

# The Surprising Challenges of Rechargeable Magnesium Batteries That Scientists are Struggling to Overcome

## The Promise of Rechargeable Magnesium Batteries

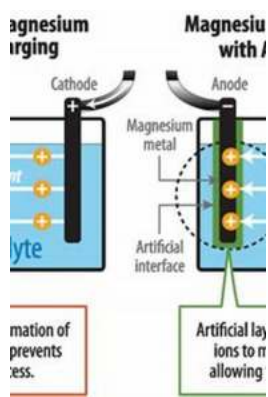
Rechargeable batteries play a crucial role in our daily lives, powering our smartphones, laptops, and electric vehicles. However, the limitations of conventional lithium-ion batteries, such as limited energy storage capacity and safety concerns, have led scientists to seek alternative battery technologies. One such promising technology is rechargeable magnesium batteries.

## The Potential Advantages of Magnesium Batteries

Magnesium is an appealing choice for battery materials due to its abundance, non-toxicity, and high energy density potential. Compared to lithium, magnesium has the potential to offer higher energy storage capacity, longer battery life, and enhanced safety features. Additionally, magnesium batteries could significantly reduce manufacturing costs, as magnesium is more readily available and affordable compared to lithium.

## The Challenges Faced by Scientists

While rechargeable magnesium batteries hold tremendous promise, scientists are still facing significant challenges in developing practical and efficient magnesium battery systems. These challenges include:



# Challenges of a Rechargeable Magnesium Battery: A Guide to the Viability of this Post Lithium-Ion Battery (SpringerBriefs in Energy)

by Abraham Loeb (1st ed. 2018 Edition, Kindle Edition)

★★★★☆ 4.2 out of 5

Language : English

File size : 1821 KB

Text-to-Speech : Enabled

Enhanced typesetting : Enabled

Print length : 120 pages

Screen Reader : Supported



## 1. Electrolyte Compatibility

Magnesium ions have a tendency to form solid deposits when in contact with certain electrolytes, limiting the battery's ability to store and release energy effectively. Scientists are working to identify new electrolytes or modify existing ones to improve compatibility with magnesium ions, thereby minimizing the deposition issue.

## 2. Cathode Material Development

Unlike lithium batteries, which have a variety of proven cathode materials like lithium cobalt oxide, magnesium batteries lack a fully developed cathode material that allows for high energy density and efficient charge/discharge cycles. Scientists are actively researching and experimenting with different cathode materials to unlock the full potential of rechargeable magnesium batteries.

## 3. High Charging Voltage

Magnesium batteries require higher charging voltages than lithium batteries, which poses additional challenges in terms of battery safety and the development of suitable charging systems. Researchers are investigating various approaches to overcome this limitation and ensure the safe and efficient charging of magnesium batteries.

#### **4. Limited Cycling Stability**

Magnesium batteries currently suffer from poor cycling stability, meaning their capacity to maintain consistent performance over numerous charge and discharge cycles. This limitation needs to be addressed to ensure the longevity and reliability of rechargeable magnesium batteries.

#### **The Ongoing Research and Breakthroughs**

Despite the challenges, ongoing research and breakthroughs in the field of rechargeable magnesium batteries offer hope for their successful implementation in various industries.

Scientists are exploring novel electrolytes, such as room-temperature ionic liquids and non-aqueous solvents, to improve the compatibility of magnesium ions and reduce solid deposition. They are also investigating nanomaterials, such as graphene and transition metal oxides, as potential cathode materials with higher energy density and improved cycling stability.

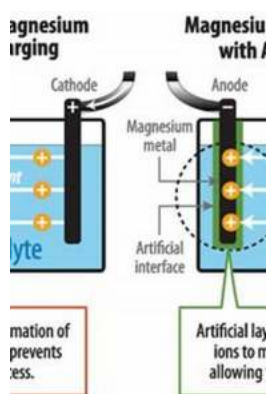
Furthermore, researchers are exploring alternative charging mechanisms, such as dual-ion intercalation and solid-state electrolytes, to address the high charging voltage requirement and enhance the safety of rechargeable magnesium batteries.

#### **The Future of Rechargeable Magnesium Batteries**

Rechargeable magnesium batteries have the potential to revolutionize portable electronics, electric vehicles, and grid energy storage. The ability to overcome the current challenges will pave the way for more sustainable and efficient energy storage solutions.

If scientists manage to develop practical and commercially viable rechargeable magnesium batteries, we can expect longer-lasting smartphones, electric vehicles with extended driving ranges, and more reliable renewable energy storage systems.

So, while the challenges faced by researchers are significant, they are diligently working towards harnessing the power of magnesium to unlock the future of battery technology.



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This expert volume addresses the practical challenges which have so far inhibited the commercial realization of a rechargeable magnesium battery, placing the discussion within the context of the already established lithium-ion battery.

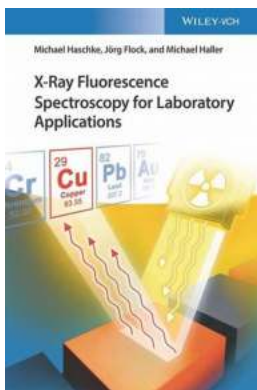
Lithium-ion batteries are becoming commonplace in most power applications, starting with portable electronics and expanding to motor vehicles, stationary storage, and backup power. Since their 25 years ago, they have slowly been replacing all other battery chemistries. As the technology has matured, it is nearing its theoretical limits in terms of energy density, so research and development worldwide is quickly shifting towards the study of new battery chemistries with cheaper components and higher energy densities.

A very popular battery candidate which has generated a lot of recent interest is the magnesium rechargeable battery. Magnesium is five orders of magnitude more abundant than lithium, can move two electrons per cation, and is known to plate smoothly without any evidence of dendritic growth. However, many challenges remain to be overcome. This essential volume presents an unfiltered view on both the realistic promises and significant obstacles for this technology, providing key insights and proposed solutions.



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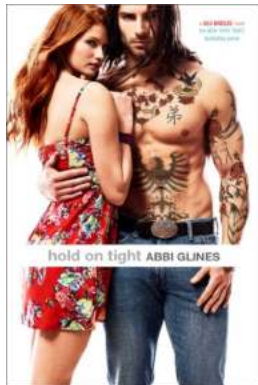
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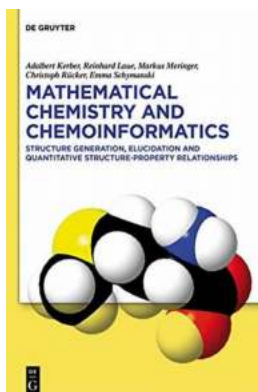
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