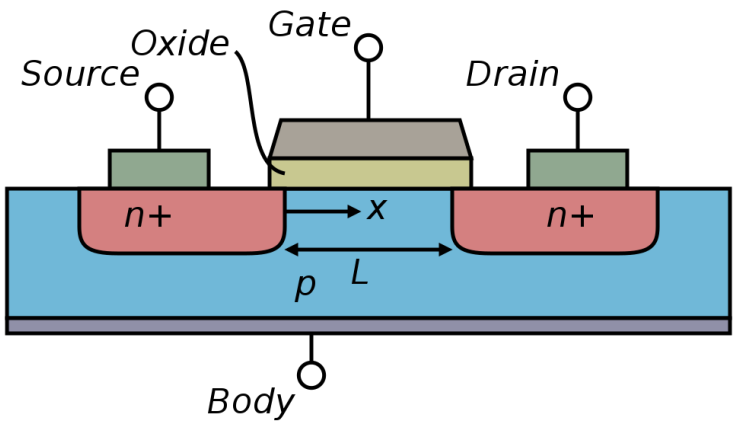
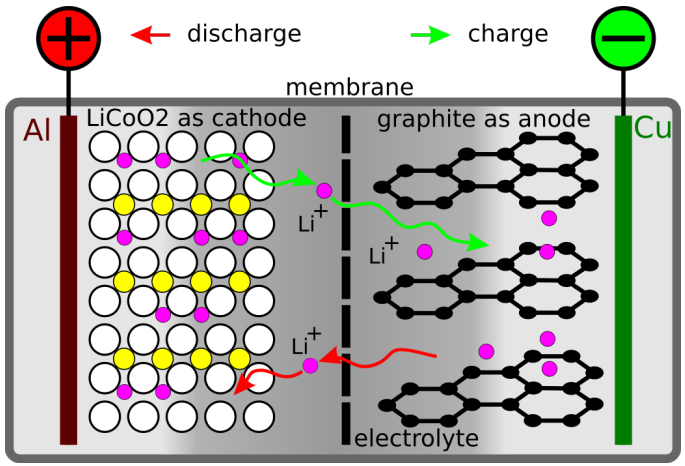
What is semiconductor: a functional electronic material

- Metals – passive electronic components (wires, electrodes)
- Insulators – passive electronic components (insulators)
- Semiconductors – active electronic components (device core)





Electronic devices: transistors, light emitters, solar cells, sensors – any device generating or transforming electronic current

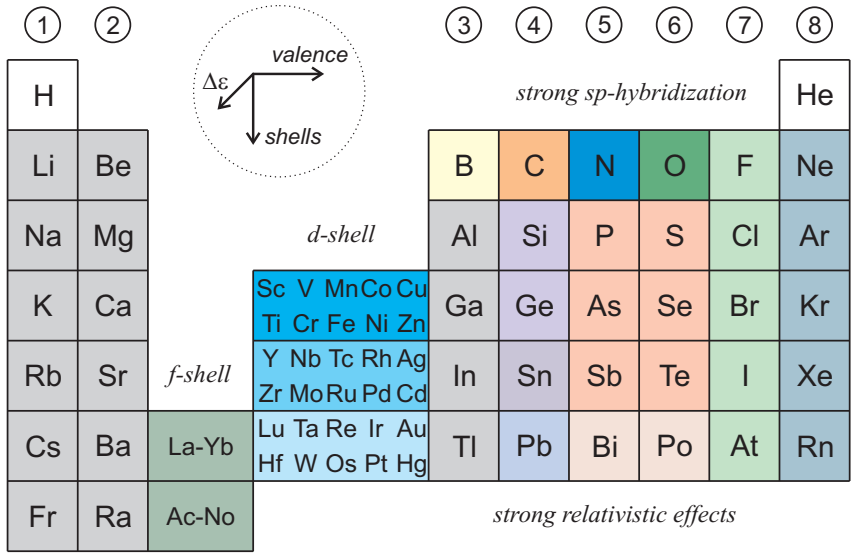
Passive electronic components in devices with electronic-ionic current, such as cathode/anode in rechargeable metal-ion batteries

What is semiconductor: definition by bandgap/conductivity

bandgap	class	electronic conductivity
several eV	insulators	no current because of self-localization
few eV	semiconductors	conductivity is easy to modulate
close to zero	semimetals	overlapping bands $\Longrightarrow$ similar to doped semiconductors
close to zero	strongly correlated	charge density fluctuations can close/open pseudogap
negative	simple metals	invariable conductivity due to large density of states at Fermi-level

Classes of semiconductors

Participating electrons: *sp*, *p*, *spd* (inorganic), π, πd (organic)



- (*sp*) "Classical" semiconductors – Si, GaAs, ZnS, CIGS
- (*sp*) Ionic "average-valence-4" semiconductors – $CsPbI_3$
- (*sp*) Electron-rich semiconductors – P, As, Se, AsSe, GeSbTe
- (*sp*) Electron-poor semiconductors – B
- (*spd*) Transition metal oxides, halides,... – TiO_2, MoO_x, $SrTiO_3$

- (π) π-conjugated (organic) semiconductors – graphene, molecules
- (πd) Metal-organic frameworks