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**15/SCI01/045**

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**APPLICATIONS OF EMF MEASUREMENTS**

EMF measurements are measurements of ambient (surrounding) [electromagnetic fields](https://en.wikipedia.org/wiki/Electromagnetic_fields) that are performed using particular sensors or probes, such as EMF meters. These probes can be generally considered as [antennas](https://en.wikipedia.org/wiki/Antenna_%28radio%29) although with different characteristics. In fact probes should not perturb the electromagnetic field and must prevent coupling and reflection as much as possible in order to obtain precise results.

**Determination of Equilibrium Constant**

Measurement of the standard Emf of the cell, E°Cell, enables one to evaluate the equilibrium constant for the electrode reaction.

The relation between the standard free energy change and the equilibrium constant of a reaction is given by:

G0= -RT In K

But the standard free energy is related to the standard electrode potential by the expression:

G0 = -nE0F

 Hence

E0 = In K

At 298K

E0 = log K

**The Application of Electromotive Force Measurements to Binary Metal Systems.**

Electromotive force studies of solutions of electrolytes have contributed to some of the most important advances in the understanding of the nature of such solutions. Today in the Debye‐Hückel theory we have a better theoretical basis for the treatment of electrolytes than for any other type of solution. On the other hand, binary liquid metal solutions, which at first sight might be thought to be relatively simple in nature, have received little attention. The thermodynamic properties of only a few such systems have been previously investigated. In our laboratories we have undertaken electromotive studies of the lower melting metal systems to supply additional data which we hope may lead eventually to some satisfactory theory of metallic solutions. The results obtained indicate that, in some cases at least, the problem may be a complex one. In this paper we shall discuss the experimental work and show how the thermodynamic properties of the solution can be evaluated from the electromotive force measurements. These thermodynamic data are then applied to the calculation of phase equilibria and to the calculation of the entropies, free energies and heats of formation of any intermetallic compounds which may occur.

**To ascertain the valency of an ion:**

Let us construct an electrolyte concentration cell without transference such that the activityof the metal ion of the left hand electrode is 10 times greater than that of the right handelectrode

**Determination of pH**

One of the most important applications of Emf measurements is the determination of the pH of solution. In principle, the activity of hydrogen ions or the concentration of hydrogen ions can be determined by setting a cell in which one of the electrodes is reversible to hydrogen ions.

In practice the hydrogen electrode is combined with another reference electrode such as standard hydrogen electrode (SHE) or a saturated calomel electrode (SCE) or any other reference electrode. ..

For the single hydrogen electrode Pt/H2(1atm)/H+, the electrode reaction is

1/2H2H++e

The electrode potential is given by

E=  In aH+                    since*E*° H+/H2= 0

By definition pH = -log10aH+Hence the above equation becomes

E = + ()pH

At 298K

E=+0.0591pH

Thus the Emf of the cell is linearly dependent on the pH value of the solution. The hydrogen electrode may be combined with a reference calomel electrode to obtain the cell;

Pt/H2 (1atm)/H+(a1)//Cl-(a2)/Hg2Cl2/ Hg

As seen from above the potential of the hydrogen electrode is given by:

EH2=  In aH+

Since the calomel electrode is a reference electrode its potential will be constant and hence its potential may simply be referred to as reference potential written as E. The Emf of the cell is given by;

Ecell= ER – EL

        = Eref – EH2

 = Eref-0.0591 log aH+

       =Eref+ 0.0591 pH

pH =  at 298K

Thus by measuring the Emf of a cell such as the one given above which has a reference electrode of known potential, the pH of the solution can be determined.