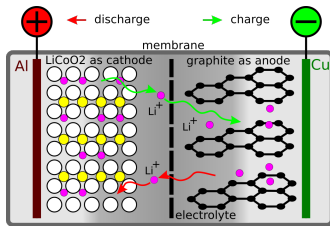
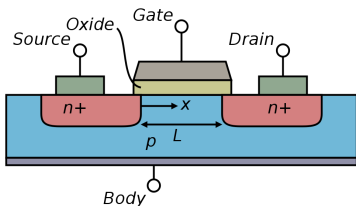


What is semiconductor: a functional electronic material

- 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 \implies 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**)

Diagram illustrating the periodic table with highlighted elements and energy levels. The diagram shows the energy gap ΔE between valence and shells. The elements are color-coded according to their classification:

- Yellow:** B, C
- Orange:** N, O
- Blue:** P, S
- Green:** F, Cl, Br, I, At
- Light Blue:** Al, Ga, In, Tl, Sn, Pb, Bi, Po, Kr, Xe, Rn

Other labels include: *strong sp-hybridization*, *d-shell*, *f-shell*, and *strong relativistic effects*.

- (sp) “Classical” semiconductors – Si, GaAs, ZnS, CIGS
 - (sp) Ionic “average-valence-4” semiconductors – CsPbI₃
 - (sp) Electron-rich semiconductors – P, As, Se, AsSe, GeSbTe
 - (sp) Electron-poor semiconductors – B
 - (spd) Transition metal oxides, halides, . . . – TiO₂, MoO_x, SrTiO₃
-
- (π) π -conjugated (organic) semiconductors – graphene, molecules
 - (πd) Metal-organic frameworks