Chapter 11: Electrochemical Cells & Nernst Equation

Chitresh Kumar Bareth*

Swami Atmanand Govt. English Medium Model College, Mahasamund (CG)

Abstract

The chapter gives an in-depth description of the electrochemical cells and the Nernst equation, which is the foundation of the conversion of energy in chemical systems. The chapter starts by making the difference between galvanic (voltaic) cells that produce electrical energy through spontaneous reactions and electrolytic cells that produce electrical energy through non-spontaneous reactions. It describes cell construction, electrode potentials, and the movement of electrons in redox reactions with a special focus on their importance in batteries, corrosion, and electrolysis in industry. The Nernst equation is presented to compute the potential of the cell at non-standard conditions relating the concentration, temperature and electrode potential to predict the viability of the reaction. Practical uses in metal extraction, electroplating, sensors, and energy storage devices are described, and it was noted how electrochemistry could be useful in the laboratory as well as in the industry. Other challenges that have been discussed in the chapter include the ability to keep electrolytes stable, the degradation of electrodes and energy efficiency. The combination of theoretical knowledge and practical examples enables the students to acquire a complete insight into electronic and chemical principles of cells, quantitative treatment of cell potentials, and methods of their use in the real world of chemicals and industries. This is the necessary knowledge in the fields of battery technology, corrosion engineering, electroplating industries and research in the field of energy storage.

Keywords: Electrochemical cells, Galvanic cells, Electrolytic cells, Nernst equation, Cell potential, Redox reactions, Industrial applications

---

[1] ***Corresponding author**

Mr. Chitresh Kumar Bareth

E-mail address: *abareth552@gmail.com*

11.1.Introduction

Electrochemistry is an essential and long-established branch of chemistry which is concerned with the conversion of chemical energy into electrical energy and vice versa by means of oxidation-reduction (redox) reactions. In these reactions, electrons are moved between one species to another and this transfer of electrons can be utilized in order to do electrical work or vice-versa. The concept of electrochemistry lies at the core of a variety of natural processes and various technological implementations and, therefore, this topic is of theoretical importance and practical necessity. The fundamental oncology of electrochemistry is the so-called electrochemical cells that are the systems that allow the redox reactions under common and controlled conditions. With these cells, oxidation and reduction reactions can be separated at the various electrodes, and the electrons may be passed on through an external circuit. Electrochemical cell study is not only a further contribution to the study of thermodynamics, kinetic and equilibrium but also offers another insight on the process of charge transfer at the interface between cells at the electrode and the electrolyte.

Electrochemical cells find extensive applications in everyday life and industry, including:

- **Batteries and fuel cells** – Providing energy for vehicles, mobile devices, medical equipment, and renewable energy systems.
- **Electroplating and metal refining** – Improving corrosion resistance, appearance, and purity of metals.
- **Analytical and sensing devices** – Such as pH meters, ion-selective electrodes, and biosensors.
- **Corrosion prevention** – Employing cathodic protection techniques to safeguard pipelines, ships, and underground structures.

Deep Science Publishing, 2026
https://doi.org/10.70593/978-93-7185-430-6_11