

Module 5 : Electrochemistry

Lecture 25 : Corrosion

Objectives

After studying this Lecture, you will be able to

- Outline the electrochemical basis for corrosion.
- Illustrate the use Pourbaix diagrams
- Outline the kinetic features involved in the corrosion process
- List the protective measures against corrosion and highlight the mechanisms involved in the protection.

25.1 Introduction

When common metals such as Fe, Cu and Zn are exposed to the environment, the surface of these materials gets deteriorated due to its interaction with the oxygen, moisture and other substances present in the environment. This process is referred to as corrosion. In the case of iron, the process is referred to as rusting. Due to corrosion, the surface of iron gets covered with brownish ferric oxide, Cu gets coated with a green deposit and Zn is covered with a white deposit. About 20% of production of these metals is to make up for the loss of these metals due to corrosion. The need for environmentally friendly technologies to combat corrosion can not be over emphasized.

The process of corrosion has an electrochemical (thermodynamic) basis. The surfaces of metals such as Fe, Cu, contain impurities and lattice defects and are reactive when they come in contact with air, moisture, acidic and or basic environments. One part of the surface acts as the anode of a galvanic cell and oxidation that occurs in this part results in the formation of $\text{Fe}^{2+}/\text{Cu}^{2+}$ ions. These ions go into the solution formed by the condensed water vapour or the acidic / basic fluids which come into contact with this part of the surface. The electrons released in this oxidation $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e$, $\text{Cu} \rightarrow \text{Cu}^{2+} + 2e$ easily travel through the conducting medium of the metal until they come into contact with H^+ of an acidic neighborhood or $\text{O}_2/\text{H}_2\text{O}$ in a neutral or basic neighborhood and react with them. The reactions involved in these reduction processes are

Table 25.1 : Reduction reactions involved in corrosion

Reaction	Nature of the solution	E° / V
$\text{H}^+ + e \rightleftharpoons 1/2 \text{H}_2 (\text{g})$	acidic	0
$\text{O}_2 + 4\text{H}^+ + 4e \rightleftharpoons 2\text{H}_2\text{O}$	Acidic	1.23
$\text{O}_2 + 2\text{H}_2\text{O} + 4e \rightleftharpoons 4\text{OH}^-$	Neutral / basic	0.40

The movement/migrations of ions in the surrounding medium completes the "circuit" consisting of production of cations, electron flow (inside the metallic medium) and ionic movement.

Module 5 Electrochemistry Lecture 24 Applications Of

Katrin Zwirgmaier



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Table of Contents Module 5 Electrochemistry Lecture 24 Applications Of

1. Understanding the eBook Module 5 Electrochemistry Lecture 24 Applications Of
 - The Rise of Digital Reading Module 5 Electrochemistry Lecture 24 Applications Of
 - Advantages of eBooks Over Traditional Books
2. Identifying Module 5 Electrochemistry Lecture 24 Applications Of
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Module 5 Electrochemistry Lecture 24 Applications Of
 - User-Friendly Interface
4. Exploring eBook Recommendations from Module 5 Electrochemistry Lecture 24 Applications Of
 - Personalized Recommendations
 - Module 5 Electrochemistry Lecture 24 Applications Of User Reviews and Ratings
 - Module 5 Electrochemistry Lecture 24 Applications Of and Bestseller Lists

5. Accessing Module 5 Electrochemistry Lecture 24 Applications Of Free and Paid eBooks
 - Module 5 Electrochemistry Lecture 24 Applications Of Public Domain eBooks
 - Module 5 Electrochemistry Lecture 24 Applications Of eBook Subscription Services
 - Module 5 Electrochemistry Lecture 24 Applications Of Budget-Friendly Options
6. Navigating Module 5 Electrochemistry Lecture 24 Applications Of eBook Formats
 - ePub, PDF, MOBI, and More
 - Module 5 Electrochemistry Lecture 24 Applications Of Compatibility with Devices
 - Module 5 Electrochemistry Lecture 24 Applications Of Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Module 5 Electrochemistry Lecture 24 Applications Of
 - Highlighting and Note-Taking Module 5 Electrochemistry Lecture 24 Applications Of
 - Interactive Elements Module 5 Electrochemistry Lecture 24 Applications Of
8. Staying Engaged with Module 5 Electrochemistry Lecture 24 Applications Of
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Module 5 Electrochemistry Lecture 24 Applications Of
9. Balancing eBooks and Physical Books Module 5 Electrochemistry Lecture 24 Applications Of
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Module 5 Electrochemistry Lecture 24 Applications Of
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Module 5 Electrochemistry Lecture 24 Applications Of
 - Setting Reading Goals Module 5 Electrochemistry Lecture 24 Applications Of
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Module 5 Electrochemistry Lecture 24 Applications Of
 - Fact-Checking eBook Content of Module 5 Electrochemistry Lecture 24 Applications Of
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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