Fahad Al-Ajmi, Innov Ener Res 2018, Volume 7
DOI: 10.4172/2576-1463-C1-002

20th International Conference on

Advanced Energy Materials and Research

August 13-14, 2018 | Dublin, Ireland

Superior hydrogenation/dehydrogenation kinetics of MgH_2 nanopowders upon mechanical doping with amorphous Zr_2Ni

Fahad Al-Ajmi
Kuwait Institute for Scientific Research, Kuwait

Hydrogen is an energy carrier, which holds tremendous promise as a new clean energy option. Hydrogen storage, which is considered to be the most important factor cutting across both hydrogen production and hydrogen transportations, has been the subject of intensive research for many years. Mg and Mg-based materials have opened promising concept for storing hydrogen in a solid-state matter. The natural abundance, cheap price, operational cost effectiveness, light weight, and high hydrogen storage capacity (7.60 wt.%, 0.11 kg H_2L^{-1}) are some advantages of Mg and Mg-based alloys making them desirable storage materials for research and development. Whereas all catalytic materials used to improve the behaviors of hydrogenation/dehydrogenation kinetics for MgH_2 have long-range order structure, the present work proposes two different types of structure; i.e. short range- and medium range- order. For the purpose of the present study, MgH_2 powders were prepared by reactive ball milling of Mg powders under 50 bar of H_2, using room-temperature high-energy ball mill [5]. Ultrafine powders of amorphous- and big cube-Zr_2Ni phases were prepared by ball milling small bulk pieces of tetragonal-Zr_2Ni alloy prepared by arc melting technique. Small volume fraction (10 wt. %) of amorphous and big- cube powders obtained after ball milling for 100 and 150 h, respectively were individually mixed with as-synthesized MgH_2 powders and then ball milled for 50 h. The results have shown that nanocomposite MgH_2/10 wt.% metallic glassy Zr_2Ni powders had high density of hydrogen (~6 wt.%) and possessed fast kinetics of hydrogen uptake/release at 250°C within 1.15 and 2.5 min, respectively. Whereas, MgH_2/10 wt.% of big cube Zr_2Ni nanocomposite showed moderate improvement on hydrogenation (1.8 min)/dehydrogenation (7 min) kinetics due to the heterogeneous distribution of their particles onto the MgH_2 powders.

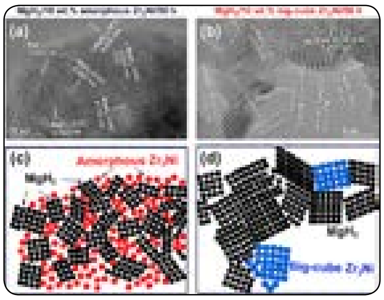

Fig. HRTEM images of nanocrystalline MgH_2 powders doped with 10 wt.% of (a) amorphous Zr_2Ni, and (b) big-cube Zr_2Ni nanopowders. The corresponding illustration sketches for the HRTEM images shown in (a) and (b) are displayed in (c) and (d), respectively.

Recent Publications:

1. El-Eskandarany, M. Sherif (2017) Synthetic nanocomposite MgH_2/5 wt. % $TiMn_2$ powders for solid hydrogen storage tank integrated with PEM fuel cell Nature, Sci. Rep. 7: 13296; doi: 10.1038/s41598-017-13483-0.www.nature.com/scientificreports.
2. El-Eskandarany, M. Sherif et al. (2017) Structure, morphology and hydrogen storage kinetics of nanocomposite MgH_2/10 wt% $ZrNi_5$ powders, Materials Today Energy, 3: 60-71.
3. El-Eskandarany, M. Sherif et al. (2016) In-situ catalyzation approach for enhancing the hydrogenation / dehydrogenation kinetics of MgH_2 powders with Ni particles. Sci. Rep. 6, 37335; DOI: 10.1038/srep37335 www.nature.com/scientificreports.
4. El-Eskandarany, M. Sherif (2016) Metallic glassy $Zr_{70}Ni_{20}Pd_{10}$ powders for improving the hydrogenation/dehydrogenation behavior of MgH_2. Nature, Sci. Rep. 6, 26936; doi: 10.1038/srep26936. www.nature.com/scientificreports.

5. El-Eskandarany M.Sherif, Shaban E., Alsairafi A. (2016) Synergistic dosing effect of TiC/FeCr nanocatalysts on the hydrogenation/dehydrogenation kinetics of nanocrystalline MgH_2 powders. Energy 104: 158-170.

Biography

Fahad Al-Ajmi works at Kuwait Institute for Scientific Research KISR in the Nanotechnology and Advanced Materials department. He obtained his master degree in advanced chemical engineering from the University of Manchester, and the bachelor degree in chemical engineering from Swansea University UK.

ftajmi@kisr.edu.kw

Notes: