Electrochemical cell wikipedia

An electrochemical cell is a device that generates electrical energy from chemical reactions. Electrical energy can also be applied to these cells to cause chemical reactions to occur.[1] Electrochemical cells that generate an electric current are called voltaic or galvanic cells and those that generate chemical reactions, via electrolysis for example, are called electrolytic cells.[2]

A galvanic cell (voltaic cell), named after Luigi Galvani (Alessandro Volta), is an electrochemical cell that generates electrical energy from spontaneous redox reactions.[3]

A wire connects two different metals (e.g. zinc and copper). Each metal is in a separate solution; often the aqueous sulphate or nitrate forms of the metal, however more generally metal salts and water which conduct current.[4] A salt bridge or porous membrane connects the two solutions, keeping electric neutrality and the avoidance of charge accumulation. The metal"s differences in oxidation/reduction potential drive the reaction until equilibrium.[1]

The chemical reactions in the cell involve the electrolyte, electrodes, and/or an external substance (fuel cells may use hydrogen gas as a reactant). In a full electrochemical cell, species from one half-cell lose electrons (oxidation) to their electrode while species from the other half-cell gain electrons (reduction) from their electrode.

A salt bridge (e.g., filter paper soaked in KNO3, NaCl, or some other electrolyte) is used to ionically connect two half-cells with different electrolytes, but it prevents the solutions from mixing and unwanted side reactions. An alternative to a salt bridge is to allow direct contact (and mixing) between the two half-cells, for example in simple electrolysis of water.

As electrons flow from one half-cell to the other through an external circuit, a difference in charge is established. If no ionic contact were provided, this charge difference would quickly prevent the further flow of electrons. A salt bridge allows the flow of negative or positive ions to maintain a steady-state charge distribution between the oxidation and reduction vessels, while keeping the contents otherwise separate. Other devices for achieving separation of solutions are porous pots and gelled solutions. A porous pot is used in the Bunsen cell.

The cell potential can be predicted through the use of electrode potentials (the voltages of each half-cell). These half-cell potentials are defined relative to the assignment of 0 volts to the standard hydrogen electrode (SHE). (See table of standard electrode potentials). The difference in voltage between electrode potentials gives a prediction for the potential measured. When calculating the difference in voltage, one must first rewrite the half-cell reaction equations to obtain a balanced oxidation-reduction equation.

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Cell potentials have a possible range of roughly zero to 6 volts. Cells using water-based electrolytes are usually limited to cell potentials less than about 2.5 volts due to high reactivity of the powerful oxidizing and reducing agents with water which is needed to produce a higher voltage. Higher cell potentials are possible with cells using other solvents instead of water. For instance, lithium cells with a voltage of 3 volts are commonly available.

The cell potential depends on the concentration of the reactants, as well as their type. As the cell is discharged, the concentration of the reactants decreases and the cell potential also decreases.

Important examples of electrolysis are the decomposition of water into hydrogen and oxygen, and of bauxite into aluminium and other chemicals. Electroplating (e.g. of Copper, Silver, Nickel or Chromium) is done using an electrolytic cell. Electrolysis is a technique that uses a direct electric current (DC).

When driven by an external voltage (potential difference) applied to the electrodes, the ions in the electrolyte are attracted to the electrode with the opposite potential, where charge-transferring (also called faradaic or redox) reactions can take place. Only with a sufficient external voltage can an electrolytic cell decompose a normally stable, or inert chemical compound in the solution. Thus the electrical energy provided produces a chemical reaction which would not occur spontaneously otherwise.