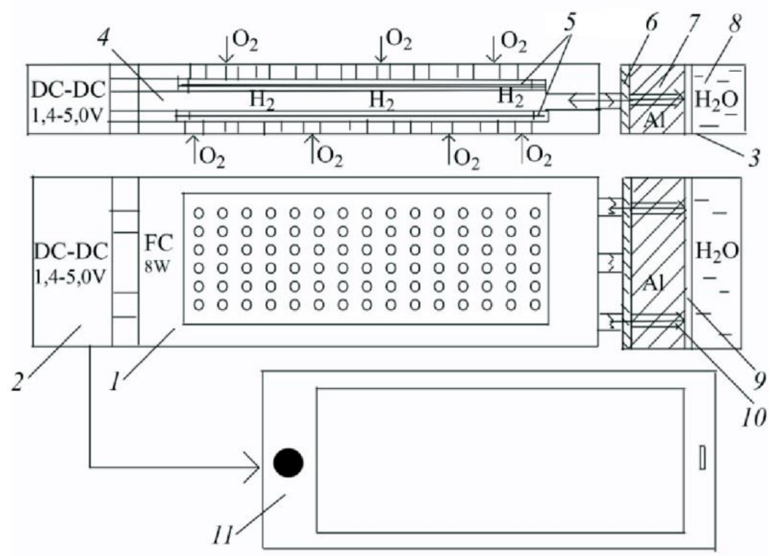

Рисунок. Схема автономного зарядного пристрою на основі паливних комірок і алюмоводневого генератора: *1* – комбінована паливна комірка; *2* – перетворювач напруги DC-DC; *3* – генератор водню гідролізного типу; *4* – камера для водню; *5* – мембранно-електродні блоки; *6* – водоутримуючий сепаратор; *7* – активований алюмінієвий порошок; *8* – ємність з водою; *9* – пориста мембрана; *10* – активаційна голка; *11* – пристрій споживання електроенергії, наприклад, смартфон.

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NANOCOMPOSITES ON THE BASE OF MAGNESIUM HYDRIDE DOPED WITH MXENES AS HYDROGEN ENERGY MATERIALS

D. Korablov[1], Yu. Solonin[2]

[1]Frantsevich Institute for Problems of Materials Science NAS of Ukraine. Krzhyzhanovsky str., 3, 03142, Kyiv, Ukraine, тел. +380443908757, +380442057901, e-mail: [1]funejima@gmail.com

Д. С. Корабльов[1], Ю. М. Солонін[2]

Інститут проблем матеріалознавства ім. І. М. Францевича НАН України

Magnesium hydride is an attractive material for solid-state hydrogen storage and for hydrogen generation via hydrolysis due to its high capacity of hydrogen and low cost. However, the hydrolysis reaction is rapidly hindered by the passivation layer formed on the surface of MgH_2. In order to improve MgH_2 hydrolysis efficiency various approaches have been applied. The present study examines the influence of two-dimensional (2D) transition metal carbides or MXenes on thermolysis and hydrolysis of the nanostructured MgH_2.

Keywords: *magnesium hydride, MXene, hydrogen storage, nanocomposites, high-energy ball milling.*

Hydrogen is an ideal choice for future energy systems due to the highest energy density per unit mass (120 MJ/kg), no environmental implications and its abundance. Generally, hydrogen can be stored under liquefied cryogenic form, compressed form and solid form in hydrides. However, one of the greatest challenges to use hydrogen in portable and automotive applications is the lack of efficient hydrogen storage methods. A promising solution to this problem is metal hydride-based storage. Metal hydrides can reversibly absorb/release large amounts of hydrogen in controlled temperature and pressure conditions. Compared to the reversible hydrogen storage materials, irreversible hydrogen storage via hydrolysis of hydrides provides a more efficient method for hydrogen generation because of the high hydrogen yield, fast hydrogen generation rate and favourable reaction conditions. For both cases, one of the most attractive metal hydrides for hydrogen generation is magnesium hydride (MgH_2) with a storage capacity of 7.6 wt.% H.

The MgH_2-based materials have a promising prospect due to abundant reserves, relatively low cost, high theoretical hydrogen yield and environmental-friendly reaction product $Mg(OH)_2$ [1]. However, major drawbacks as slow absorption kinetics and high thermolysis temperature impede its utilization. Whereas the hydrolysis of MgH_2 is rapidly hindered due to the formation of a passive $Mg(OH)_2$ layer on top of hydride particles as the pH increases. To solve this problem, various alloying systems were developed and a significant improvement in kinetics has been made through nanostructuring and modifying with small amounts of catalytic additives. At the same time, addition of acid, alkali, salt or inert additives, with or without increasing water temperature, electromagnetic stirring and ultrasonic irradiation can suppress the formation of $Mg(OH)_2$.

In this study, we investigated the synthesis, phase composition, microstructure and hydrogen storage properties of Mg-based nanocomposites containing MXenes as additives. The nanocomposites were prepared by reactive high-energy ball milling under hydrogen atmosphere and different concentrations of the additives. The correlations between the microstructure and hydrogen generation after thermolysis and hydrolysis are discussed.

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