

Chapter 2


Nickel–Metal Hydride Batteries: A Reliable Energy Storage Solution for Consumer Electronics and Renewable Energy Storage

Oscar Sotelo

 <https://orcid.org/0000-0002-3664-1286>


Instituto de Ciencias Fisicas, Mexico

John Henao

 <https://orcid.org/0000-0002-8954-6039>

SECIHTI-CIATEQ, Mexico

Nestor Starlin Flores-Garcia

 <https://orcid.org/0000-0002-9352-9688>

Instituto de Ciencias Fisicas, Mexico

Victor Zezatti

 <https://orcid.org/0000-0001-6470-6772>

CIICAp, Mexico

Carlos A. Poblano-Salas

CIATEQ, Mexico

Horacio Martinez-Valencia

Instituto de Ciencias Fisicas, Mexico

ABSTRACT

Nickel–Metal Hydride (Ni–MH) batteries remain a relevant technology for safe and sustainable energy storage, especially in consumer electronics, renewable energy systems, and hybrid vehicles. The novelty of this chapter lies in its comprehensive discussion of the latest advances in metal hydride alloys for negative electrodes, particularly AB₅, AB₂, and A₂B₇ systems, highlighting their impact on hydrogen storage capacity, electrochemical performance, and long-term stability. Special attention is given to how alloy design, microstructural control, and surface modifications address the growing demand for higher energy density and durability. By bridging fundamental electrochemical principles with recent material innovations,

DOI: 10.4018/979-8-3373-3156-0.ch002

this chapter provides new perspectives on the future potential of Ni-MH technology as a competitive and environmentally friendly alternative within the energy storage landscape.

INTRODUCTION

Batteries have played a pivotal role in the technological advancements of modern society, from the invention of the Voltaic cell to the development of contemporary lithium-ion batteries. The ongoing pursuit of high-energy, high-power-density, low-cost, and environmentally friendly rechargeable batteries is driven by the increasing energy demands of applications ranging from spacecraft and smartphones to electric vehicles. These compact energy sources have significantly transformed modern life and continue to shape technological progress (Notten & Latroche, 2009).

The history of batteries dates to the late 18th century, when Italian physicist Alessandro Volta made a groundbreaking discovery. In 1800, he developed the first electric battery, the Voltaic cell, comprising alternating discs of copper and zinc, separated by pieces of cardboard soaked in saltwater. Although rudimentary, this invention marked the first step toward electrochemical energy storage (Notten & Latroche, 2009).

Over the following century, battery technology evolved gradually. The first commercially available batteries, such as zinc–carbon and lead–acid types, emerged in the mid-19th century. Despite their size and weight, these batteries provided reliable energy storage for early technologies like telegraphs and electric lighting. A breakthrough occurred in the late 20th century with the introduction of cylindrical cell formats, which remain widely used today in various applications (Ying et al., 2006).

The development of rechargeable batteries started in the 1890s, when the growing demand for portable power sources led to the fabrication of the first nickel-cadmium (NiCd) batteries. These were invented by Swedish engineer Waldemar Jungner in 1899. Jungner patented the battery and conducted experiments with various electrode materials, primarily nickel and cadmium. The NiCd battery represented the first rechargeable alternative to lead-acid batteries, offering several advantages, although the materials were costly and progress in commercialization was gradual (Dehghani-Sanij et al., 2019).

By 1910, NiCd batteries were introduced to the Swedish market, but significant improvements in electrode technology, such as the deposition of active materials within a porous nickel-plated electrode, were not achieved until 1932. The technology reached the United States in 1946.

NiCd cells possess unique physical and electrical properties. The active materials in the electrodes undergo oxidation state changes without physical degradation.

34 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/nickel-metal-hydride-batteries/396315

Related Content

The Metric Structure of Nucleic Acids and the Higher Dimension of Their Constituents

Gennadiy Vladimirovich Zhizhin (2018). *International Journal of Chemoinformatics and Chemical Engineering* (pp. 1-15).

www.irma-international.org/article/the-metric-structure-of-nucleic-acids-and-the-higher-dimension-of-their-constituents/232244

Long Destruction of Structurally Damaged Composite Pipe

Akhundov Mohammed B. and Sadayev Azber Sh. (2013). *International Journal of Chemoinformatics and Chemical Engineering* (pp. 37-47).

www.irma-international.org/article/long-destruction-structurally-damaged-composite/75222

Moss Biomonitoring in Former Soviet Union Countries: A Review

Inga Zinicovscaia, Nikita Yushin, Konstantin Vegeland Dmitrii Grozdov (2020). *Handbook of Research on Emerging Developments and Environmental Impacts of Ecological Chemistry* (pp. 511-529).

www.irma-international.org/chapter/moss-biomonitoring-in-former-sovet-union-countries/251599

Power Electronics and Controls in Solar Photovoltaic Systems

Radian Belu (2013). *Handbook of Research on Solar Energy Systems and Technologies* (pp. 68-125).

www.irma-international.org/chapter/power-electronics-controls-solar-photovoltaic/69087

Recent Advances in Anticancer Drug Screening

Wei Xiao and Xiao bin Wang (2026). *Advanced Materials and Chemical Engineering* (pp. 379-408).

www.irma-international.org/chapter/recent-advances-in-anticancer-drug-screening/409437