Announcements

- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).

- Will begin Materials section next week.
- Reading will be e-mailed to you.
- Make sure you got the lab handout for next week.
- Wear clothes you do not care about to lab next week, making paint is at least as messy as painting.

Review

- Standard half-cell reduction potentials
  - $E^o_{cell} = E^o_{red} + E^o_{oxid}$
  - $E^o_{cell} = E^o_{cath} - E^o_{anode}$
  - $E^o_{cell} = |E^o_1 - E^o_2|$
- Concentration dependence of cell potential (Nernst equation)

$$E_{cell} = E^o_{cell} - \frac{RT}{nF} \ln Q$$

- to calculate E_{cell}.

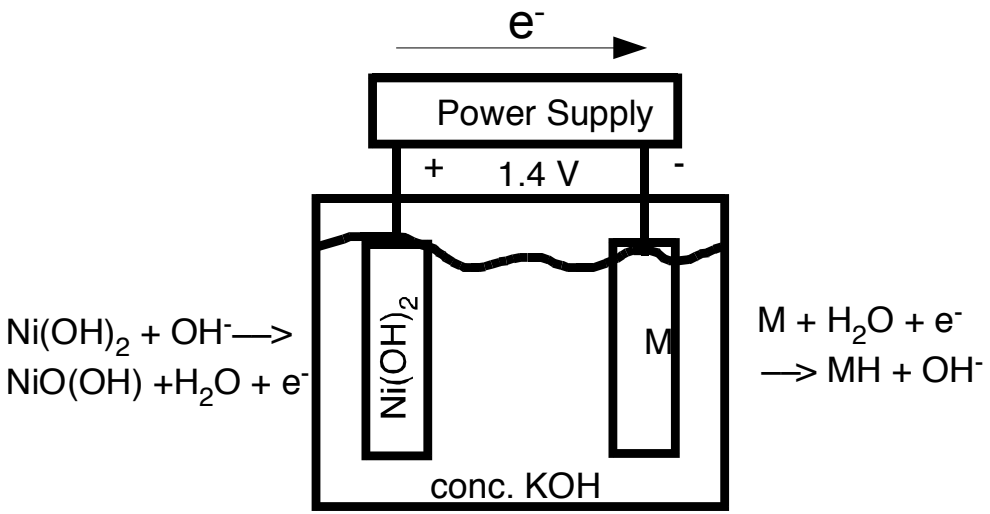
$$at\ 25^oC\ E_{cell} = E^o_{cell} - \frac{0.0592}{n} \log Q$$

- K_{eq} can be calculated given E^o_{cell} because Q = K_{eq} when E_{cell}=0.
- Total energy capacity of batteries in terms of moles (or grams) of reagent available also calculating coulombs charge passed.

Reduction Potentials for NiMH

	E^o (V)		E^o (V)
$NiO(OH) + H_2O + e^- \longrightarrow Ni(OH)_2 + OH^-$	1.32	$2H^+ + 2e^- \longrightarrow H_2$	0.000
$M(s) + H_2O + e^- \longrightarrow MH + OH^-$	0.0	$2H_2O + 2e^- \longrightarrow H_2 + 2\ OH^-$	-0.83
		$K^+ + e^- \longrightarrow K$	-2.95

Electrolysis

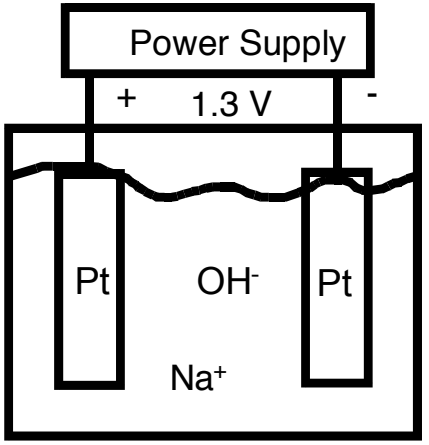


Electroysis Summary

- Any pair of reactions where $|E_1-E_2|$ less than $V_{applied}$ can go.
- RXN with highest E^o_{red} in a pair will go in reverse as an oxidation.
- Pair with the smallest potential difference is the most likely.
- RXNs that use species(reactants) in low concentration are not very likely.
- Reduction of alkali metal ions (K^+, Na^+, etc) to metal is unlikely since the metals reoxidize with water to form $M^+ + OH^- + H_2(g)$
- RXNs that produce gases have an **overpotential,** so go very slowly without a significantly larger potential difference than the one expected from reduction potentials.

Electrolysis of NaOH(aq)

	E^o (V)		E^o (V)
$O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$	1.229	$2H^+ + 2e^- \longrightarrow H_2$	0.000
$O_2 + 2H_2O + 4e^- \longrightarrow 4OH^-$	0.401	$2H_2O + 2e^- \longrightarrow H_2 + 2\ OH^-$	-0.83
		$Na^+ + e- \longrightarrow Na$	-2.71



Ballard Fuel Cell

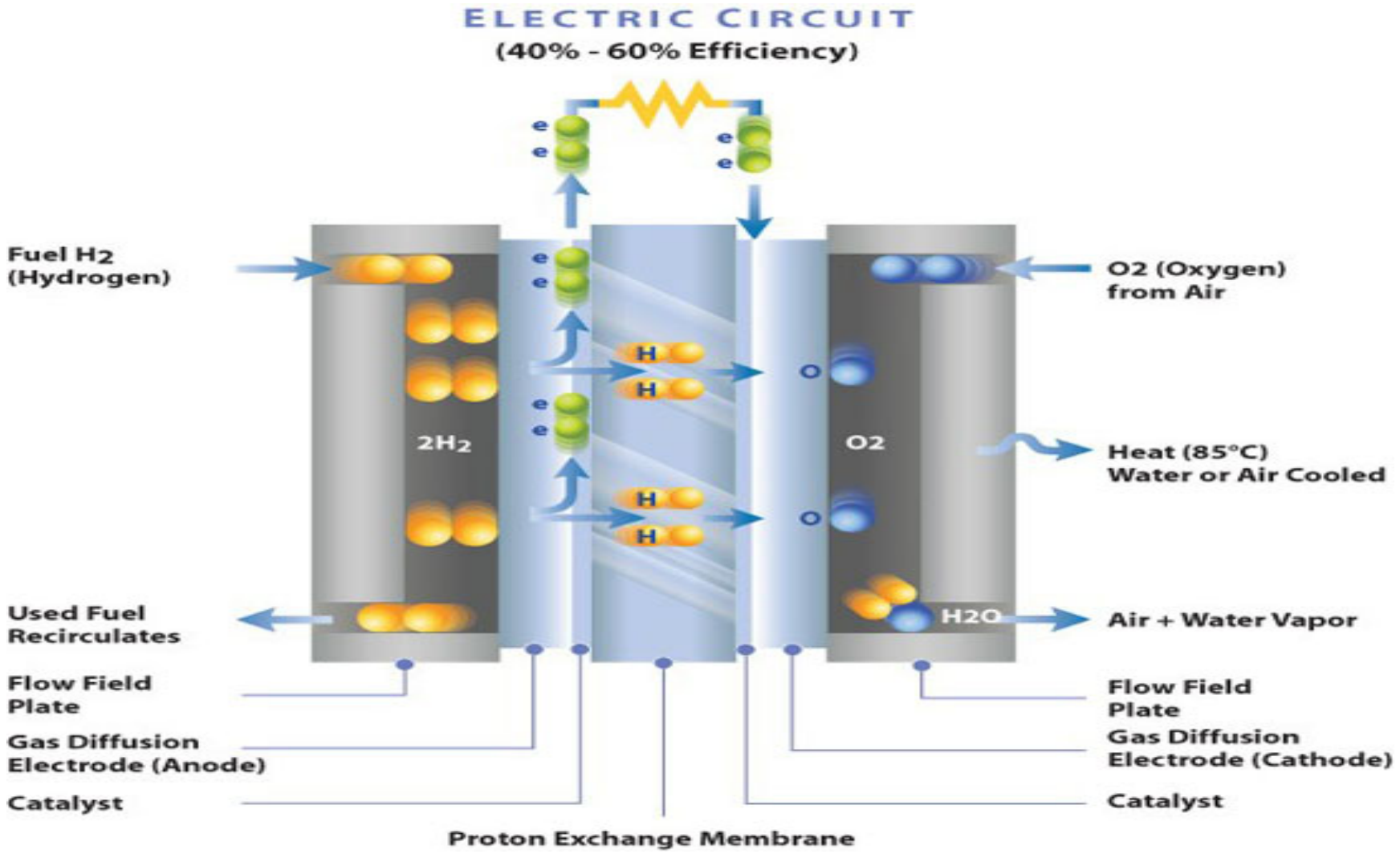


Image courtesy of Ballard Power Systems Inc. Found 11/28/07 at http://www.ballard.com/About_Ballard/Resources/How_Fuel_Cells_Work.htm
Honda Fuel Cell car: http://automobiles.honda.com/fcx-clarity/