

Can high entropy alloys be used to store hydrogen?

Hydrogen is a clean energy carrier and has potential applications in energy storage, power generation, and transportation. This study explores the efficient and safe storage of hydrogen, particularly through solid-state methods using high entropy alloys (HEAs).

What are high entropy alloys (HEAs)?

Due to their composition of diverse elements and unique crystal structures, high-entropy alloys (HEAs) offer a promising avenue for hydrogen storage.

Can high entropy alloys revolutionize solid-state hydrogen storage?

His research interests include novel magnesium-based hydrogen storage materials, control of second phases in magnesium alloys, and microstructure-property relationships in metallic materials. Abstract High-entropy alloys (HEAs) have emerged as a groundbreaking class of materials poised to revolutionize solid-state hydrogen storage technology.

Are high-entropy alloys a promising material for hydrogen storage?

In recent years, high-entropy alloys (HEAs) have been extensively applied to structural and functional materials owing to their unique physical and chemical properties. Therefore, HEAs have emerged as a promising materials. This review summarizes recent research progress on HEAs for hydrogen storage.

Are high entropy alloys a conflict of interest?

The authors declare no conflict of interest. High entropy alloys (HEAs) have attracted substantial attention in diverse fields, including hydrogen storage, owing to their unique structural and functional properties. The diverse components of ...

Are high entropy oxides good for hydrogen storage?

In electrochemical energy storage systems, high-entropy oxides and alloys have shown superior performance as anode and cathode materials with long cycling stability and high capacity retention. Also, when used as metal hydrides for hydrogen storage, remarkably high hydrogen storage capacity and structural stability are observed for HEMs.

The development of modern society is driven by energy. The world energy consumption in 2020 reached 557.10 EJ, which is an increase of 172.8% over the energy consumption of 204.20 EJ in 1970 [1]. A recent report, the U.S. Department of Energy (DOE) predicts that global energy demand will increase by 50%, up to 830 EJ in 2050 [2]. Meanwhile, ...

In electrochemical energy storage systems, high-entropy oxides and alloys have shown superior performance as anode and cathode materials with long ...

Traditional alloys were historically favored for their simplicity, typically starting with a base element to which additional elements are added, forming alloys like aluminum (Al), cobalt (Co), nickel (Ni), titanium (Ti), and chromium (Cr) [33]. However, high-entropy alloys (HEAs) offer distinct advantages, possessing unique properties that traditional alloys may lack, prompting ...

High entropy alloys (HEAs) are distinguished for their unique properties, particularly in hydrogen storage applications. Their diverse compositions offer significant potential for ...

Due to global shifts in energy consumption and increasing demand for efficient, safe, and cost-effective energy storage solutions, high-entropy materials (HEMs) have garnered great attention. The HEMs, composed of five or more elements in near-equimolar ratios, exhibit unique properties such as high entropy effects, lattice distortion ...

Energy Technology is an applied energy journal covering technical aspects of energy process engineering, including generation, conversion, storage, & distribution. High entropy alloys (HEAs) have attracted substantial attention ...

This review paper covers an analysis of the empirical calculations, additive manufacturing (AM) and hydrogen storage of refractory high-entropy alloys undertaken to determine the structural compositions, particularly ...

In the past decade, efforts have been made to optimize these parameters to improve the energy-storage performances of MLCCs. Typically, to suppress the polarization hysteresis loss, constructing relaxor ferroelectrics ...

An equiatomic TiZrHfMoNb high-entropy alloy (HEA) was developed as a solar thermal energy storage material due to its outstanding performance of hydrogen absorption. The TiZrHfMoNb alloy transforms from a ...

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The advantages of high-entropy alloys in hydrogen storage performance are shown. ... Owing to its high energy density (120-142 kJ/kg, which is 2.7 times that of gasoline) [2] and the absence of CO₂ emissions when burned, hydrogen is considered an increasingly important piece of the strategy to achieve net-zero emissions by 2050. However, the ...

The room temperature pressure composition isotherms were studied with a pressure range of 0 to 40 atm. Continuing from our previous study in which we reported a hydrogen storage capacity of ~1.5 wt% in an as-cast high-entropy alloy synthesized using Arc melting, the total hydrogen storage capacity of TiZrVCrNi high-entropy melt-spun ribbons was ...

Phase-field simulations of high-entropy effect. To theoretically evaluate the high-entropy engineering on improving the energy storage performance of dielectrics, we first perform phase-field ...

High-entropy alloys (HEAs) have emerged as a groundbreaking class of materials poised to revolutionize solid-state hydrogen storage technology. This comprehensive review delves into ...

The crystal structure of high entropy alloys (HEA) is usually based on a single lattice model, and common crystal structures include face-centered cubic (FCC) or body-centered cubic (BCC). ... Xiao et al. found that this facilitates the ion diffusion rate of the HEM anode, which increases the energy storage capacity at high currents [53].

High-entropy systems can present a range of striking physical properties, but mainly involve metal alloys. Here, using low-energy proton irradiation, a high-entropy superparaelectric phase is ...

Intermetallic high-entropy alloys (HEAs) with C14 Laves phase structure have shown promise as hydrogen storage materials due to their ability to maintain the advantages of the AB 2-type hydrogen storage alloys while offering the potential for the improvement of hydrogen storage properties through the use of multi-principal elements. However, some ...

A high entropy of mixing affects the tendency to form cubic solid solutions or amorphous phases [5]. According to the phase formation rule for multicomponent alloys [6], there are four important factors for designing the phase composition of alloys. The thermodynamic properties of an alloy are defined by the values of entropy and enthalpy of mixing (i.e., ΔS_{mix} ...

Oxygen electrocatalysts play a fundamental role in several energy conversion and storage technologies [1, 2]. Oxygen catalysts are required to facilitate the oxygen evolution reaction (OER) at the anode of water electrolyzers [3, 4], the oxygen reduction reaction (ORR) at the cathode of fuel cells [5, 6], and both OER and ORR at the cathode of rechargeable metal ...

Nowadays, lithium-ion batteries (LIBs) have held the dominant role in various electric energy storage devices. With the rapid development of new energy vehicles and large-scale ...

In addition to its excellent electrochemical and energy storage potential, high-entropy MOF can also be used as a self-sacrificing template to prepare high-entropy alloys, high-entropy sulfides, high-entropy selenite, etc. Zhao et al. prepared FeCoNiCuMnZn high-entropy MOF with terephthalic acid as a ligand by hydrothermal method, and ...

High-entropy materials (HEMs), including high-entropy alloys (HEAs), high-entropy oxides (HEOs), and other high-entropy compounds, have gained significant interests over the past years. ... such as catalysis, energy storage, etc. In this work, we review the research progress of energy-related applications of HEMs.

After an introduction on the ...

This paper presents a review of a number of works devoted to the studies of high-entropy alloys (HEAs). As is known, HEAs represent a new class of materials that have attracted the attention of scientists due to their unique ...

As the first high entropy materials discovered, alloys have demonstrated superior properties in the fields of mechanics, electromagnetism, and electrocatalysis. The properties exhibited by high-entropy alloys (HEAs) have led researchers to modify non-metallic elements with "high entropy", resulting in a series of HEMs.

Hydrogen is emerging as a key energy carrier as the world moves towards cleaner and sustainable energy sources [1, 2]. High energy density and a minimal environmental impact make it a clean and viable option for power generation, transportation, energy storage, and other uses [3]. Identifying appropriate materials for safe and efficient hydrogen storage is of utmost ...

With the deliberate design of entropy, we achieve an optimal overall energy storage performance in Bi₄Ti₃O₁₂-based medium-entropy films, featuring a high energy density of 178.1 J cm⁻³ with ...

The emergence of high-entropy materials has inspired the exploration of novel materials in diverse technologies. In electrochemical energy storage, high-entropy design has shown advantageous ...

High entropy alloys (HEAs) have attracted substantial attention in diverse fields, including hydrogen storage, owing to their unique structural and functional properties. The diverse components of HEAs have made them a ...

Machine learning (ML) was used in designing high entropy alloys (HEA) for energy storage. KNN stands out as the most effective algorithm, balancing precision and model ...

As a novel type of material composed of a minimum of five components, high-entropy materials (HEMs) have demonstrated significant potential across a range of fields including catalysis, thermoelectricity, superionic conductivity, and energy storage [14], [15], [16]. The presence of a high degree of configurational entropy in disordered multi-metallic ...

HEAs play a crucial role in batteries, fuel cells and supercapacitors, improving capacity, lifetime and electrochemical performance. Their high-entropy structures facilitate the stability and efficiency of electrode ...

The general high entropy concept was first introduced by Cantor et al. and Yeh et al. based on the configurational entropy of mixing multiple principal elements with near-equimolar ratios. 10,47 For HEAs, the high entropy term refers to alloys ...

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