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Incorporation of CIGS Cells into Photo-Electrochemical Reactors…

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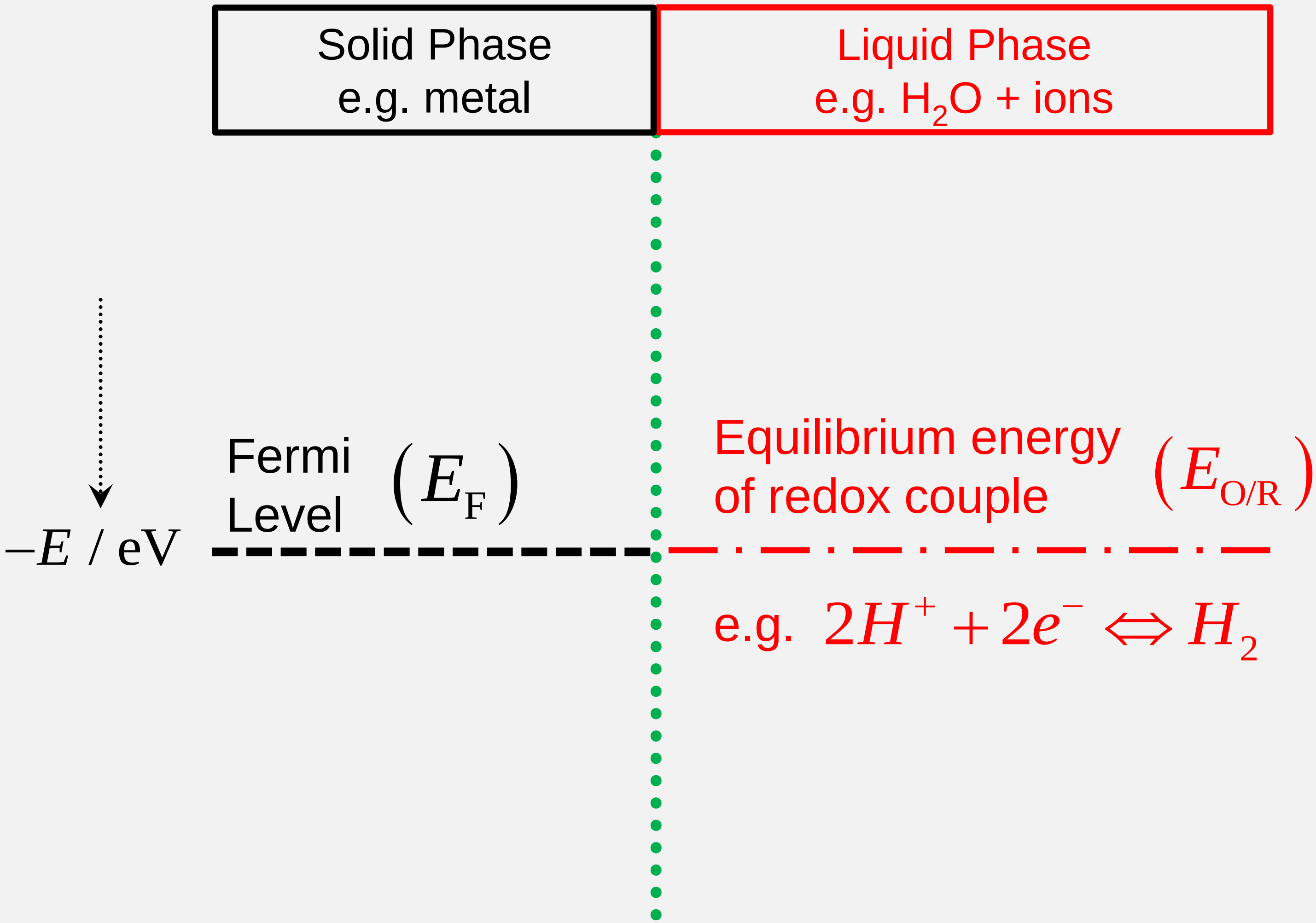
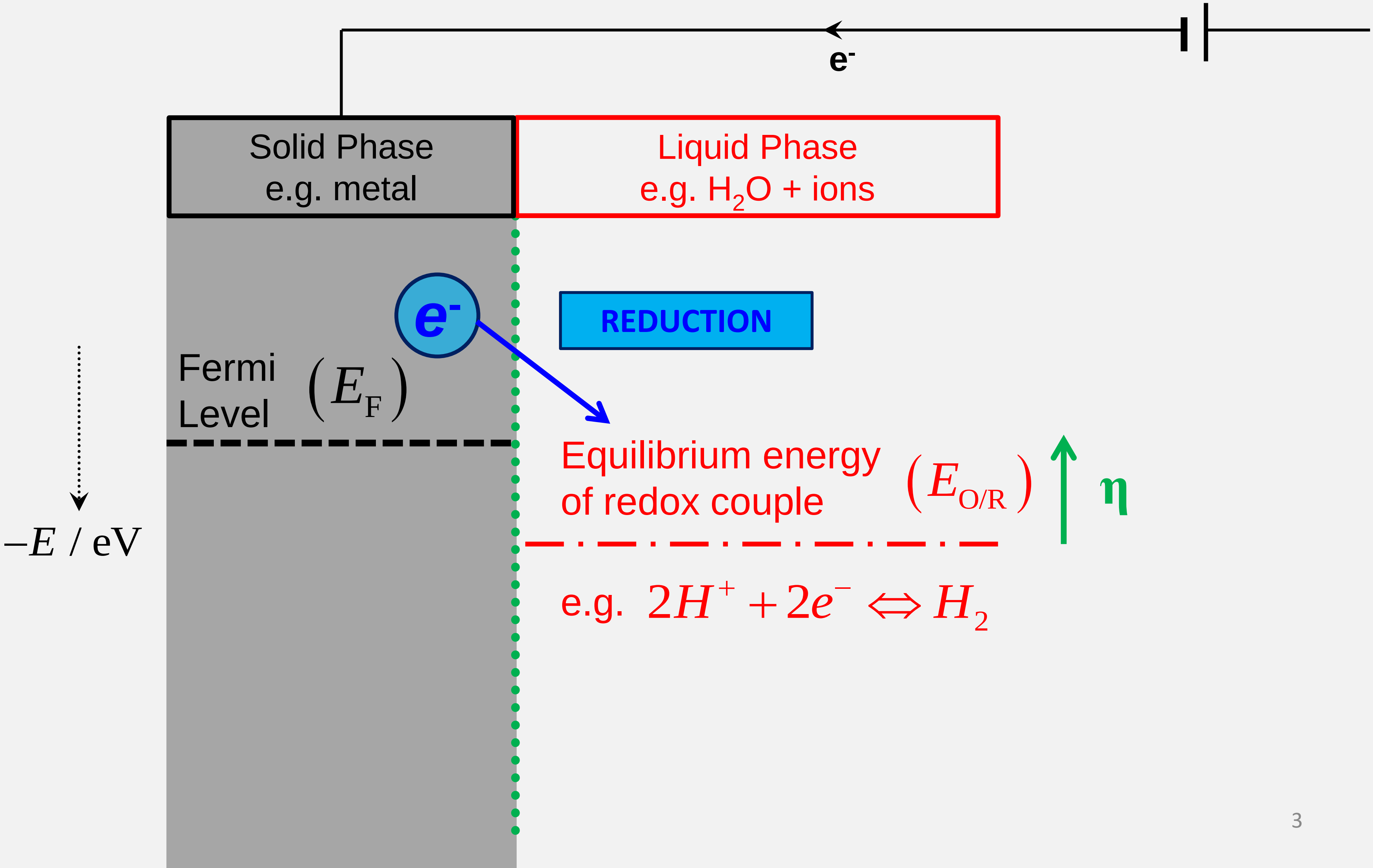
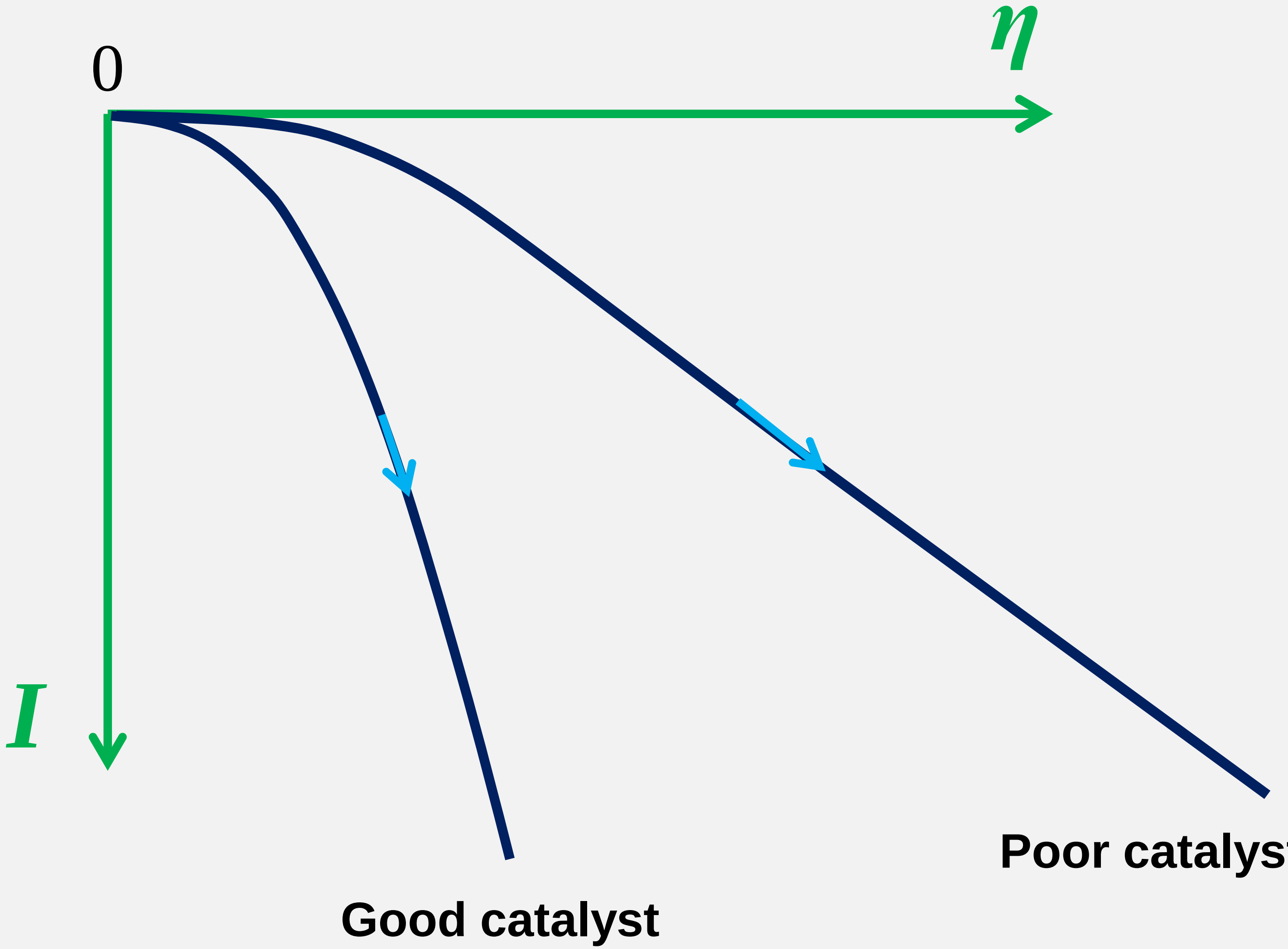
Principles of electrochemical reactions



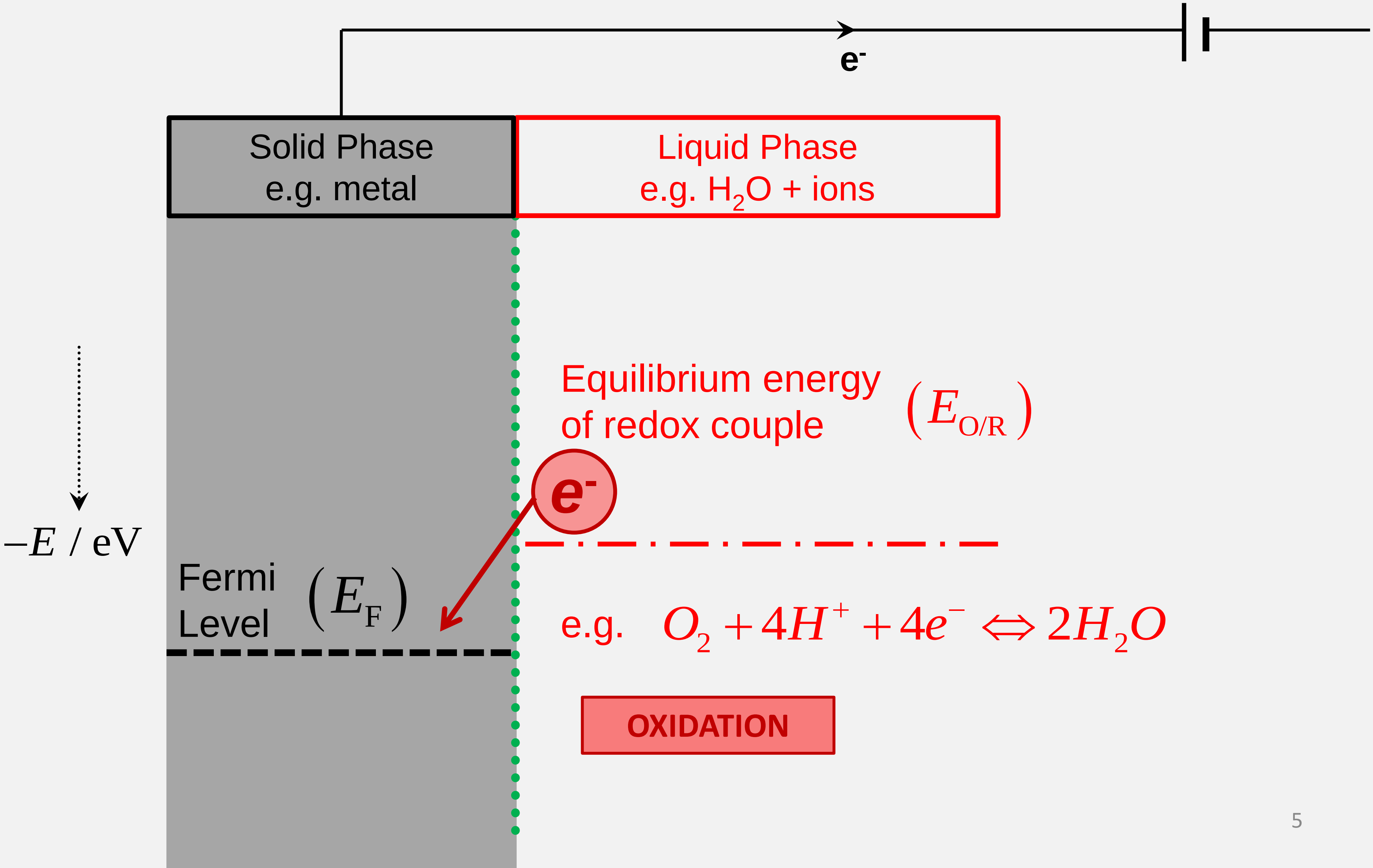
Principles of electrochemical reactions



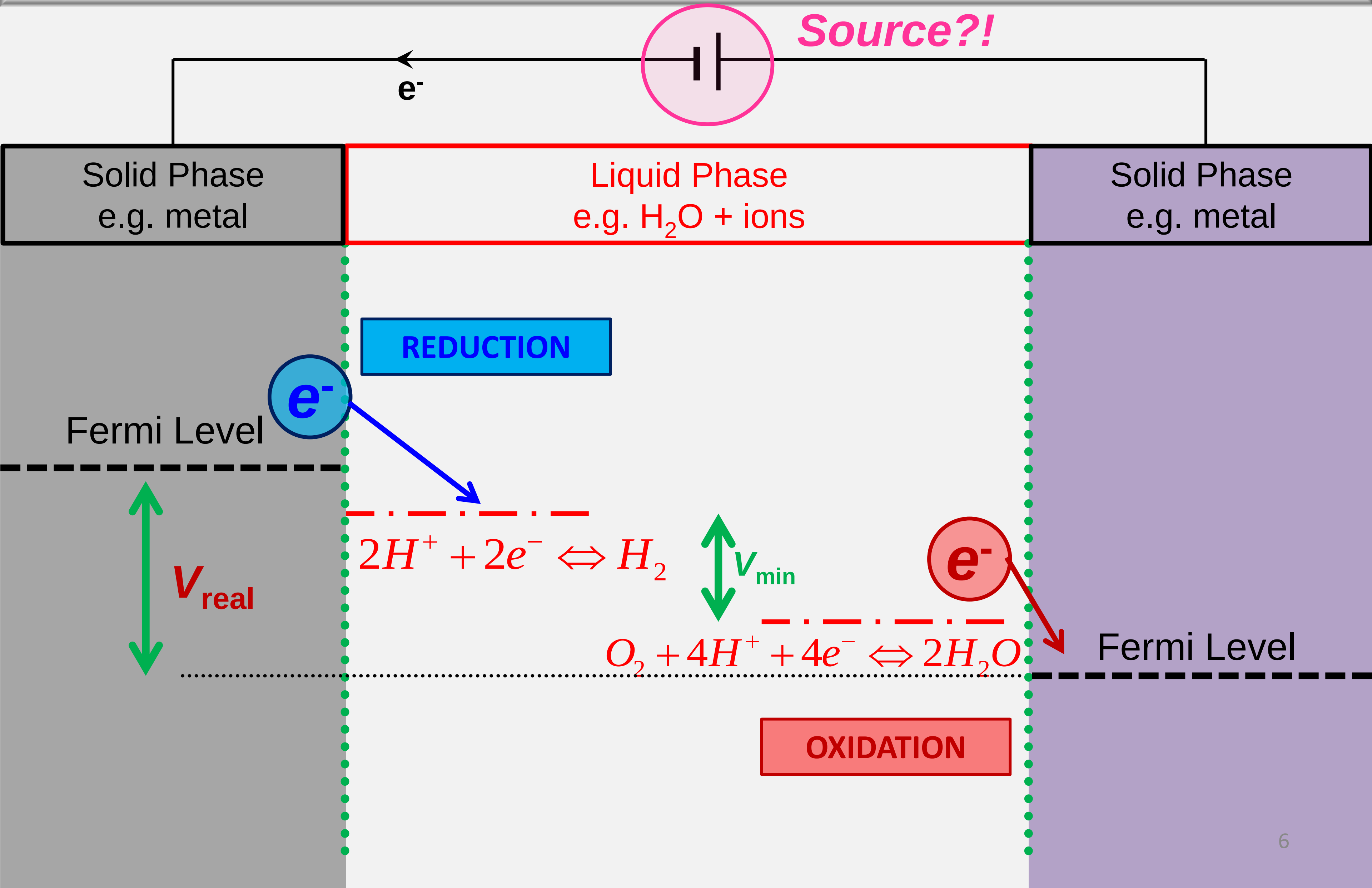
Kinetics



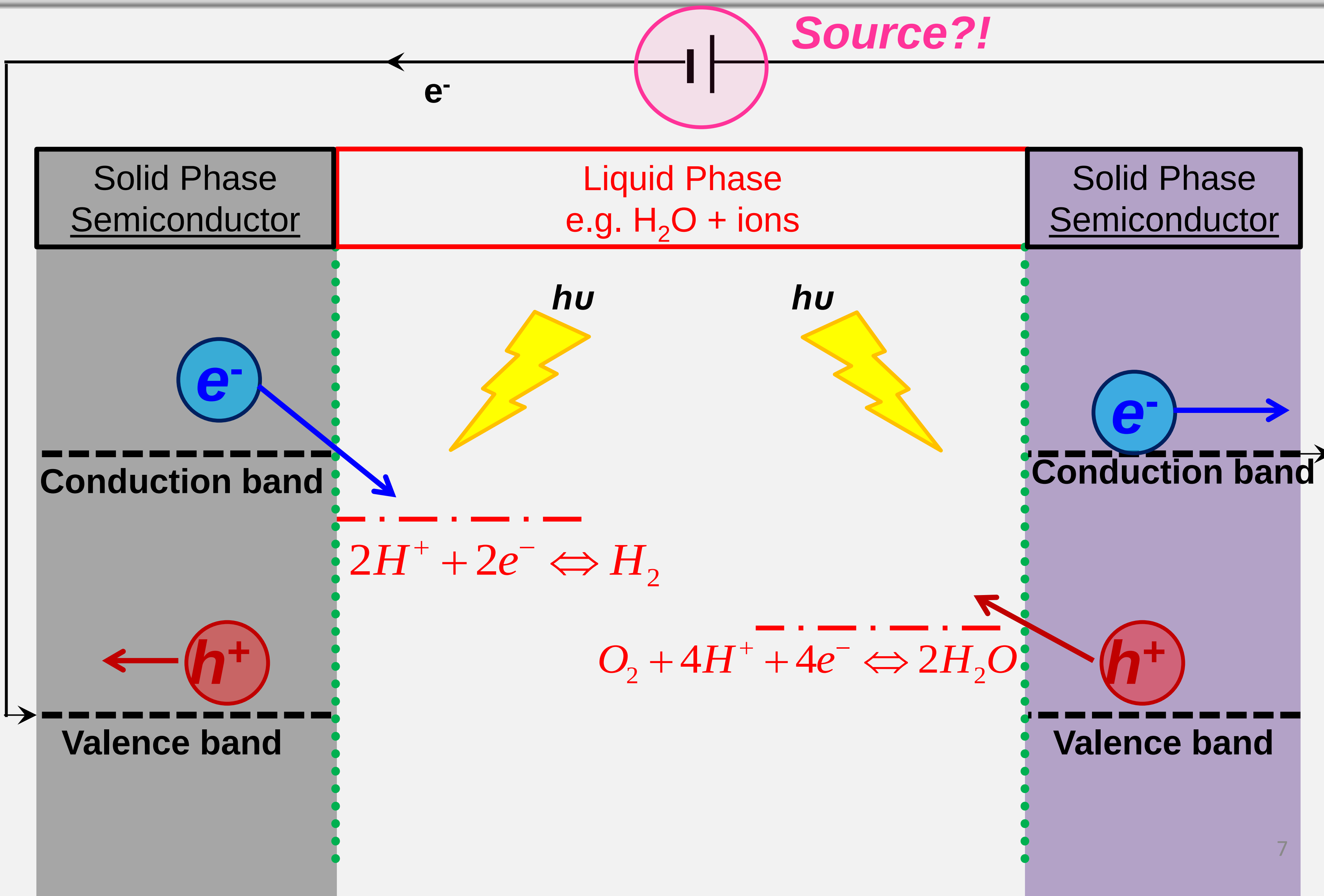
Principles of electrochemical reactions



Principles of electrochemical reactors



Electrochemical to Photo-Electrochemical



Electrode Design

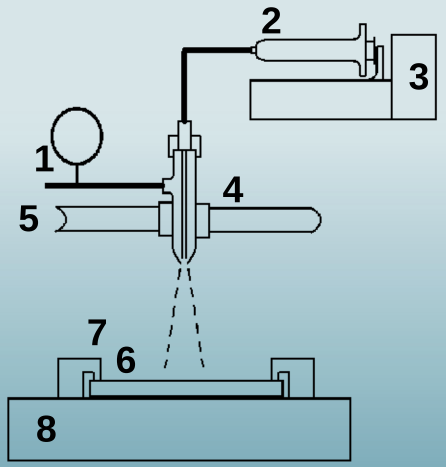
Principal requirements for a photo-electrode:

- Good photo-absorber
- Suitable conduction and valence band energies
- Suitable direction of internal bias
- Chemically robust
- Cheap

Hematite Photo-Anode Production

Spray Pyrolysis Setup

1. Compressed Air
2. Precursor reservoir
3. Syringe pump
4. Quartz nebuliser
5. CNC machine
6. Substrate
7. Clamping block
8. Hotplate

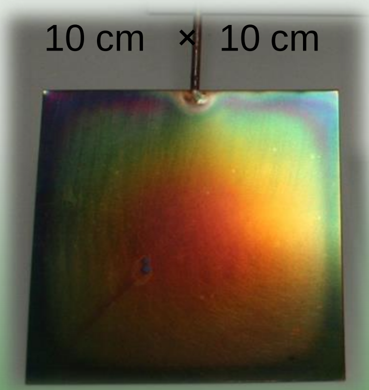


Fe_2O_3 coatings produced by nebulising $Fe^{III}Cl_3$ in solvent onto heated substrate

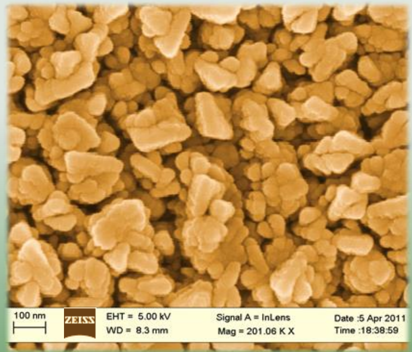
Ti | Fe_2O_3-SnO_2

Variables:

- **Dopants → Sn^{IV}** (0.6 %) (increase photocurrent)
- **Substrate → Ti, FTO** (flexibility with illumination)

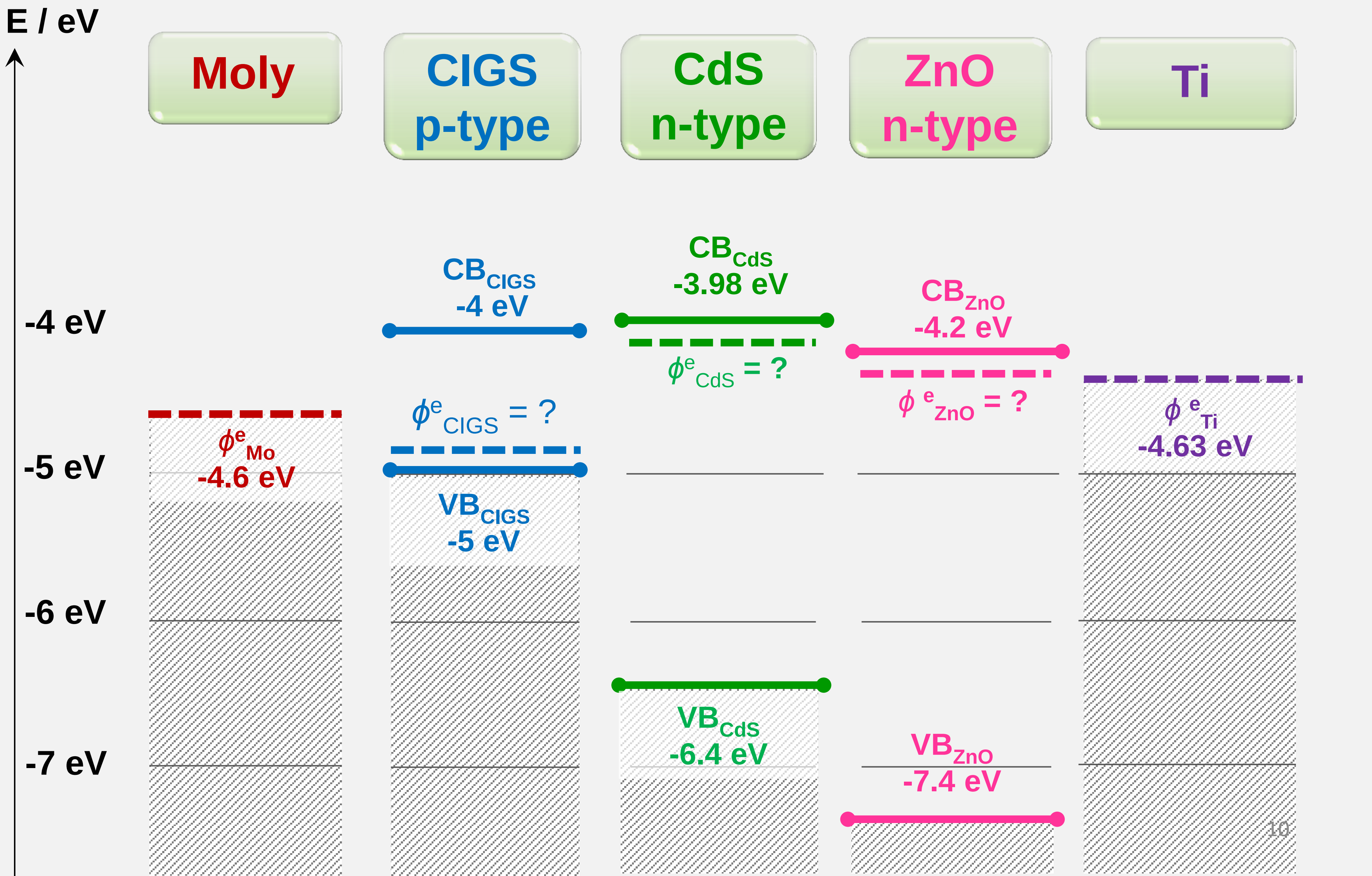


Photographic image



SEM image

The Mo | CIGS | CdS | ZnO | Ti system



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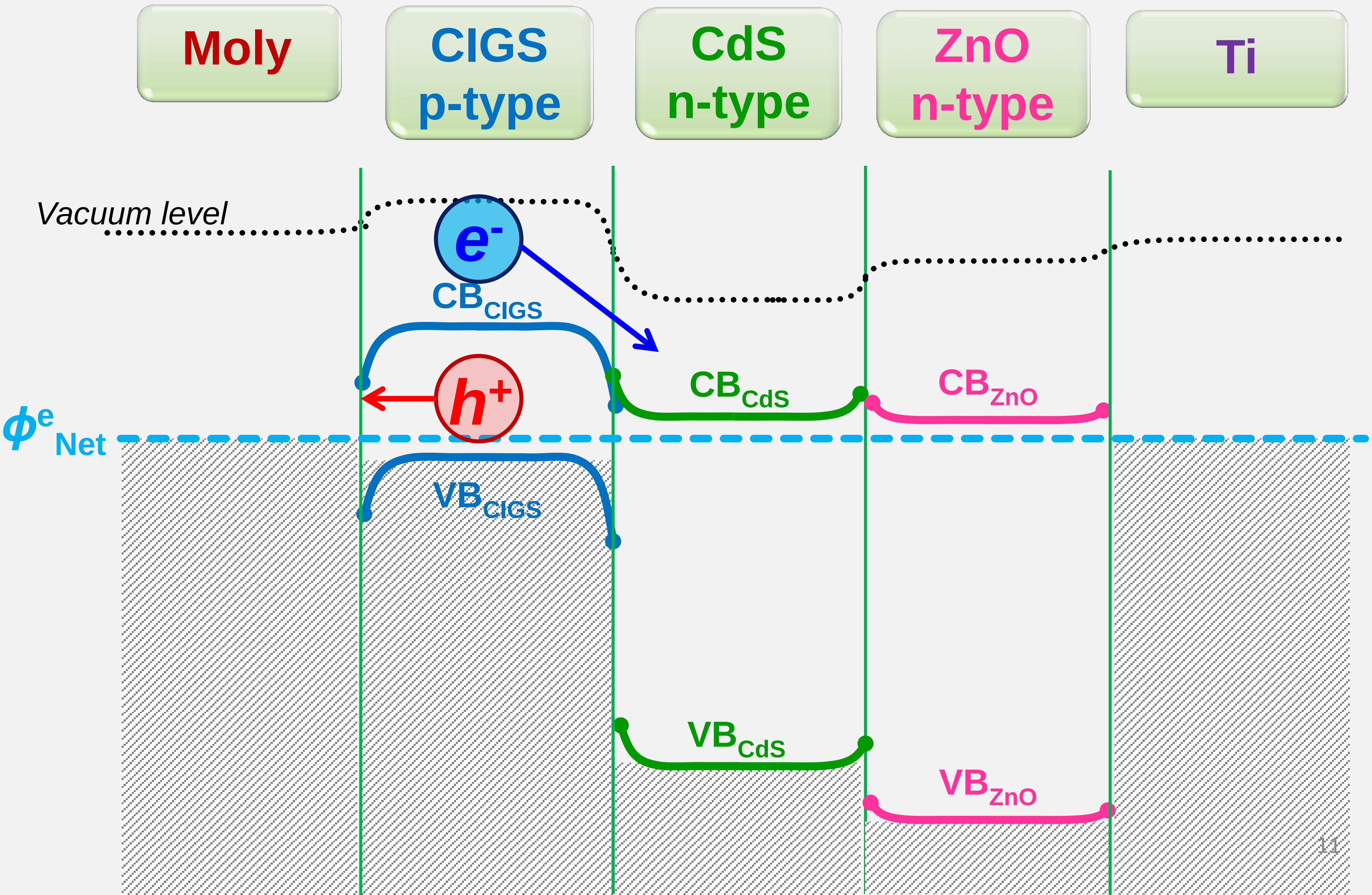
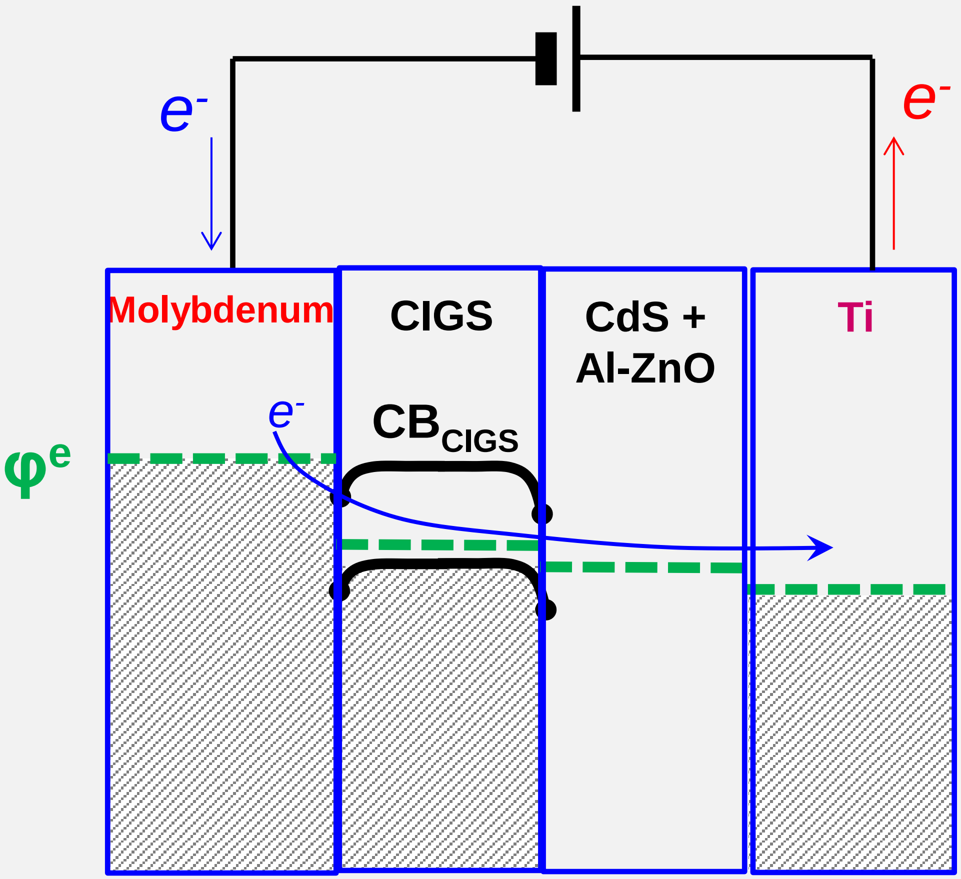


The Mo | CIGS | CdS | ZnO | Ti system

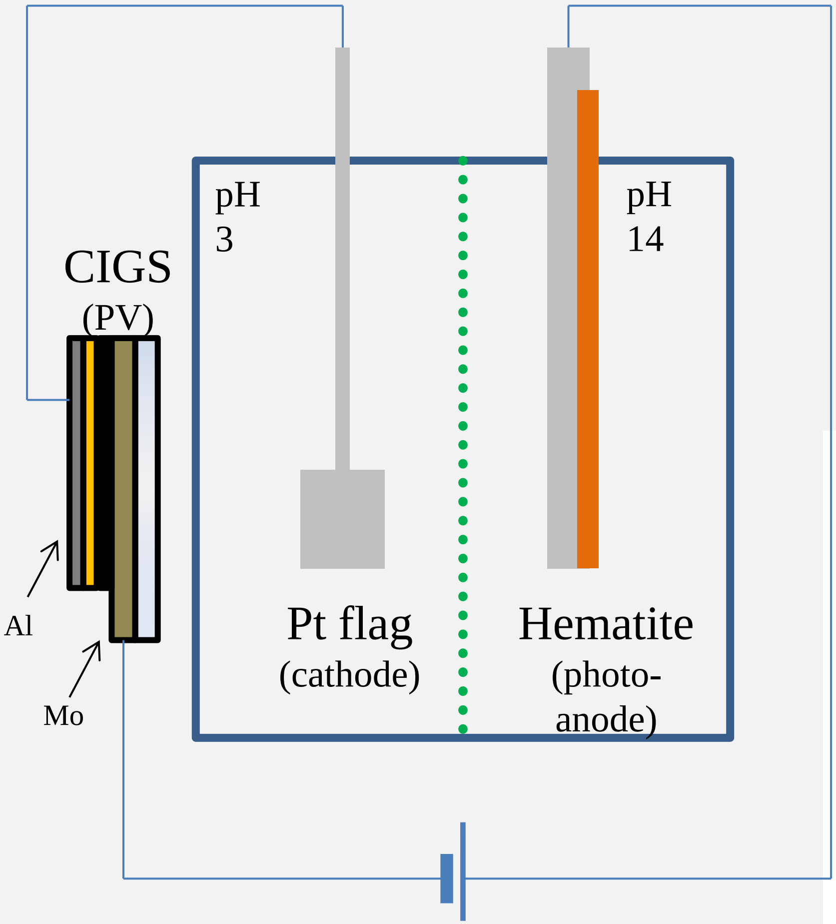
To replicate the effect of illumination on energy levels within the photo-cathode, the photo-cathode (when studied in the air) must be biased in this way:



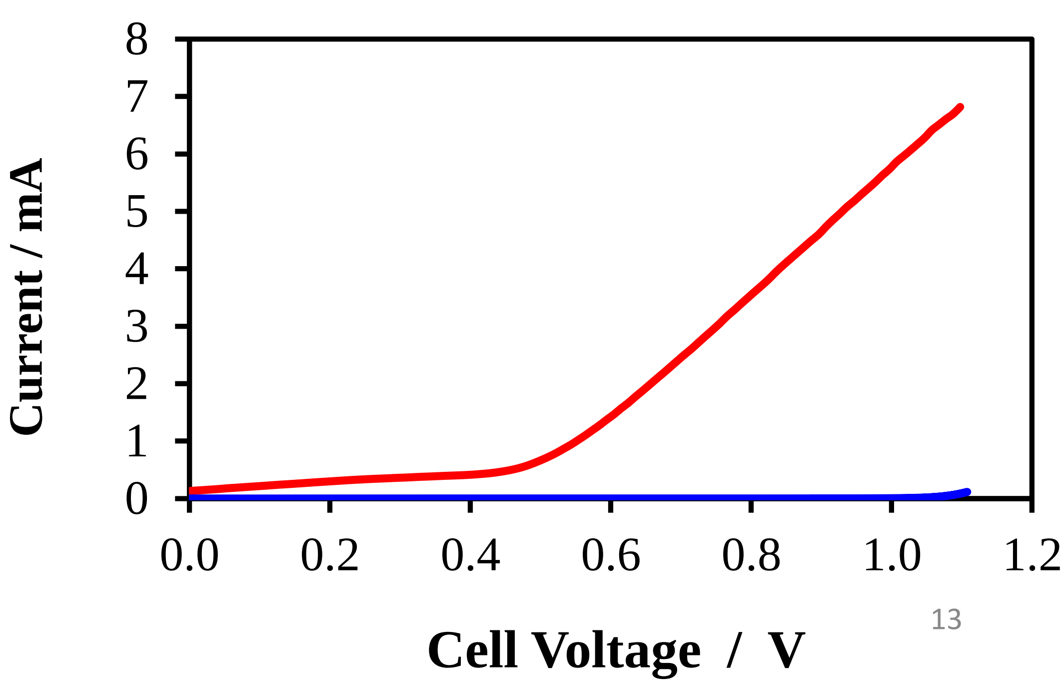
For the physicists:
This is 'reverse bias' ?

For the electrochemists:
Dark current and photo-current refer to the flow of electrons in this direction.

Performance of Al coated CIGS Cells



Current was measured in response to an applied cell bias:



Device & System Development

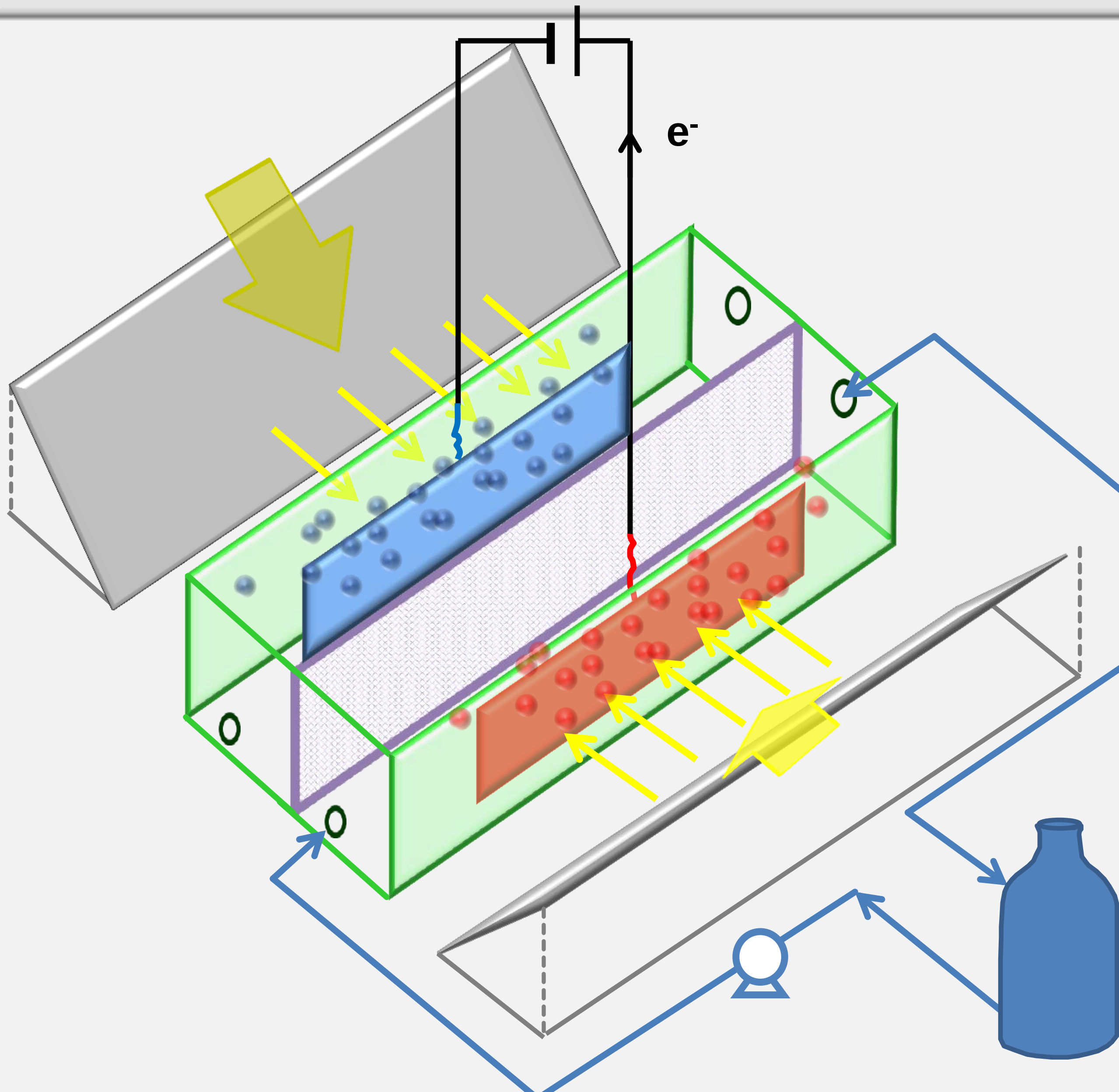


Photo-cathode fabrication
- Substrate
- Electrical contact

Photo-anode fabrication
- Substrate
- Electrical contact

Reactor body
- Geometry
- Materials

Illumination
- Mirrors
- Concentrators

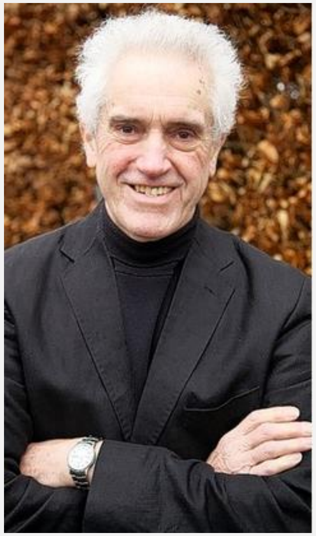
Membrane

External bias

Electrolyte flow circuit
- Pumps
- Reservoirs
- Dosing

Product harvesting & storage

The London Team



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