

The Incredible Gaseous And Electrochemical Hydrogen Storage Properties Of Mg Based Thin Films

Magnesium (Mg) based thin films have been attracting significant attention in recent years due to their exceptional gaseous and electrochemical hydrogen storage properties. These films offer a promising avenue for hydrogen storage, an essential component in the development of clean and sustainable energy systems. In this article, we explore the fascinating features and potential applications of Mg based thin films as hydrogen storage materials.

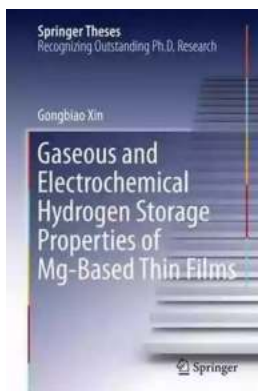
The Need for Hydrogen Storage

Hydrogen, often referred to as the "fuel of the future," is a clean and abundant energy source that can be utilized in various sectors, such as transportation, power generation, and industrial processes. However, the efficient storage of hydrogen remains a challenge due to its low density and low boiling point. Finding suitable materials for hydrogen storage is, therefore, crucial for the widespread adoption of hydrogen-based technologies.

Importance of Mg Based Thin Films

Magnesium is a lightweight metal with a high hydrogen storage capacity, making it an ideal candidate for hydrogen storage applications. By depositing Mg films onto suitable substrates using techniques like physical vapor deposition or sputtering, researchers have been able to exploit the unique characteristics of Mg to enable efficient hydrogen storage.

**Gaseous and Electrochemical Hydrogen Storage
Properties of Mg-Based Thin Films (Springer**



Theses) by Philip Ball(1st ed. 2016 Edition, Kindle Edition)

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Gaseous Hydrogen Storage Properties

The gaseous hydrogen storage properties of Mg based thin films are truly remarkable. These films exhibit exceptional hydrogen absorption and desorption kinetics, allowing for rapid and reversible hydrogen uptake. Mg films can absorb hydrogen at room temperature and moderate pressures, making them highly efficient and practical for hydrogen storage. Additionally, the hydrogen absorption capacity of Mg films can be tuned by controlling the film deposition parameters, such as thickness and crystallinity.

The mechanism behind the hydrogen absorption in Mg films involves the formation of hydride phases. These hydride phases have an ordered crystal structure that allows for the reversible storage of hydrogen. The unique crystal structure of Mg hydrides ensures that hydrogen molecules are securely stored within the film, preventing their escape even at elevated temperatures.

Electrochemical Hydrogen Storage Properties

Mg based thin films also exhibit excellent electrochemical hydrogen storage properties. These films can be utilized as anodes in rechargeable magnesium-ion batteries, a potential alternative to lithium-ion batteries. The high hydrogen

storage capacity of Mg films allows for the transportation of a greater number of ions during the charging and discharging cycles, resulting in increased battery storage capacity and improved overall performance.

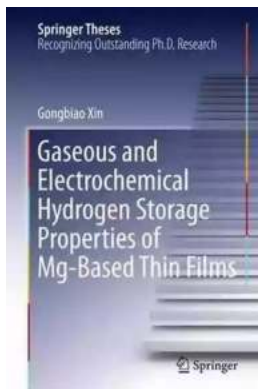
Potential Applications

The remarkable gaseous and electrochemical hydrogen storage properties of Mg based thin films enable various potential applications. Some of these applications include:

- **Hydrogen Storage Systems:** Mg films can be integrated into hydrogen storage systems for fuel cell vehicles, ensuring efficient and safe hydrogen storage for extended driving ranges.
- **Portable Power Sources:** Mg based thin films can be utilized as efficient hydrogen storage materials in portable fuel cell systems, providing a compact and lightweight power source for electronic devices.
- **Energy Storage:** The electrochemical hydrogen storage properties of Mg films make them suitable for energy storage applications, including grid-level energy storage for renewable energy sources.

Mg based thin films have demonstrated remarkable gaseous and electrochemical hydrogen storage properties, positioning them as promising materials for hydrogen storage applications. The ability of these films to efficiently absorb and release hydrogen, along with their potential in rechargeable magnesium-ion batteries, opens new opportunities for clean and sustainable energy systems. With further research and development, Mg based thin films may play a vital role in the transition towards a hydrogen-based economy.

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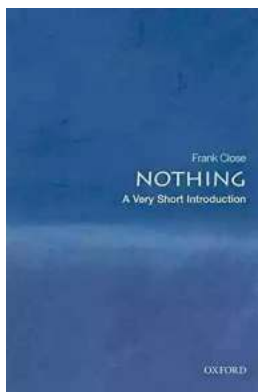
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This thesis introduces the preparation of a series of Mg-based thin films with different structures using magnetron sputtering, as well as the systematical investigation of their gaseous and electrochemical hydrogen storage properties under mild conditions. It reviews promising applications of Mg-based thin films in smart windows, hydrogen sensors and Ni-MH batteries, while also providing significant insights into research conducted on Mg-based hydrogen storage materials, especially the Mg-based films. Moreover, the unique experimental procedures and methods (including electric resistance, optical transmittance and electrochemical methods) used in this thesis will serve as a valuable reference for researchers in the field of Mg-based hydrogen storage films.



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