

Thailand Environment Institute

Presents...

Fuel Cell: A Clean Energy Transformer

Roongrojana Songprakorp

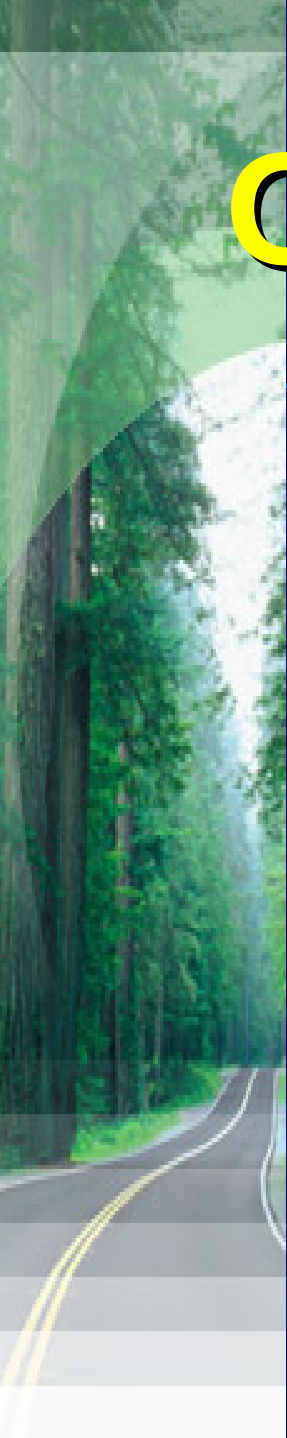
Kaokanya Sodprasert

School of Energy Environment and Materials

King Mongkut's University of Technology

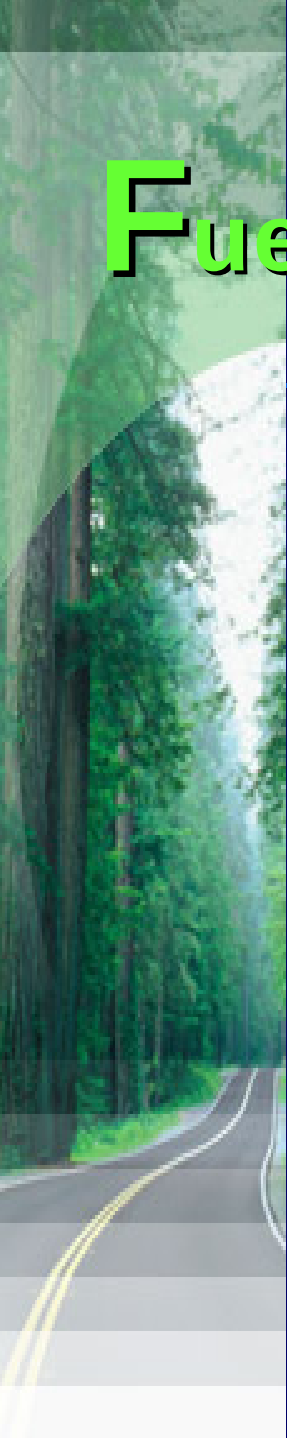
Thonburi

October 1, 2009



Outline

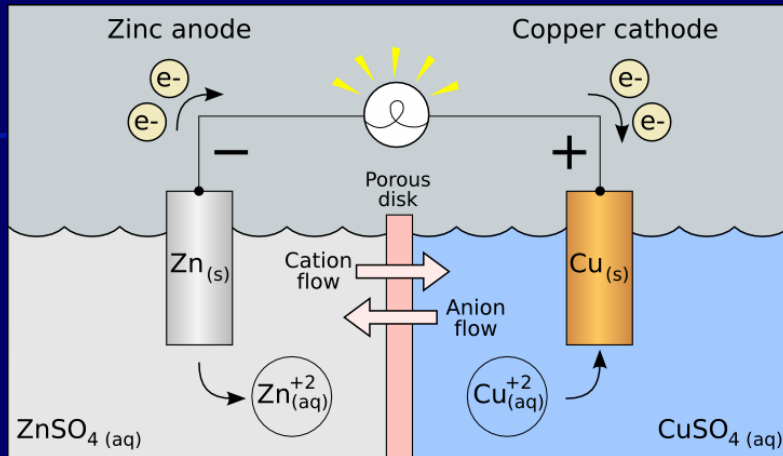
- Fuel Cell: What's it and how it works
- Fuel Cell Family
- Applications
- Fuel Cell Vehicles (FCVs)
- General Outlooks
- Why Fuel Cells?



Fuel Cell: What's it and how it works

- Energy converter (transformer)
- Electrochemical device
 - Two electrodes with an electrolyte
 - Electrons and protons produced at a negative electrode and recombined at a positive electrode
 - Electrons flow through load via an external circuit while protons flow into the electrolyte

Fuel cell's like battery



hydrogen

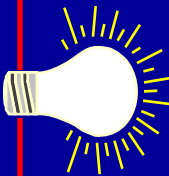
electrode

electrolyte

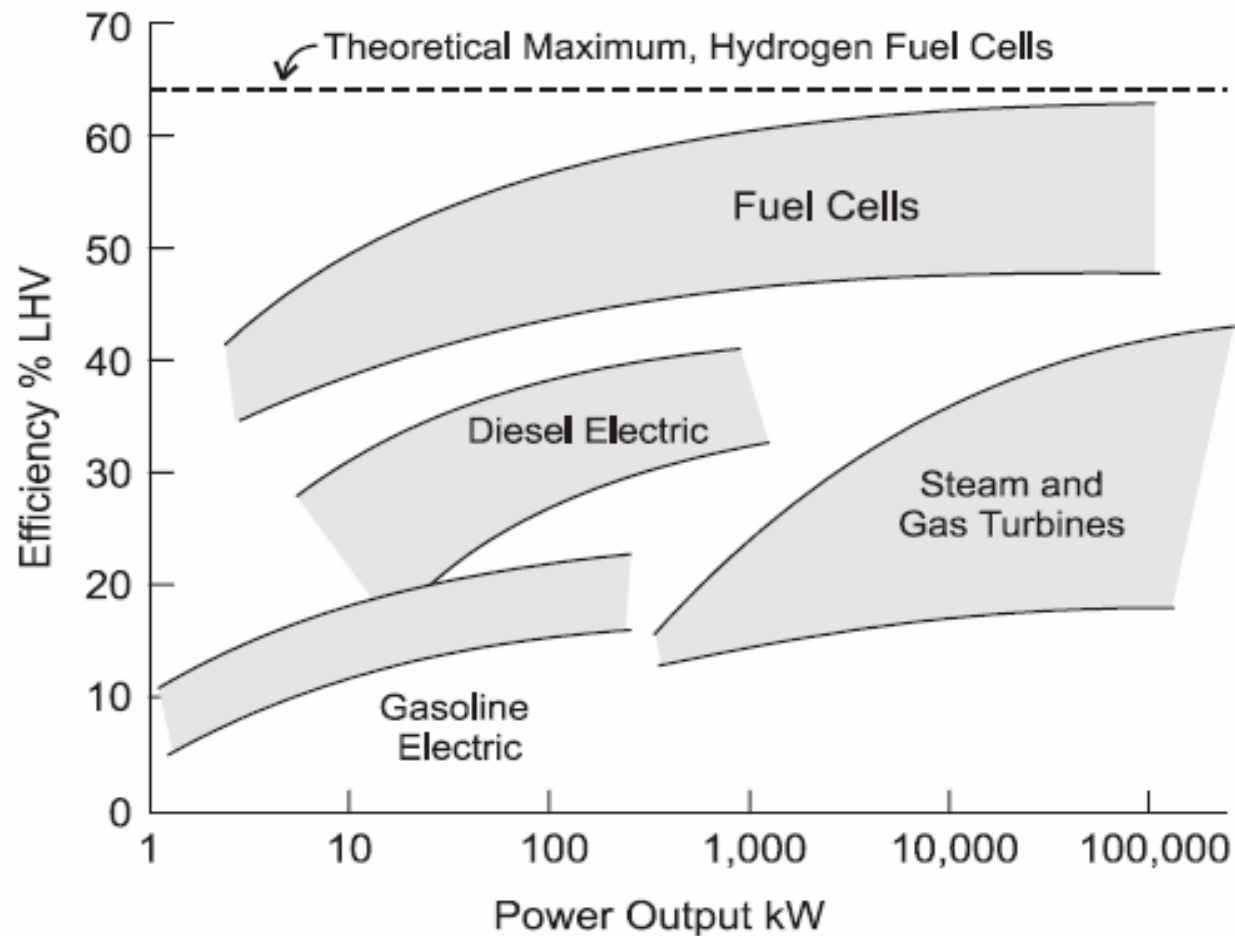
oxygen

electrode

water



Efficiency Aspect



Fuel Cells: An Energy Transformer

Energy Sources



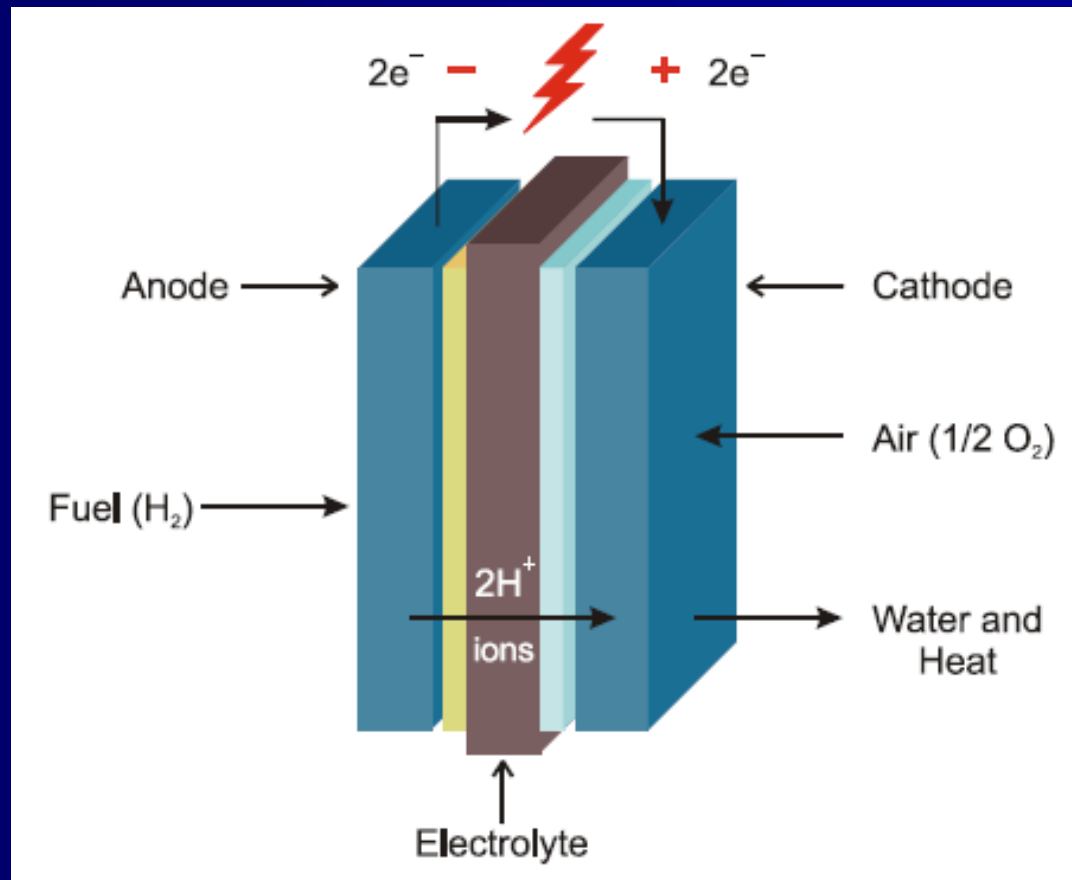
Transformer Technologies

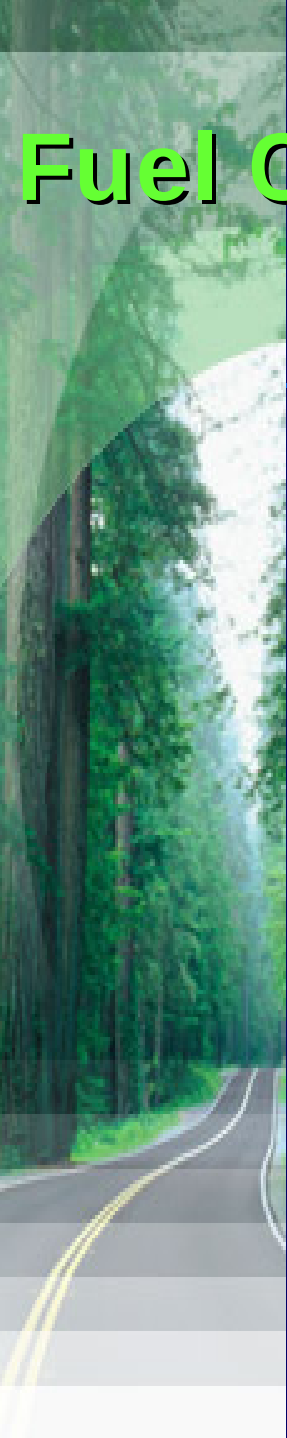


Services



Fuel Cells: Main Components & Working Principle





Fuel Cells: Main Components

- 5 main layers
- 2 electrodes: anode/cathode
- 2 very thin ($\sim 10\text{ }\mu\text{m}$) catalyst layers
- Electrolyte

+2 flow channel plates

Major components

MEA

Membrane

Catalyst

Catalyst support

Catalyst layer

Gas diffusion layer

Gaskets/frames

Flow field

Separator/connector

Bus plates/terminals

End plates

Clamping mechanism

Fluid connections

Manifolds

Cooling

plates/arrangements

Humidification section

(optional)

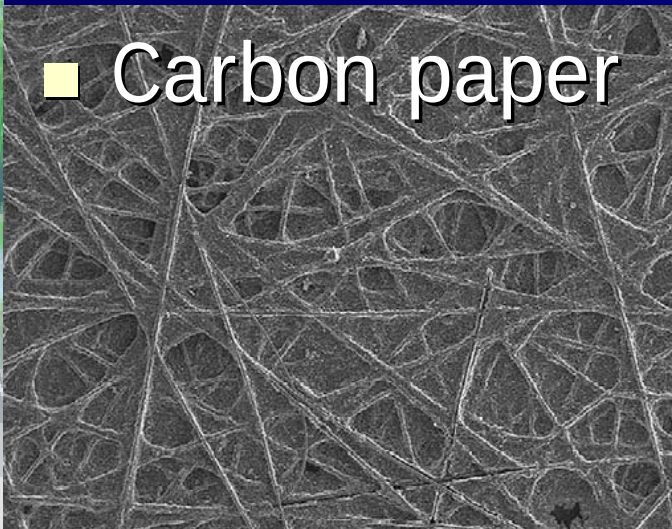
Bi-polar
plate

Cell assembly

Electrode: Fibrous materials

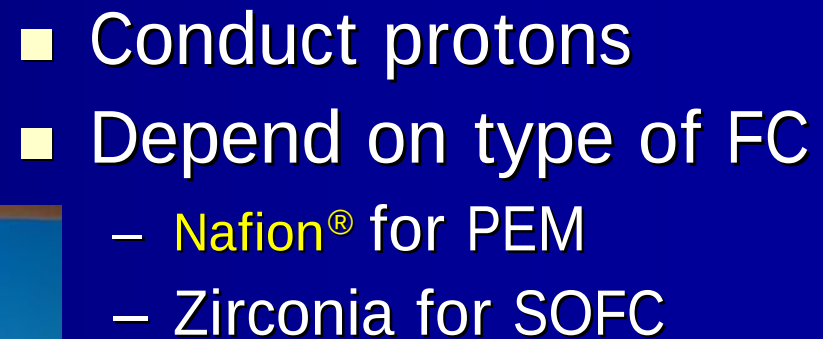
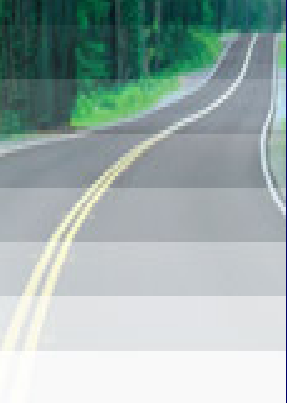


■ Carbon cloth

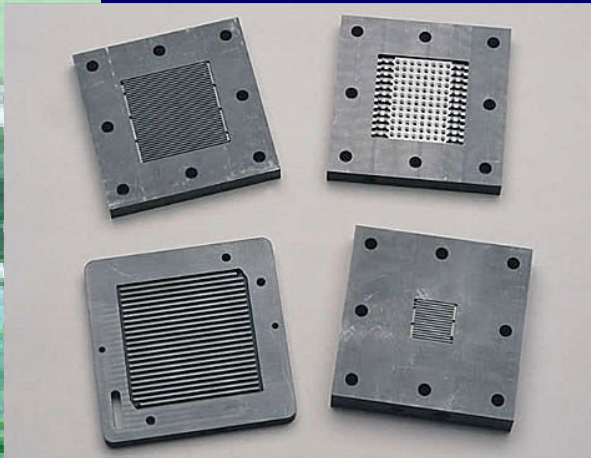


■ Carbon paper

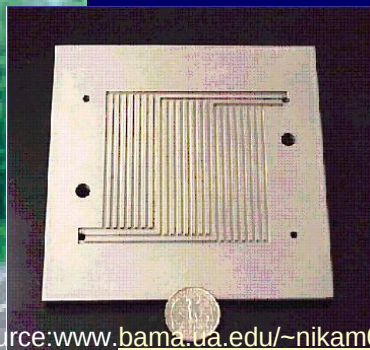
- Flow path
 - Gas, water vapor and liquid
 - Electrons
- Catalyst layer (Pt, +Ru)
- Supporting layer
- Materials
 - Carbon fiber paper
 - Carbon cloth
 - Non-woven materials
 - Metallic screens
 - Foams



Gas flow plates: Graphite



<http://www.directindustry.com/prod/electrochem/>



Source: www.bama.ua.edu/~nikam001/My%20Research.htm

- Flow path
 - Gas, water vapor and liquid
 - Electrons
- Supporting layer



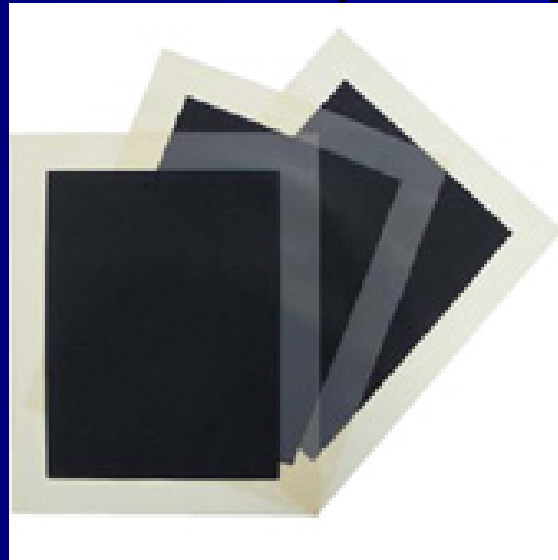
<http://www.tech-etch.com/>

Membrane Electrode Assembly (MEA)



http://www.agc.co.jp/english/csr/environment/products/images/env_sp01b_08i.jpg

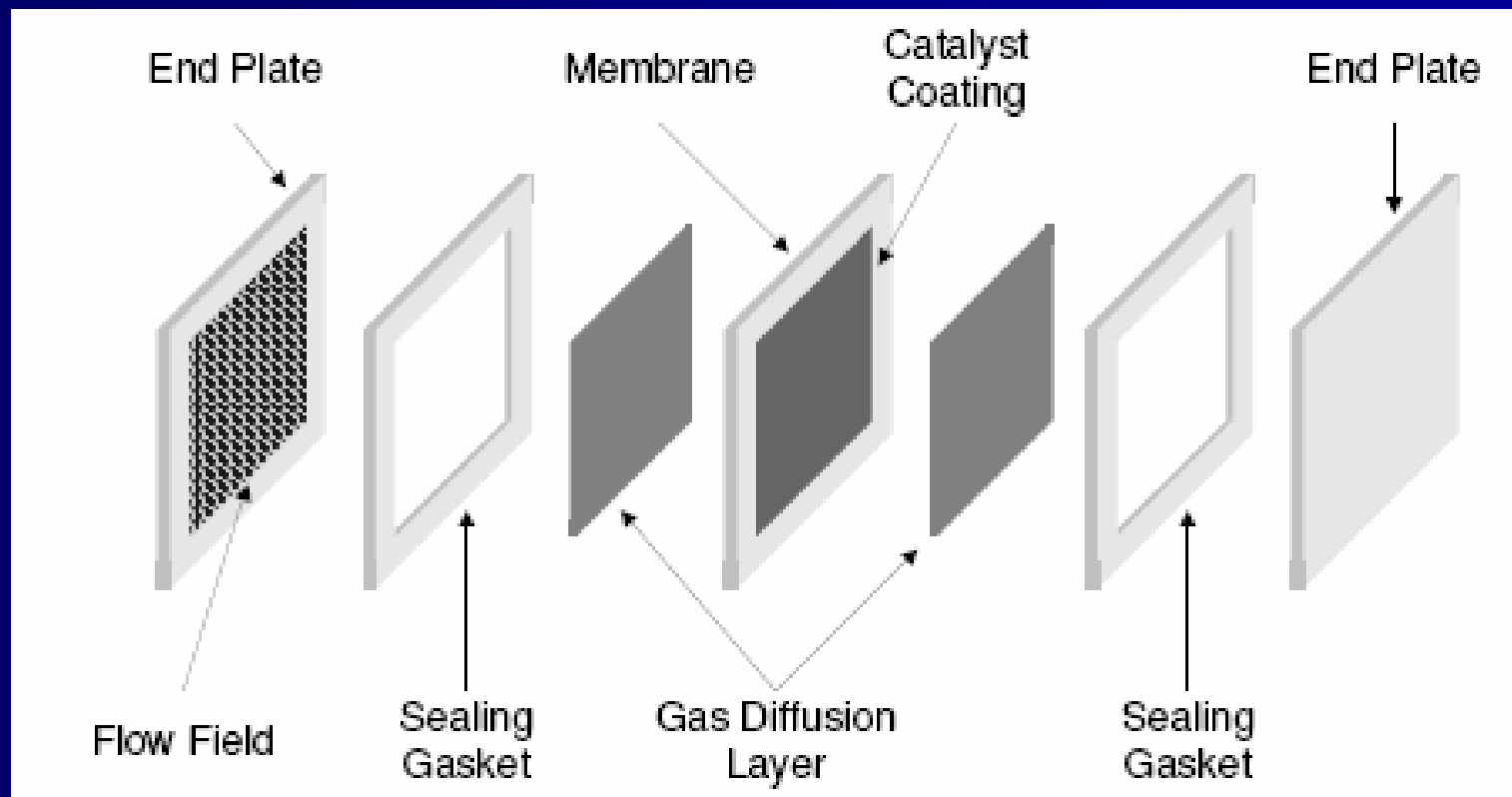
- Membrane/Electrodes + catalysts
- Pt painted/sprayed on membrane or gas transport layer



Assembly: Cell



<http://www.petfc.com>



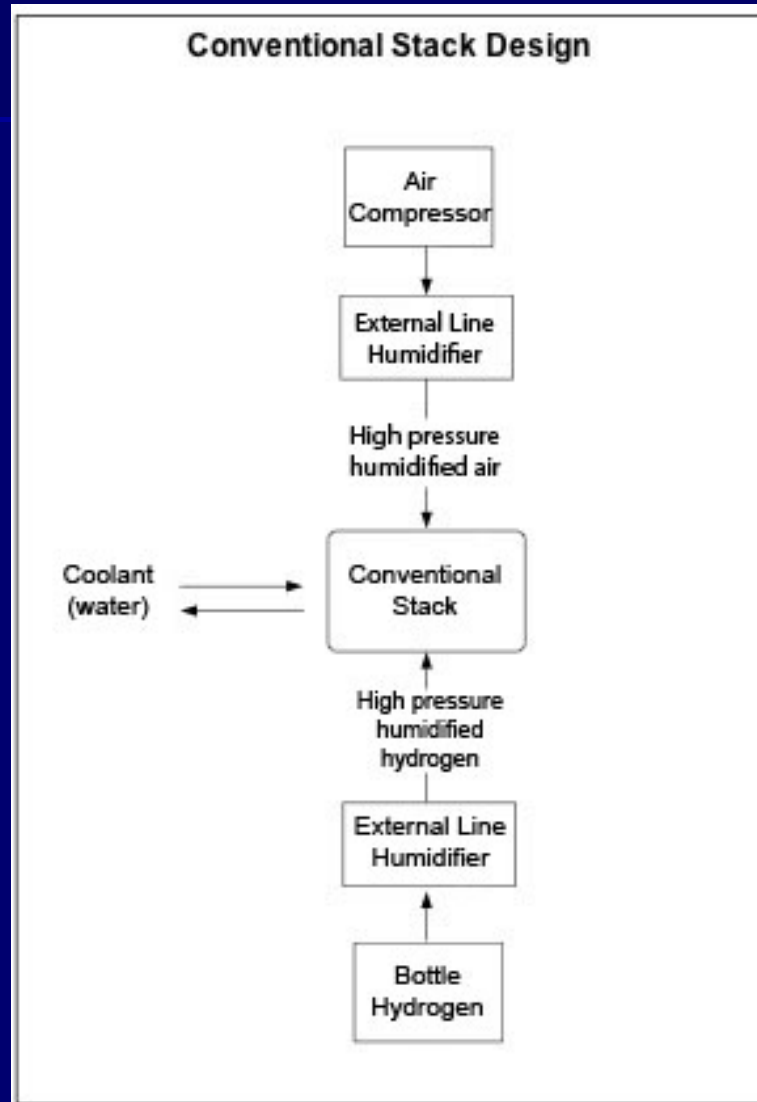
Assembly: Stack



Actual Fuel Cell Stacks

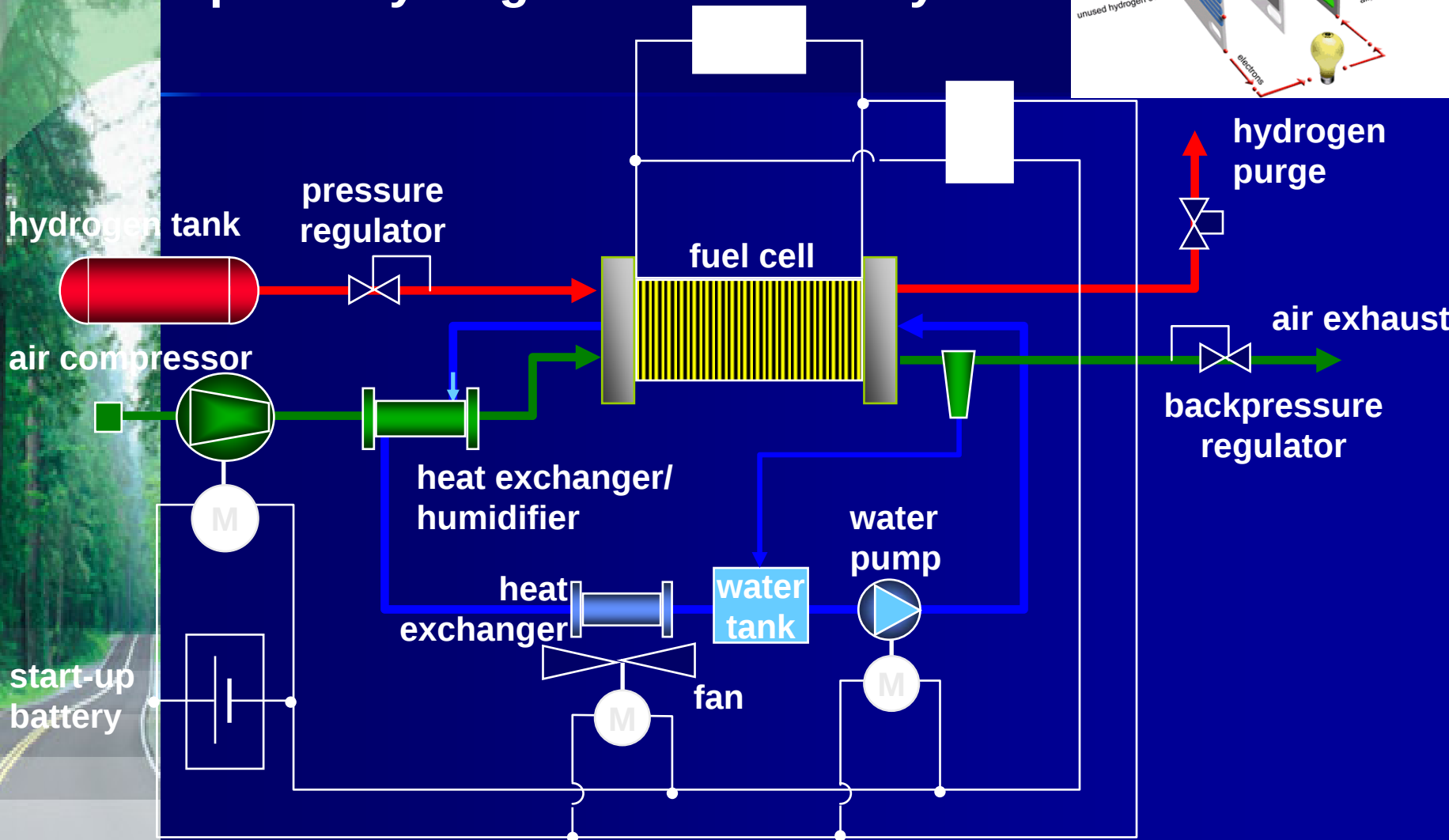
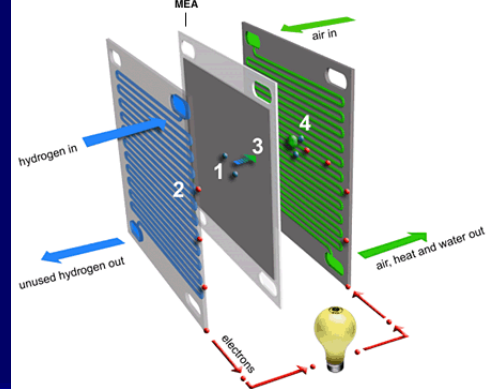


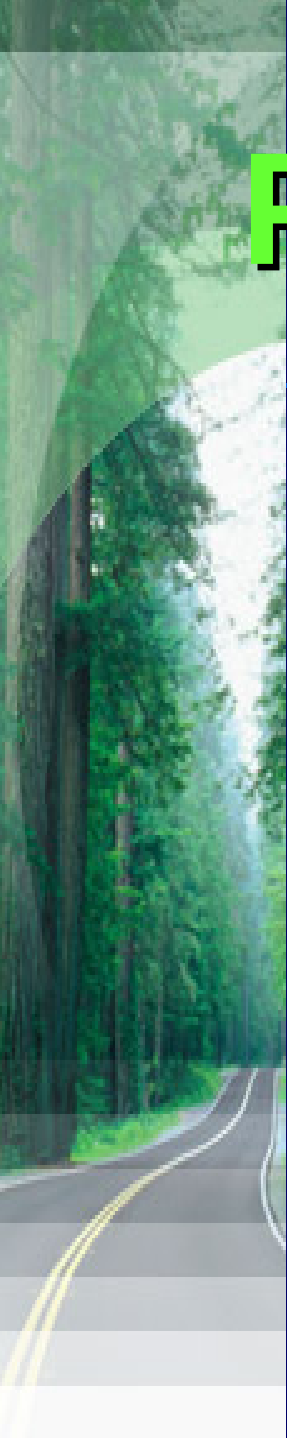
Stack Design



Fuel cell on operation

Example of hydrogen/air fuel cell system



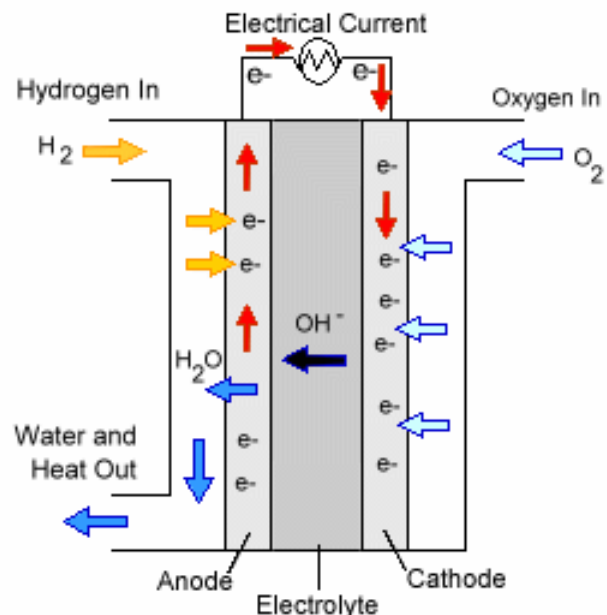


Fuel Cells Family

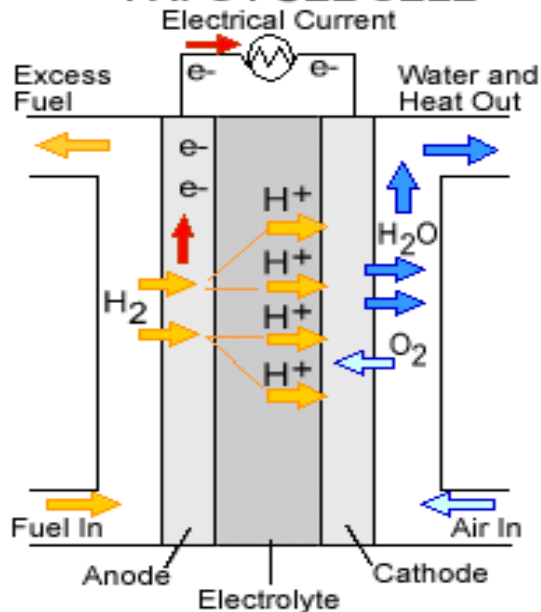
- Alkaline
- Phosphoric
- Proton exchange membrane
(Solid) polymer electrolyte, Acid membrane
- Direct methanol fuel cell
- Molten carbonate fuel cell
- Solid oxide fuel cell

Low Temperature

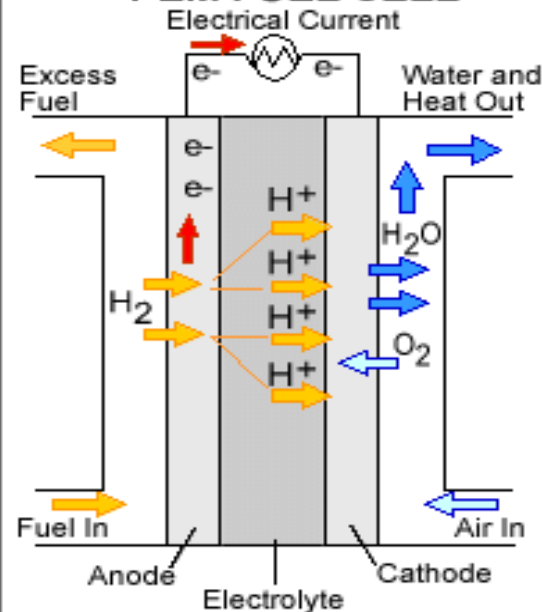
ALKALINE FUEL CELL



PAFC FUEL CELL

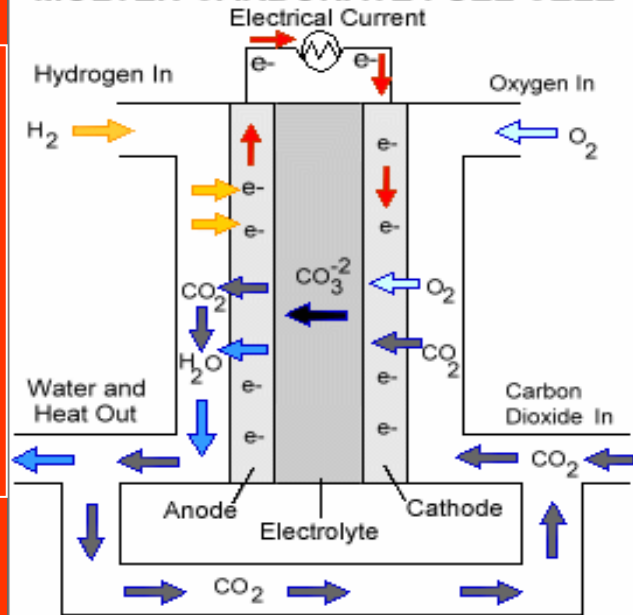


PEM FUEL CELL



High Temperature

MOLTEN CARBONATE FUEL CELL



SOFC FUEL CELL

