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An overview for solving future energy need and hydrogen storage by Nanotechnology

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Abstract
Nano technology contribute in this field by developing new hydride molecules that allow high hydrogen loading new hydride molecules. Nano tubes, graphite nano fibers, Zeolite, nanocrystalline etc are used in the storage of hydrogen.

Keywords: Nanotechnology in the storage of hydrogen

1. Introduction

In view of a globally increasing energy demand, threating climatic changes due to continuously increasing co_2 emissions as well as scarcity of fossil fuels, the development and provision of sustainable methods for power generation is the most urgent challenges of mankind. Growing efficiency and new methods through nanotechnological components provide potentials for more efficiently utilisation of energy. In order to reduce our dependence on fossil fuels it is vital to explore various sustainable energy options, Hydrogen can be a promising energy source in the future as it is a very clean fuel. Any technology creating devices smaller than 100 nm opens the doors for the development of new ways to capture, store and transfer energy [1]. Nano particles posses' high surface energy, a large % of atoms becomes surface atoms compared to their bulk compounds. Such an increase in surface area in thin film will be useful to enhance the sensing property in solar cells, catalytic activity [1, 2] of surfaces, surfaces reactivity etc. Nanotechnology is relevant in solving the future energy need by implementing in the solar cell, Improvement of light bulb, Batteries, Hydrogen and fuel cells with nano structure materials and nano powder etc. This technology (a) secure global power supply, (b) Develop existing energy sources as efficiently and environment freely, (c) Minimise energy losses during transport from source to user. (d) Renewable energy production.

Hydrogen Extraction:-The problem in extraction of hydrogen is due to it's freely availability. It needs to be extracted from a source. Extraction of hydrogen from water by solar energy would be the best option. Nano technology is leading the way in solving some of the problems associated with solar energy adsorption rates. Recently it has been developed TiO_2 nanotube arrays having a modified band gap for generating hydrogen by splitting water using sunlight. Professor Orlors group found that when the size of metal particle is reduced to nano scale, there is a tremendous increase in the ability of this particle to facilitate hydrogen production from water from sunlight. Evolution of hydrogen becomes 35 times more as compared to ordinary material.

1.1 Explanation: The main objective of this paper is to provide an overview of the three principal forms of hydrogen storage. Metal hydroxide is the newest addition to research in solid storage. These are seen as for improved storage safety and stability [3, 4]. Hydrogen is stored at a relatively high density and low temperature within interstices in the lattice of reversible metal hydrides and released by heating.

Table 1

Method of storing	volume in liter	Weight in kg.	Density wt. % H_2
Metal hydrides	57	218	1.6
Compressed Hydrogen	158	45	6.9
Liquid Hydrogen	93	42	6.5

Volume and weights for hydrogen storage

1.2 Hydrogen Storage: Most critical obstacles in developing hydrogen technology are its storage and transport. The problem is seen by comparing the energy –volume ratio for gaseous hydrogen (3.0MJ/L) to that of conventional gasoline (32.0MJ/L). Some possible solutions are to use Liquid hydrogen (8.5MJ/L), to use compressed hydrogen or store hydrogen in solid metallic support such as metal complex (hydride)

The use of compressed hydrogen implies using liquid tanks that need to be made of a strong, light weight material. This material should also have also had outstanding insulating and pressurization properties, in order to avoid hydrogen leakage. Nanotechnology develop new materials with exceptional properties in terms of strength and density. Solid metallic supports are probably the most favourable option for hydrogen storage. In this approach hydrogen is loaded to a solid support and extracted from it when needed. Main challenges here are the material loading capacity and the regeneration kinetics to re-extract hydrogen from the support. Nano technology contributes by developing new hydride molecules. Carbon nanotubes are also currently investigated as support for hydrogen storage. It has ability of manipulating matter at the atomic scale level, together with high surface to volume and characterise nanomaterials.

1.3 Storage of Hydrogen: The most common method to store hydrogen in gaseous form is steel tanks, although light weight composite tanks designed to endure higher pressure. A more novel method to store hydrogen gas at high pressure is to use glass microspheres. Composite tanks c-fibre wrapped H_2 storage low weight meets key target pressure in the range of 350-700bar.

Liquid hydrogen: - The most common way to store hydrogen [5, 6] in liquid form is to cool it down to cryogenic temperature (-253^{0}c) other options including storing hydrogen as a constituent in other liquids such as $NaBH_4$, rechargeable organic liquids.

Solid Hydrogen: - Storage of hydrogen in solid materials has the potential to become a safe and efficient way to store energy, both for stationary and mobile applications. There are four main groups of materials. (a) Carbon and other high surface area materials. (b)H_2O reactive chemical hydrides. (c) Thermal chemical hydrides. (d) Rechargeable hydrides.

1.4 Carbon and other high surface area material: Carbon based materials, such as nanotubes and graphite nanofibers have received a lot of attention in the research community. Study carbon-metal composite capable of catalysing H_2 dissociation and so called spill over. Zeolites, metal oxide framework and clathrate hydrates. Metal oxide framework-ZnO structured bridged with benzene rings. These materials have an extremely high surface area. Clathrate hydrates H_2O (ice) cage structures, often containing guest molecules such as CH_4 and CO_2. The cage size and structure can often be controlled by organic molecule. Alanates $NaAlH_4$ being intensely studied on many fronts. The low-temperature kinetics and reversibility of these alanates are improved by adding a catalyst [7]. The research on catalysed Mg (AlH_4) shows that this type of alanate is not nearly as reversible as $NaAlH_4$.

Table 2: Alanates

Type	storage density wt. % H_2	Desorption Temp.^{o}c
$LiAlH_4$	10.6	190
$NaAlH_4$	7.5	100

1.5 Chemical hydrides: Chemical hydrides can be handled in semi liquid form, such as mineral oil slurry. In this form hydrides can be pumped and safely handled. Controlled injection of H_2O during vehicle operation is used to generate H_2 via hydrolysis reactions. MgH_2 probable offers the best combination of H_2-yield having storage density 6.5. NH_4BH_4 another group of chemical hydrides that potentially could be used to store hydrogen in a solid state.

1.6 Nano technology: Nano technology contributes by developing new hydride molecules that allows high hydrogen loading. Electro catalytic material properties are also proportional to particle size, so nanoparticles and nonmaterial's have increased catalytic activity in compared to bulk materials.

Table 3: Mean distance between the molecules\

CGH_2	CGH_2	CGH_2	LH_2	Conventional Metal hydrides
1bar	350bars	700bars	1bar	1bar
3.3nm	0.54nm	0.45nm	0.36nm	0.21nm
$5.6x10^{19}$ atoms/cm^3	$1.32x10^{22}$ atoms/cm^3	$2.3x10^{22}$atoms/cm^3	$4.2x10^{22}$atoms/cm^3	$10.7x10^{22}$atoms/cm^3

2. Conclusion

Renewable energies have a long term potential to take over the entire global energy supply. Nanotechnologies provide the potential to enhance energy efficiency across all branches of industry through new technological solutions and optimized production technologies. The application of nanotechnology in the field of energy, which involves lithium ion battery, fuel cell, light emitting diode, ultra capacitor and solar cells. Its current development is hampered by the expensive cost of production compared to conventional technologies. Therefore, priority should be given to nanotechnology in the energy storage sector to obtained higher efficiency, lower production cost and easier in its application.

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