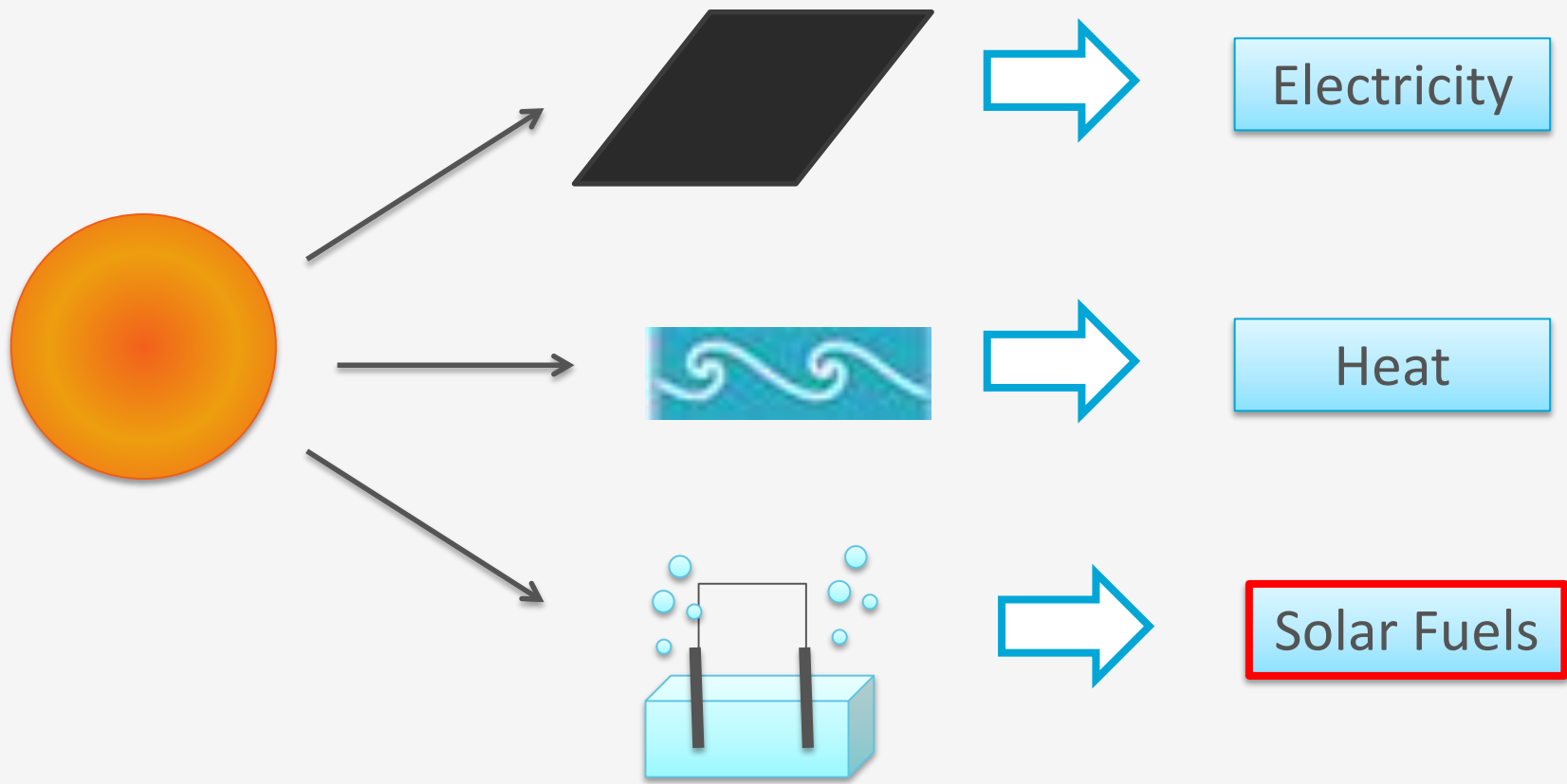


Third Generation PV and Other Ways to Utilize Solar Energy

Solar Fuels

Week 6.3

Arno Smets, Wilson Smith, Paula Perez Rodriguez



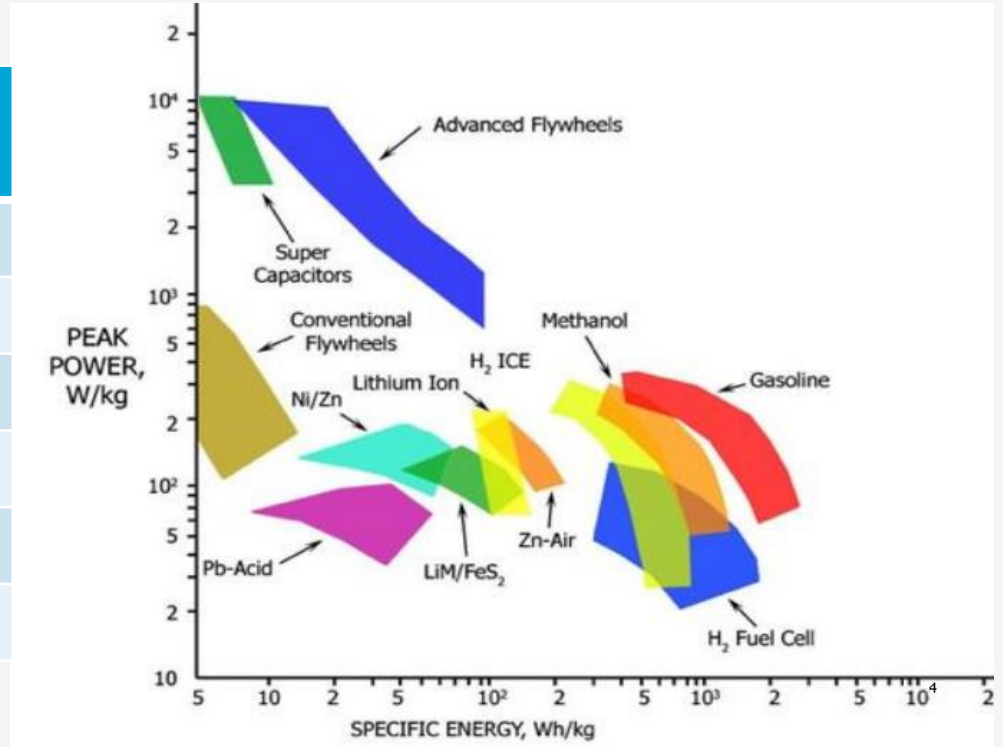
Electricity

Heat

Solar Fuels

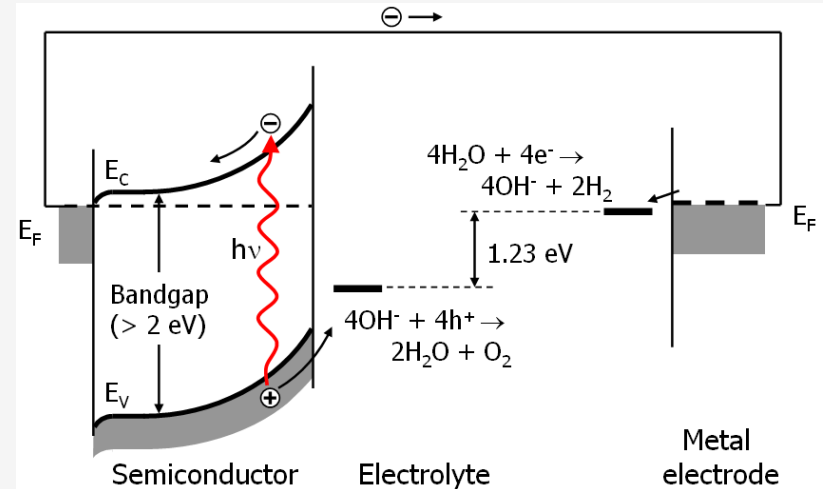
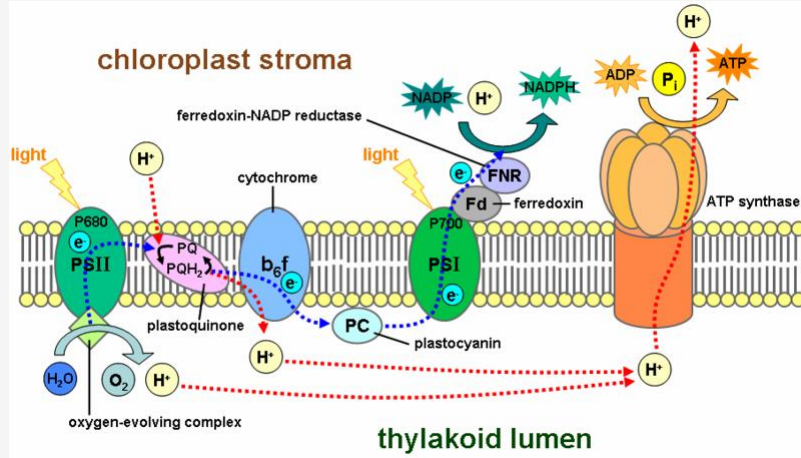
Ragone Plot: Energy vs Power Density

Fuel	Energy [kJ/g]	Energy [kJ/l]
Coal	29.3	-
Wood	14.6	-
Gasoline	43.5	30590
Diesel	42.7	29890
Natural Gas	50.02	31.7
Hydrogen	119.9	10

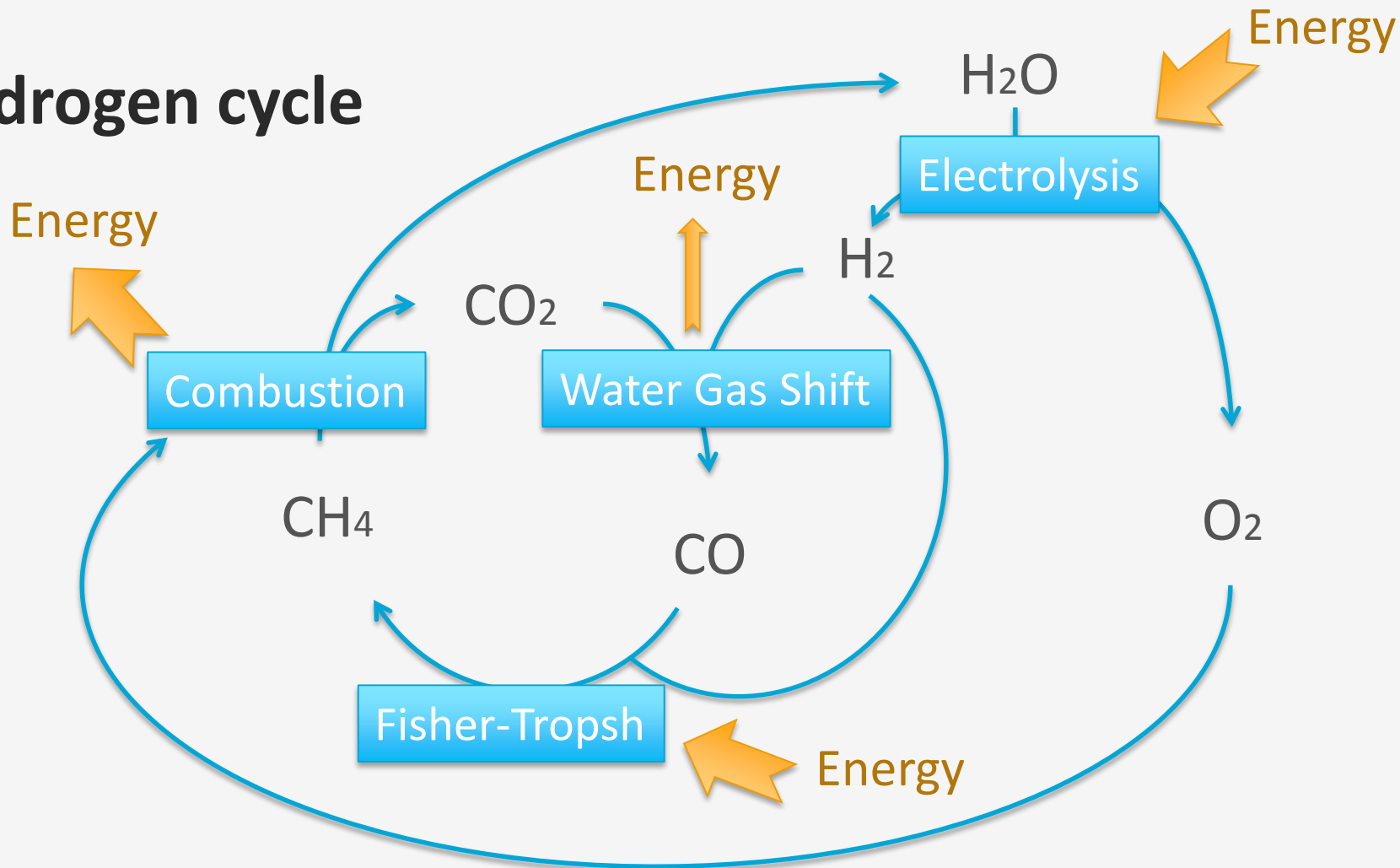


Source: “Indication of anomalous heat energy production in a reactor device containing loaded nickel powder”. Levi et al. 2013

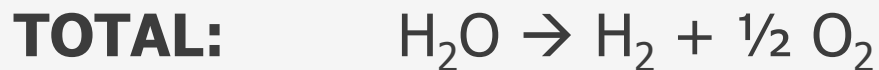
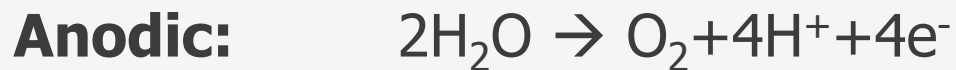
Can we learn from Nature?



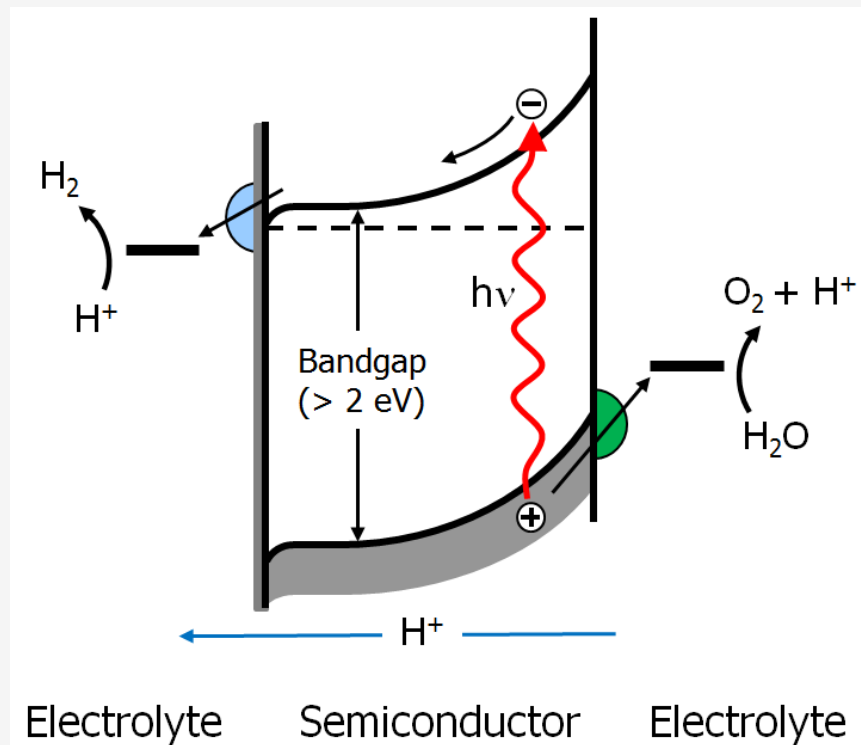
Hydrogen cycle



Direct photoelectrolysis

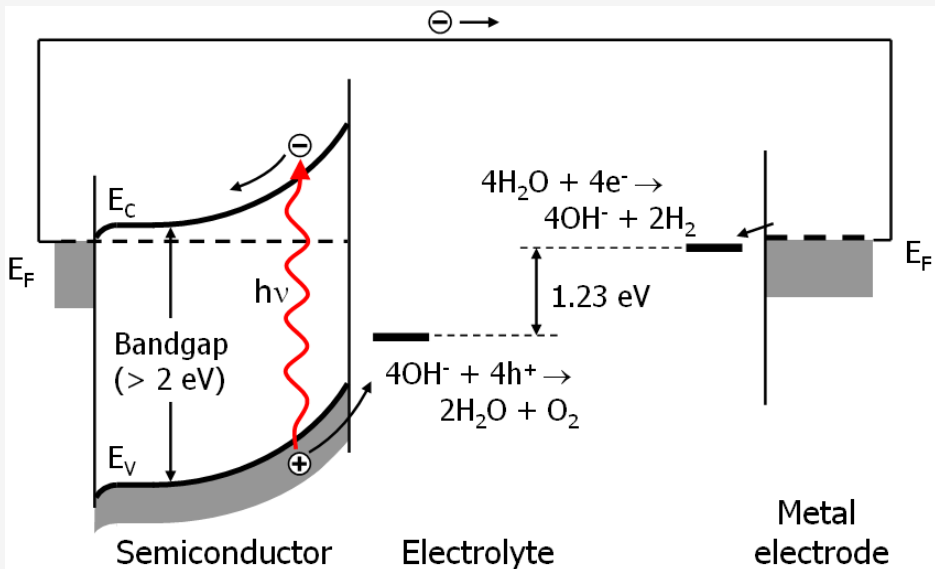


Potential: 1.23 V

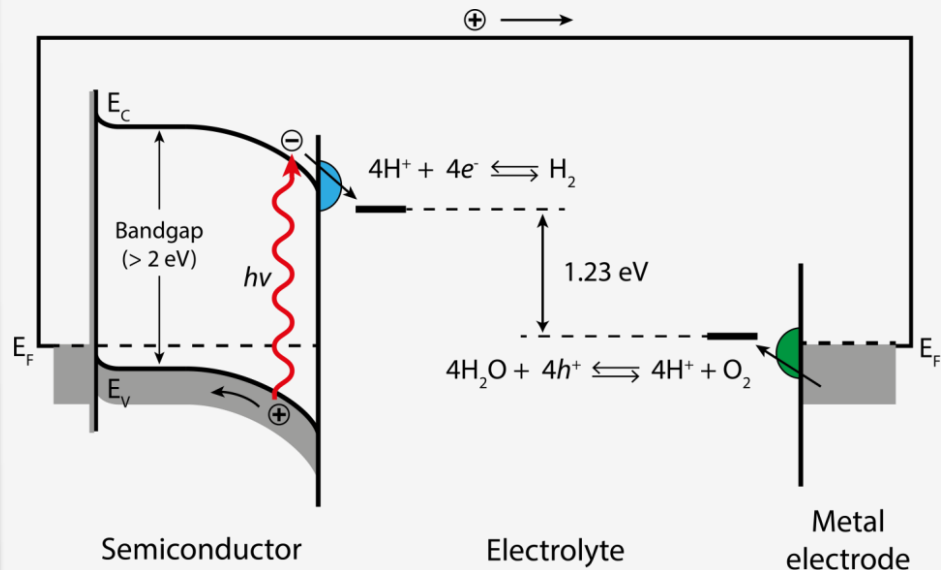


Band bending

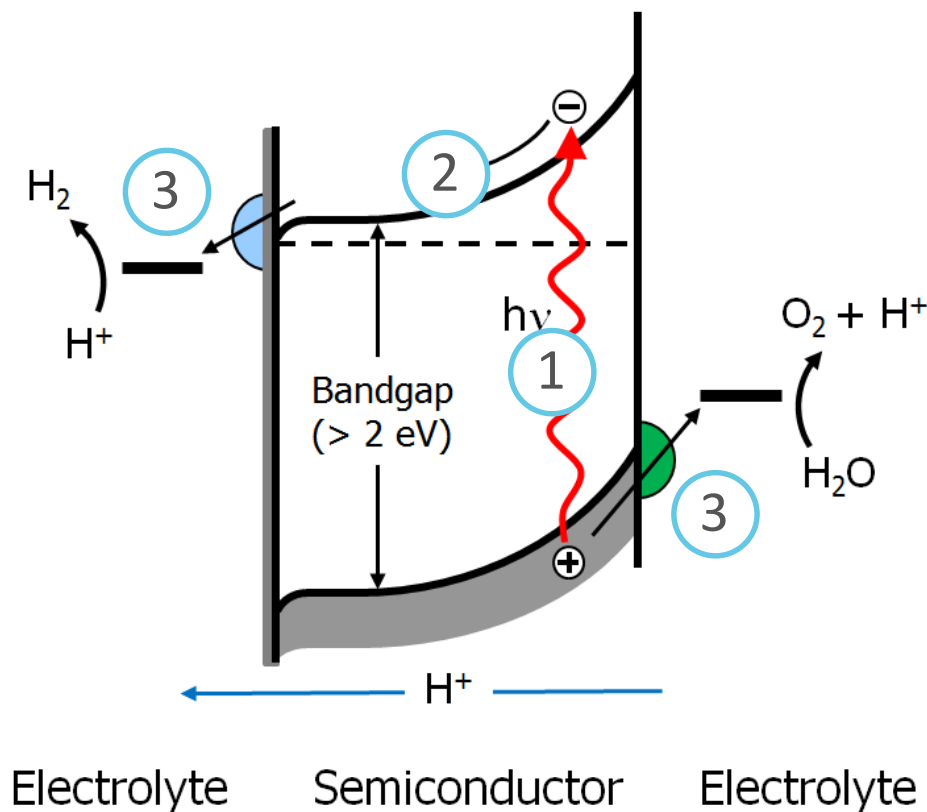
N-type semiconductor: Anode



P-type semiconductor: Cathode

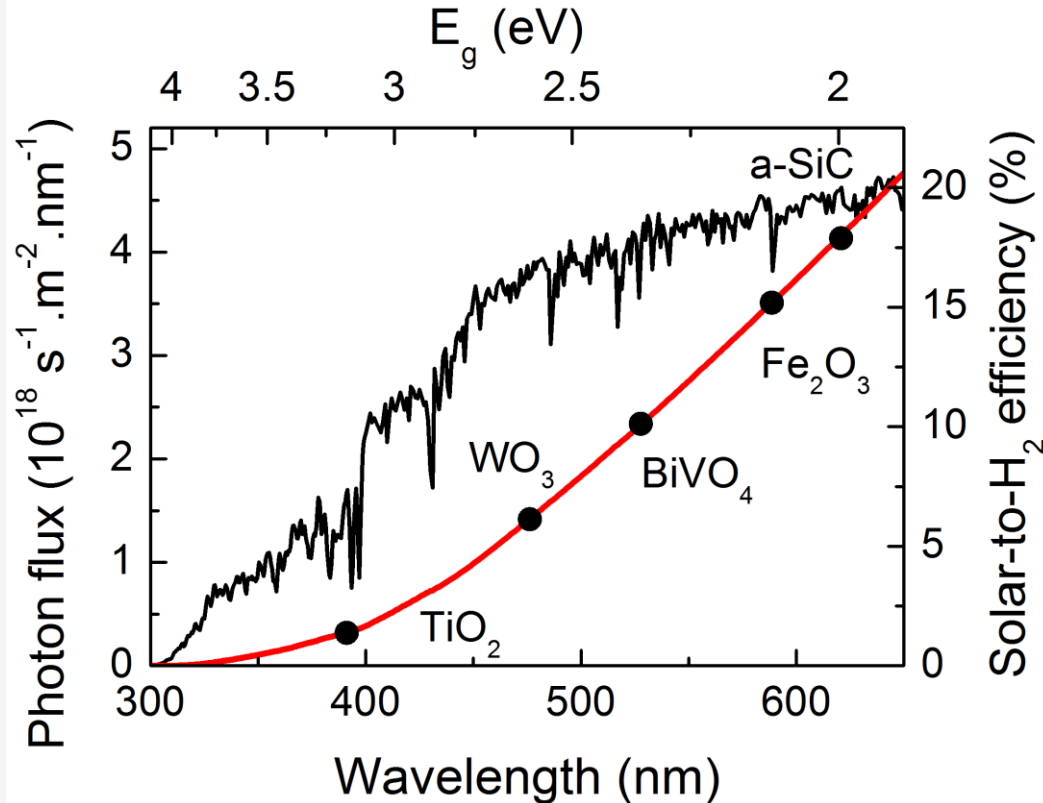


Challenges for photoelectrochemistry

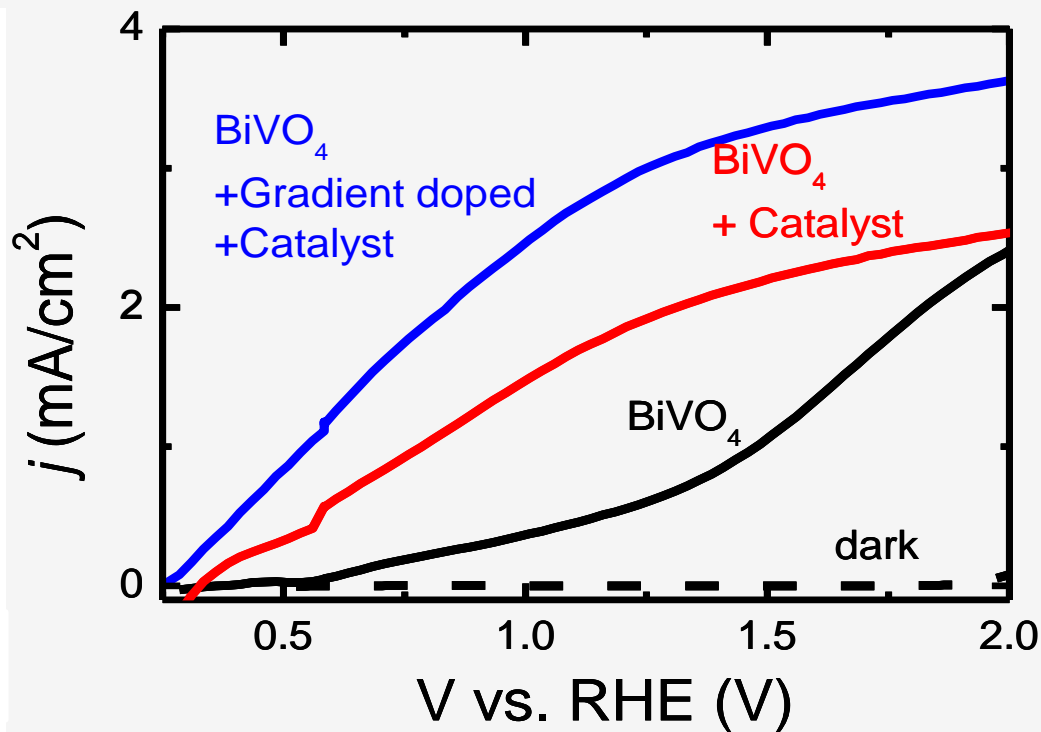
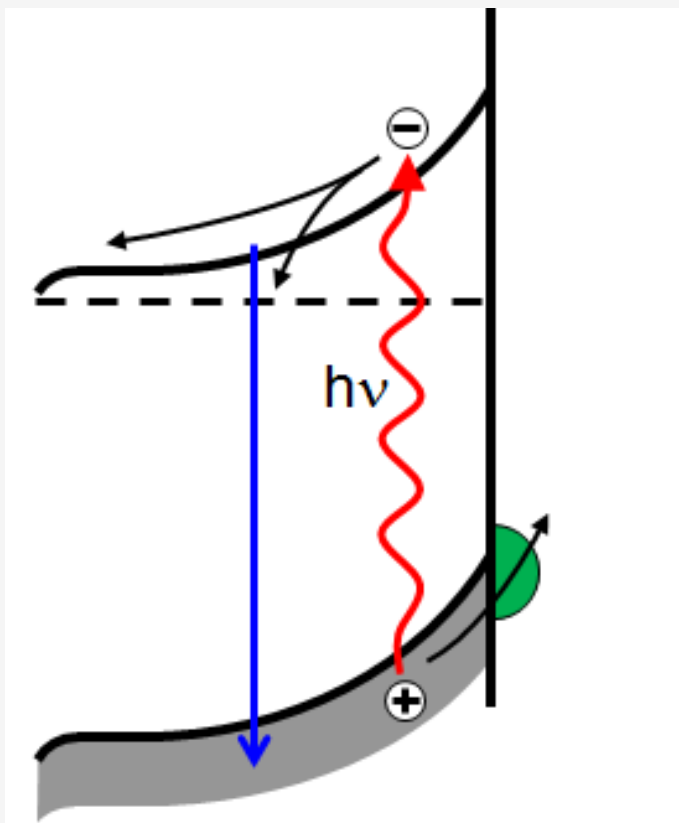


1. Absorption
2. Separation of charges
3. Catalysis

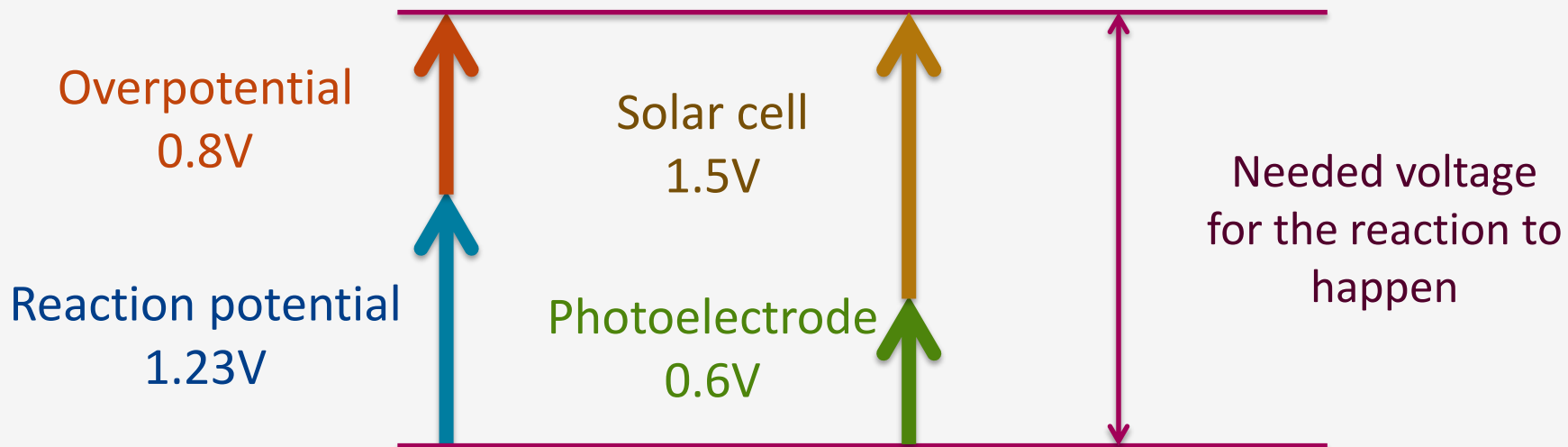
Materials for photoelectrodes



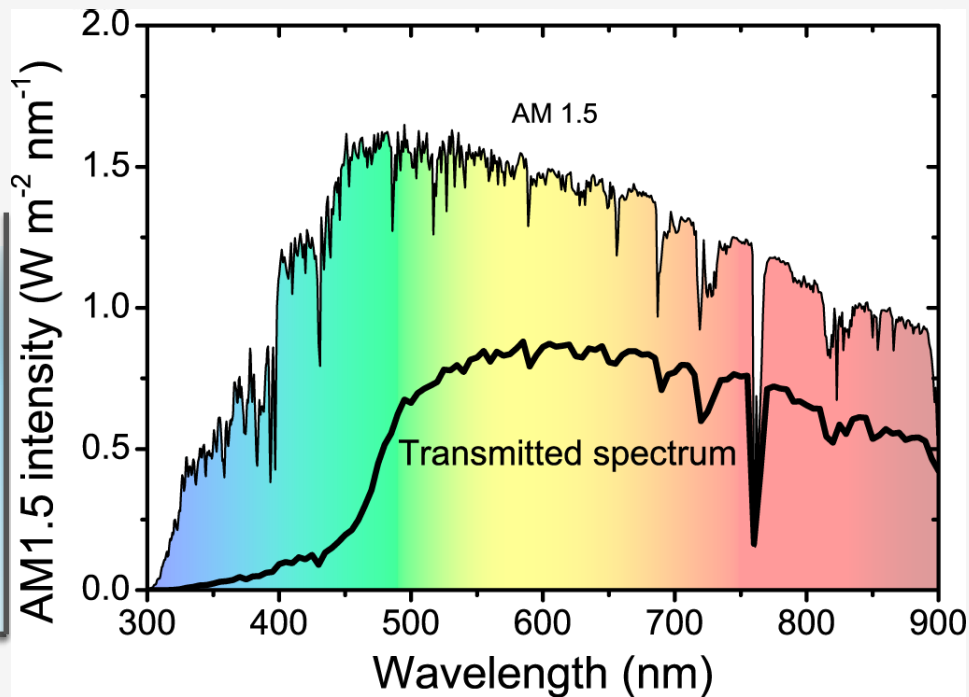
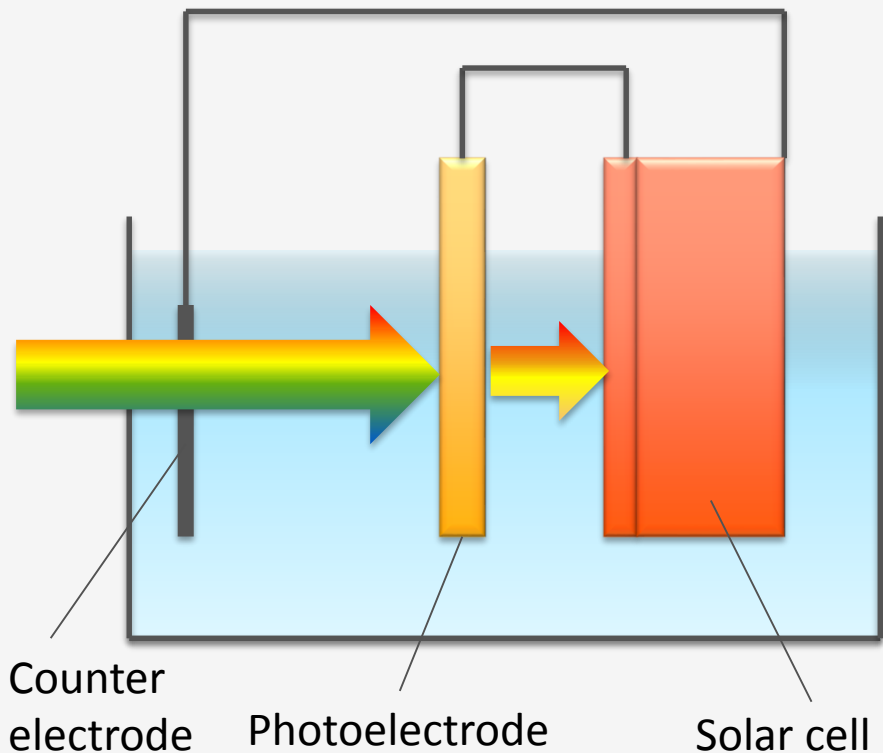
Improving photoelectrode efficiency



Potential of the reaction

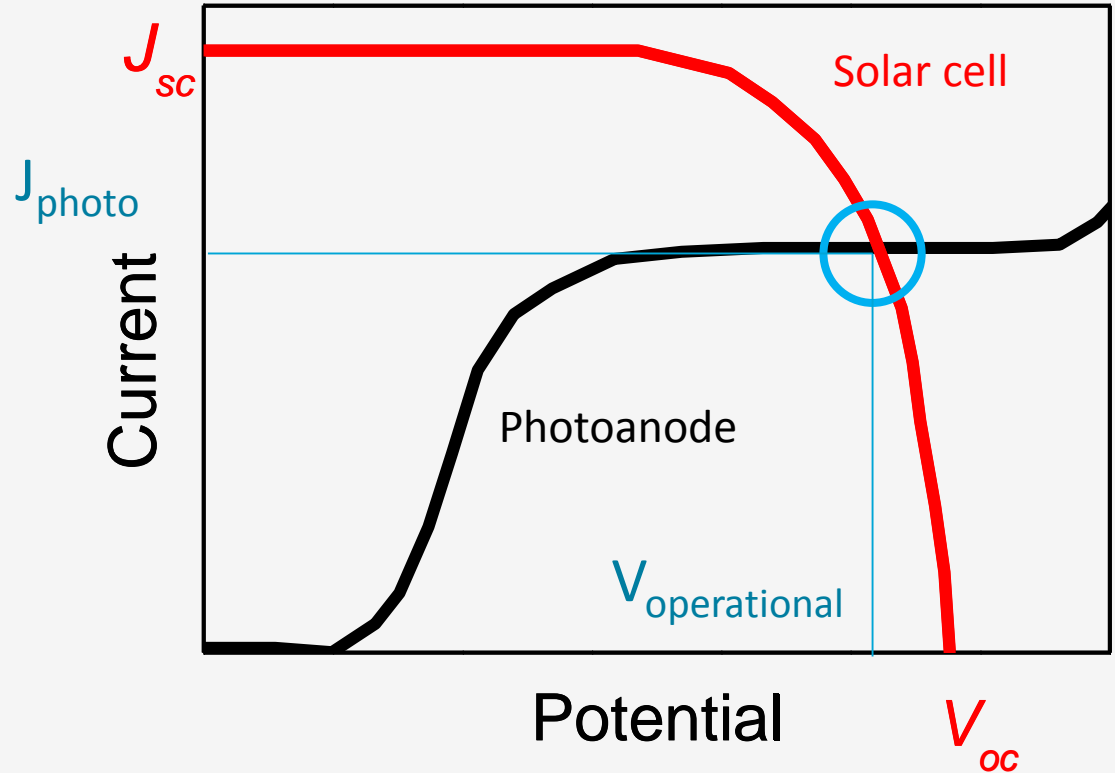


Hybrid photoelectrode

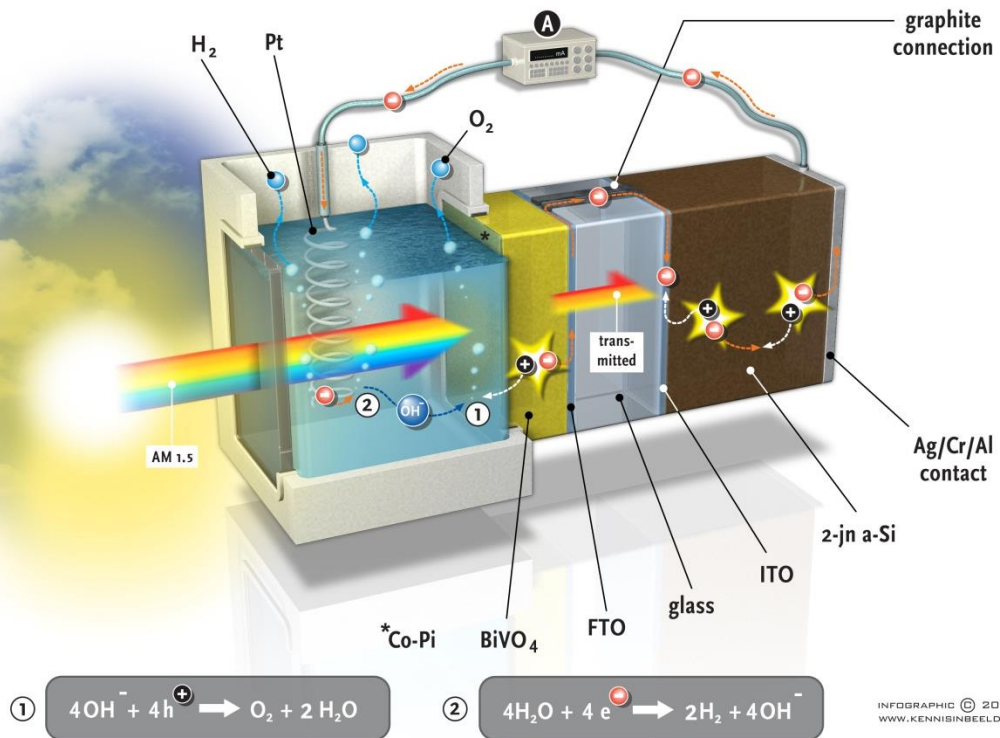


Hybrid photoelectrode

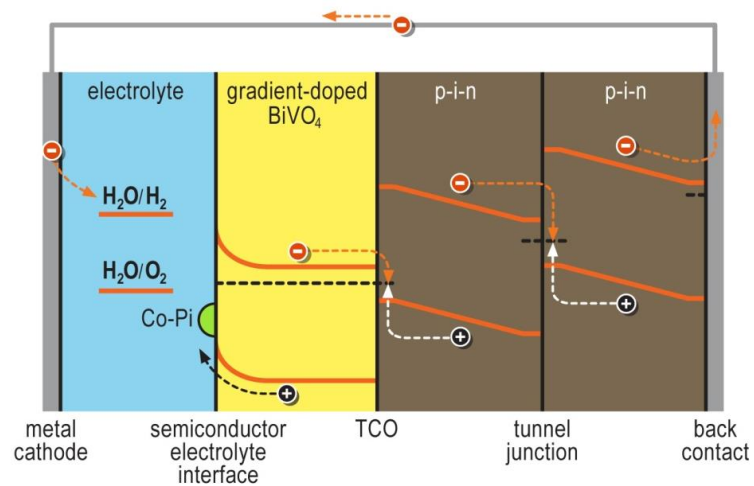
$$\eta_{STH} = \frac{J_{photo} \cdot 1.23V}{P_0}$$



MECS PV-PEC Device



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4.9%
Solar to Hydrogen
Conversion Efficiency!

Thank you for your attention!