. At equilibrium, E

April 22, 2019 : Electrochemistry 4

$Ni^{2+}_{(aq, 1.0M)} \rightarrow Ni^{2+}(0.001M)$

· $E_{cell} = 0$: means there is no driving force, so

calculating E of the cell : $Ni_{(s)} \rightarrow Ni^{2+}_{(aq)}(0.001M) + 2e^-$ anode

$Ni^{2+}_{(aq)}(1M) + 2e^- \rightarrow Ni_{(s)}$ cathode

add equation

$$E = E^0 - \frac{0.0592V}{n}\log Q = 0 - \frac{0.0592V}{2\text{ mols}}\log\frac{[Ni^{2+}]_{dilute}}{[Ni^{2+}]_{concentrated}} = \frac{-0.0592}{2}\log\frac{.001}{1}$$

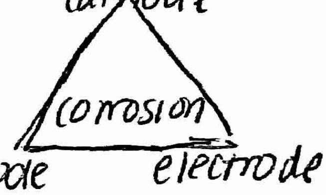
$= 0.0888V$

corrosion: oxidation of a metal to a metallic compound

-Anode and cathode must be in electrical contact

Ex. cathode: $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ $E° = 1.23V$

anode : $M(s) \rightarrow M^{n+}_{(aq)} + ne^-$ $E° = ?$



-under standard conditions ≠ driving force, so $E°$ for the anode/metal must be less than 1.23 V for spontaneous rxn

-"Noble" metals are relatively resistant to corrosion

Preventing corrosion: some metals oxidize to form an adherent

• coating that can protect against further oxidation

Ex. $4Al + 3O_2 \rightarrow 2Al_2O_3$

$2Mg + O_2 \rightarrow 2MgO$

$3Ag_2S + 2Al \rightarrow 6Ag + Al_2S_3$

Al $E° = -1.7V$

For aluminum, $E°_{cell} = 1.23V - (-1.7V)$

• Metal alloy: more resistant to corrosion (higher $E°$)

Ex. Stainless steel : Fe + Cr + Mo + Ni -changing ~~m~~ reduction potential by mixing all of the metals together

• cathodic protection: presence of "~~catho~~ "sacrificial anode" to keep rusting

Ex. Galvanized steel is Fe with a coating of Zn

- $E° = -0.76$ V for zinc, and $E° = -0.44$V for iron

-Zn more easily oxidized, acting as sacrificial anode to prevent rusting

voltaic cell : spontaneous reaction

cadmium: ~~anode~~ cathode - $Cd^{2+}_{(aq)} + 2e^- \rightarrow Cd_{(s)}$

copper : anode - $Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$

can reverse reaction by adding electricity- electrolysis

Electrolysis: can drive a non-favorable reaction using electrical energy

·Nonspontaneous reactions can occur if electricity is used to drive rxn

Ex. $2Al_2O_3(s) + 3C(s) \rightarrow 4Al(l) + 3CO_2(g)$