



Australian Government

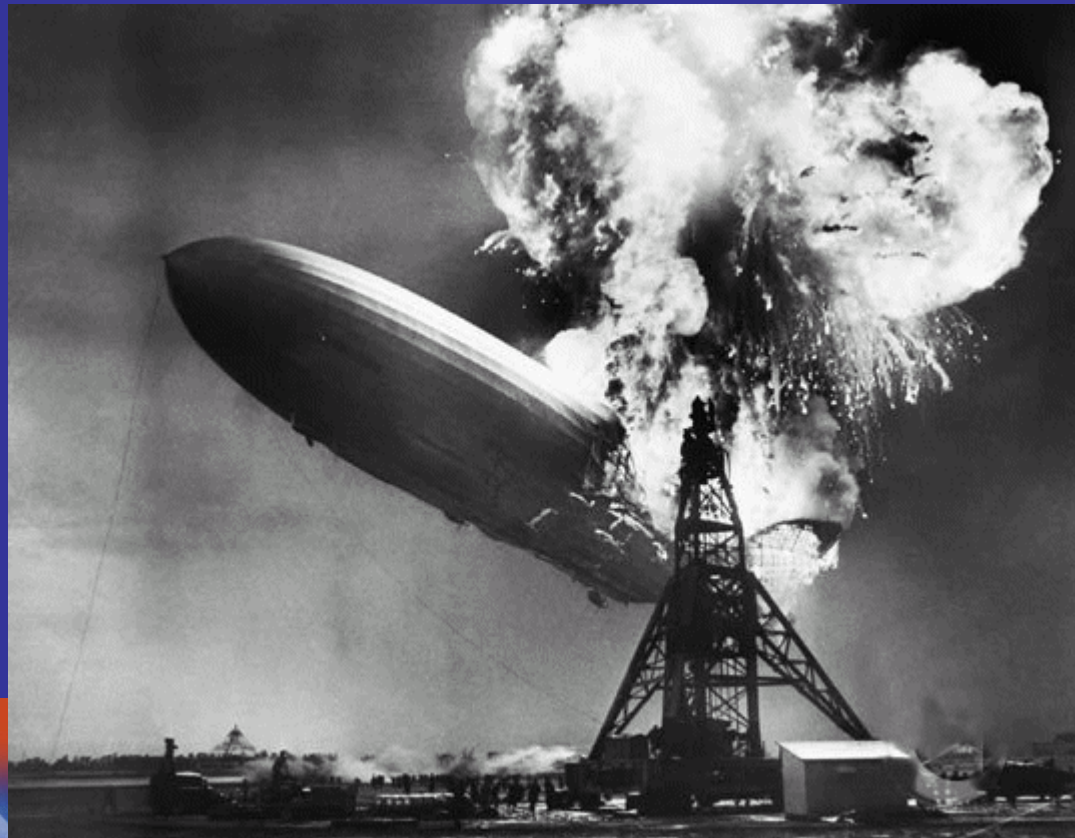
Australian Nuclear Science and Technology Organisation

Fuel cells and batteries in energy production (+ a few words on neutron diffraction)

Maxim Avdeev

Now, we have hydrogen produced and stored...

let's burn it!



What are fuel cells

Defined as “a device that converts the chemical energy of a fuel directly into electricity by electrochemical reactions”

Batteries are a subclass of fuel cells: closed systems with fixed amount of fuel and usually based on oxidation/reduction of metals



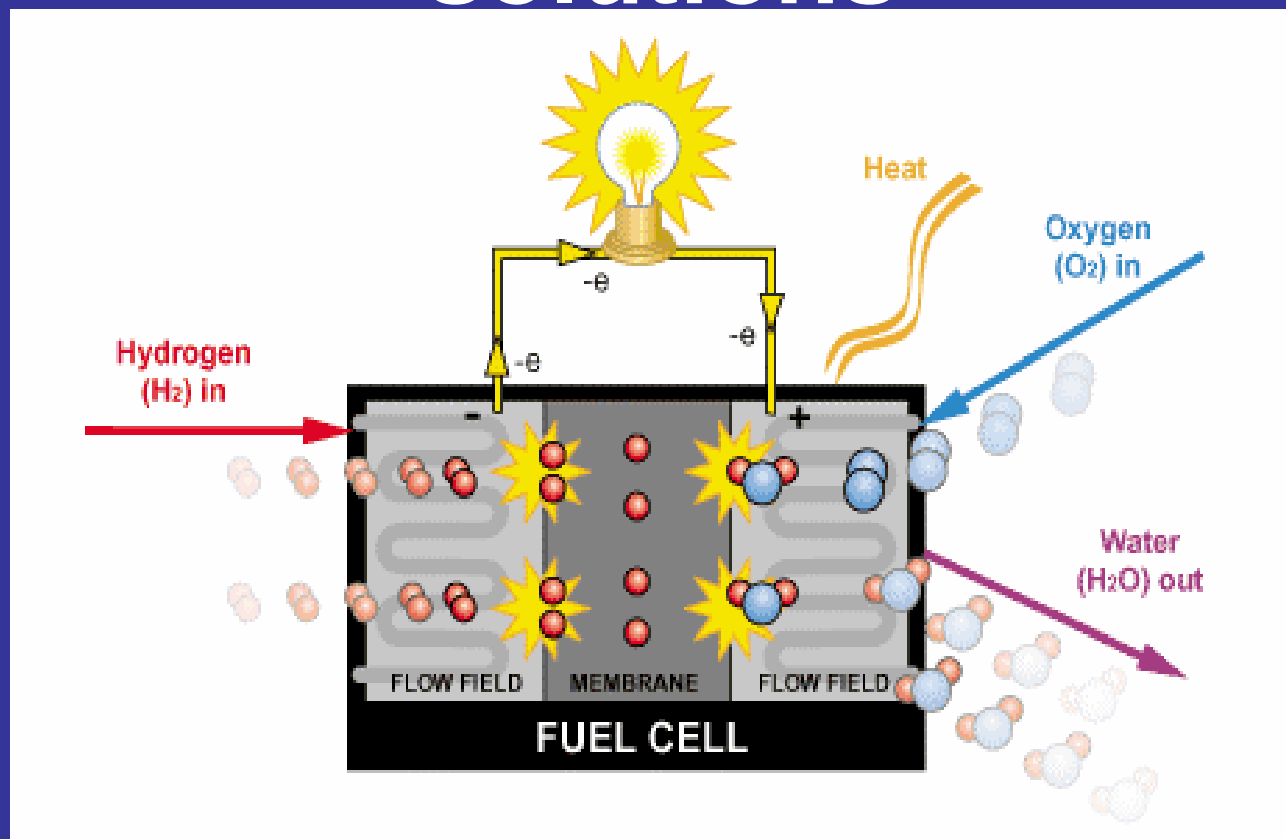
Fuel cells:
fuel can be
supplied
indefinitely



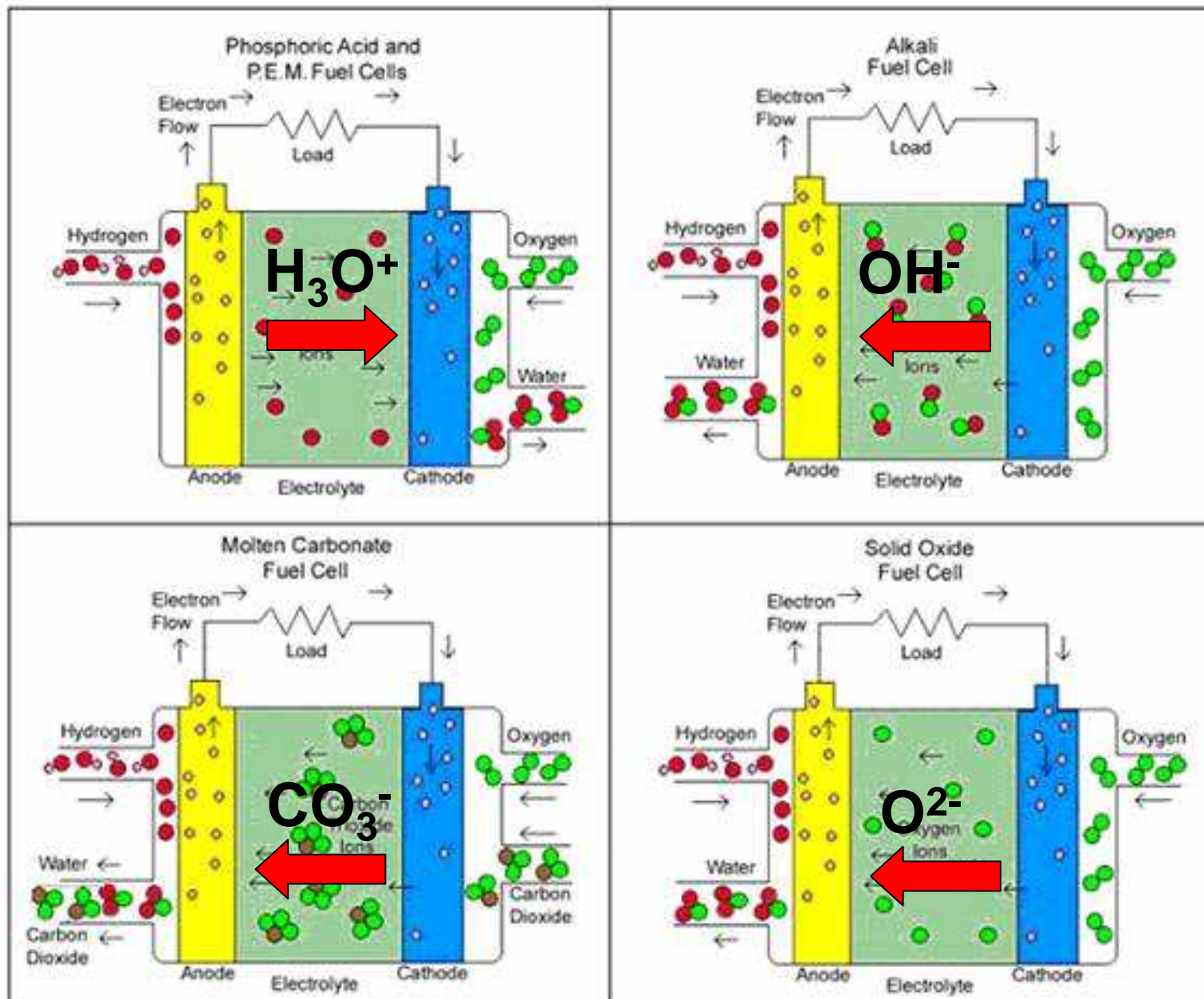
used systems
with fixed amount of fuel



Principle and current technical solutions



Principle and technical solutions



Current status

The main challenge is cost!

- ~\$2000/kW vs \$30/kW (internal combustion engines)
- no infrastructure

Membranes

Higher ionic conductivity

Operation in lower humidity, more strength, and durability

Cathodes

Non-Pt catalysts

Tolerance to impurities: S, hydrocarbons, Cl

fuel cells are currently is a weak link in the chain!

hydrogen production



hydrogen storage



energy production

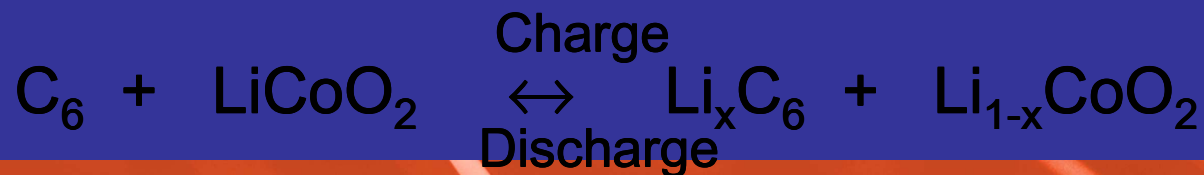
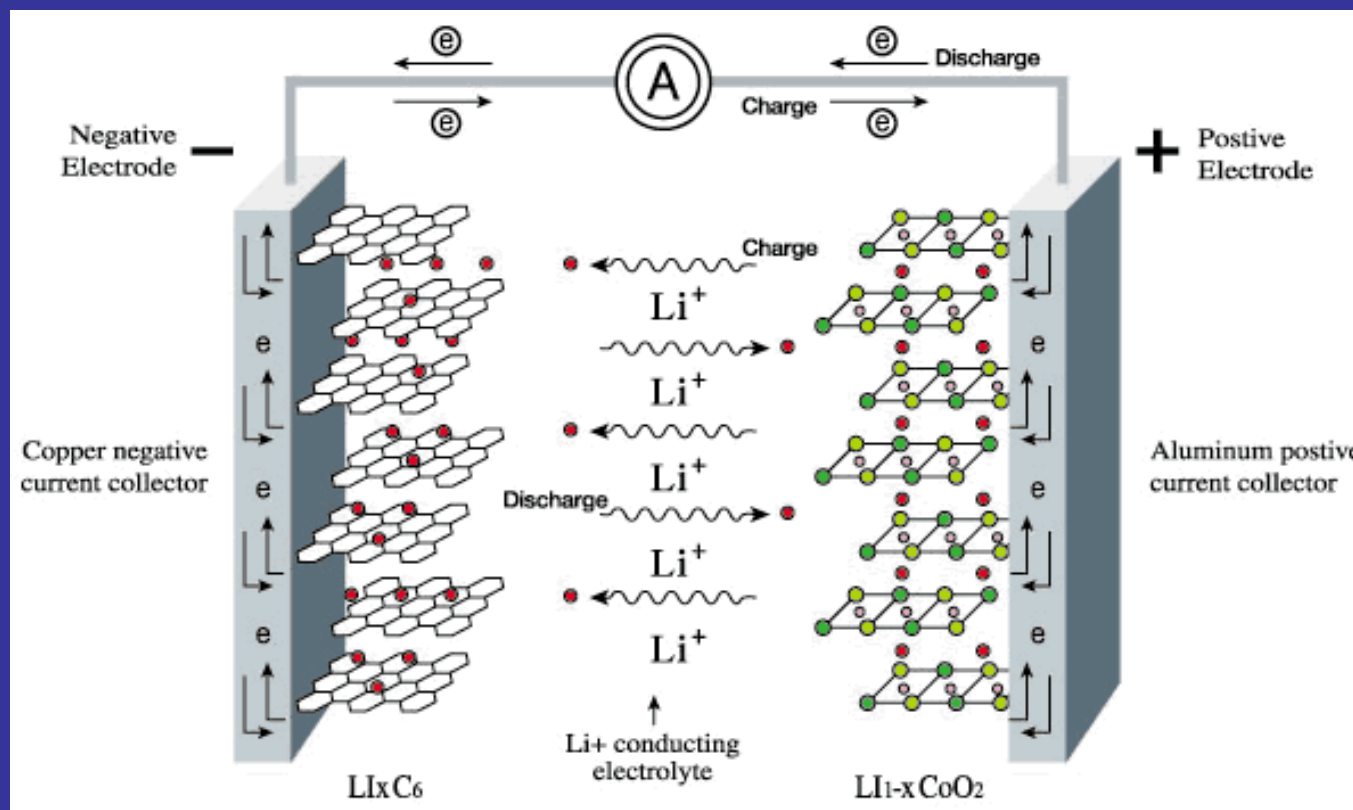


energy use

New materials are needed!

Batteries: current status

In contrast to fuel cells we have a solution!

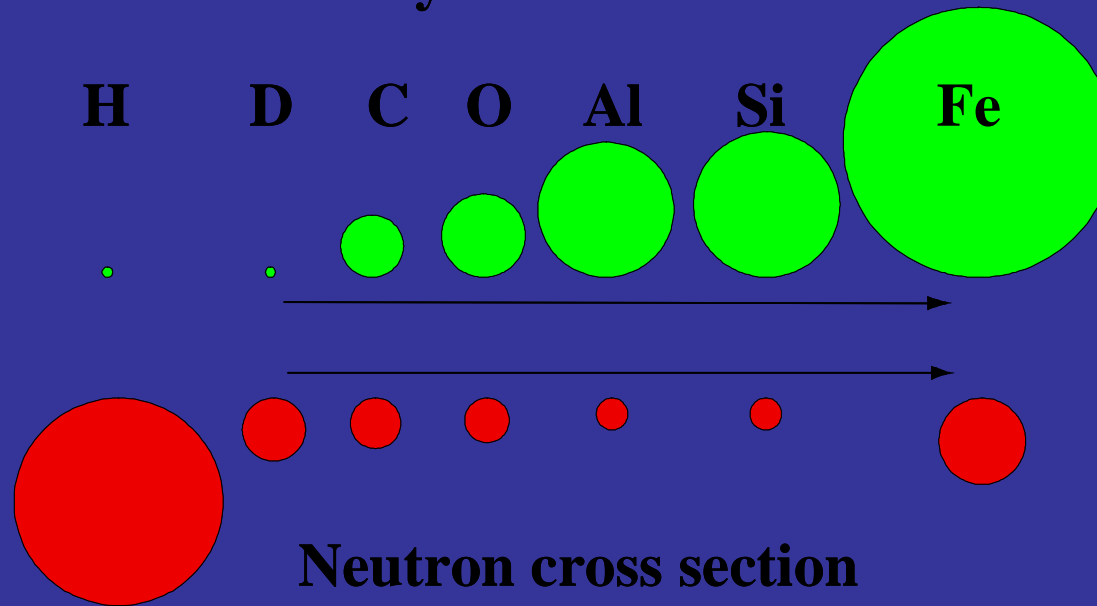


Batteries: current status

- High operating cell voltage (2.4 - 4V)
- Rechargeable many hundreds of times
- Operating over a wide range of temperatures
- High energy density (volumetric and gravimetric)

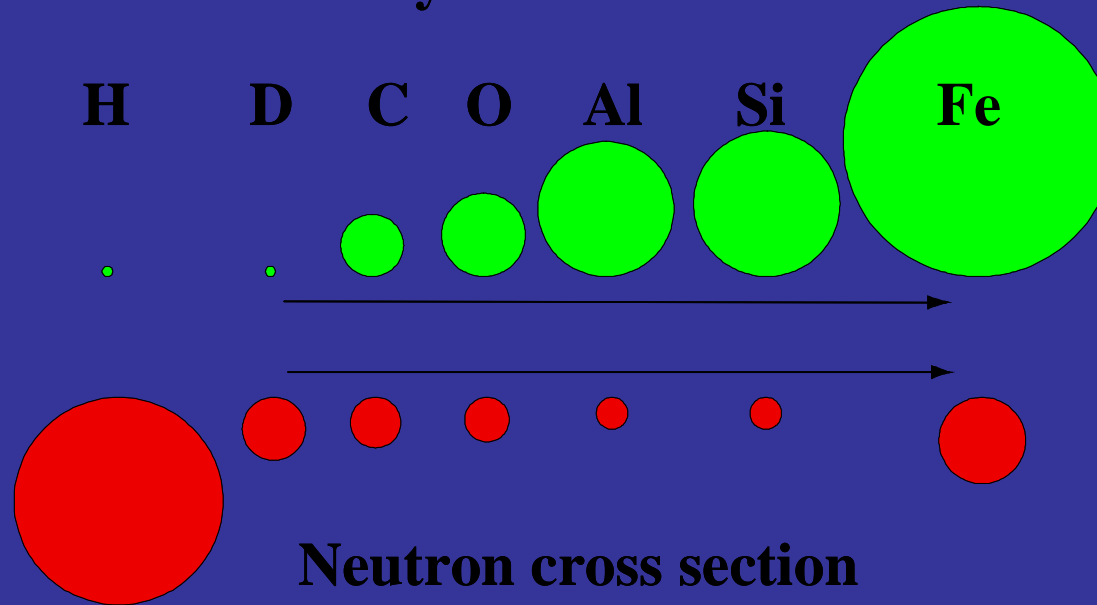
Why neutrons

X ray cross section



Why neutrons

X ray cross section



- highly penetrating (in situ experiments with samples in furnaces, electrochemical cells, etc)
- much more sensitive to light elements like H/D, O than X-rays