# Chapter 4
# Effects of Corrosion on the Durability of Battery

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## ABSTRACT

*The term "corrosion" refers to the degradation of metallic materials (metals and their alloys) caused by a reaction with environmental factors. This phenomenon causes serious financial and health problems. Corrosion is one of the electrochemical phenomena that manifests itself as the formation of clusters on the surface of metals, where one electrode, known as the "anode", consumes the other, known as the "cathode", which remains dormant. In reality, these clusters form as soon as the metal surface becomes heterogeneous, forming the anode and cathode domains where the two primary electrochemical reactions (oxidation and reduction) take place. For example, dissolution or passivation of active electrode materials and dissolution, oxidation or passivation of current collectors are the main causes of corrosion in batteries. An in-depth analysis of battery corrosion is necessary due to the rapid development of battery research. We begin with an overview of recent developments in corrosion and electrode protection for different battery types.*

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## 1 INTRODUCTION

Corrosion is a natural process whereby materials, especially metals, lose their structural and functional properties little by little through chemical or electrochemical reactions with their environment (Rached et al., 2023, 2024a). Considering that energy storage systems rely on corrosion for some of their key components, such as electrodes, electrolyte solutions, and protective coatings, all of which are required to enable optimum performance and safety (Kleiner & Ehrenberg, 2019; Rached et al., 2024b; Sanguesa et al., 2021). Corrosion degradation can be caused in a variety of ways: it can be manifested in terms of a cycle life reduction, an increase in internal resistance, a capacity loss, or-even worse-safety risks, such as thermal runaway and short circuiting (Mzioud et al., 2020) (Rached et al., 2023).

Batteries form the base of modern technology and are at the heart of portable electronics, electric vehicles, and renewable energy storage. With the world transitioning towards renewable energy sources such as solar and wind, the demand for effective and long-life energy storage technologies has never been higher (Goodenough & Park, 2013). Such batteries are responsible for storing excess energy generated from intermittent sources and supplying it at the right time to ensure a constant supply of electricity under various conditions. Among other types of batteries, lithium-ion batteries have gained much interest since they stand out due to their superior energy density, long cycle life, and outstanding efficiency (Shirvanimoghaddam et al., 2018) .

Despite wide usage, these types of batteries are still prone to corrosion-related degradation, which may substantially reduce their life and effectiveness. Based on an in-depth analysis of the specific corrosion mechanisms that operate in batteries and how these mechanisms contribute to degradation, this review tries to investigate how corrosion impacts battery durability. Such corrosion can accelerate performance loss after successive cycles of charging and discharging, lead to weakening in the internal structures, increase the resistance internally, and result in a total reduction of capacity (W. Li et al., 2022; Song et al., 2022). A deep understanding of such processes allows for the establishment of specific corrosion mitigation strategies that will enhance reliability, efficiency, and safety for the batteries. Applications where long-term performance and safety are particularly crucial, such as high-performance portable electronics, electric cars, and renewable energy storage systems, have a particular relevance to this research. The objective of this study is to provide insights that will guide the creation and maintenance of superior and durable energy storage systems.