GRAPHENE BASED HYDROGEN STORAGE MATERIAL

IITM Technology Available for Licensing

Problem Statement

- Hydrogen energy is a promising clean energy source, but the challenge of efficient hydrogen storage hinders practical applications.
- To be viable, **hydrogen storage materials must meet criteria such as high gravimetric and volumetric densities**, rapid reaction kinetics, low hydrogen sorption temperature, reversibility, and affordability.
- Conventional carbon-based materials, like **activated carbon, carbon nanofibers, carbon nanotubes, and graphene, have limitations due to their low hydrogen storage capacity (<1 wt%) at ambient conditions.**
- Therefore, there is a need to **develop modified carbon materials, such as transition metal decorated nitrogen doped graphene**, to improve hydrogen storage capabilities for practical energy storage systems.

Technology Category/ Market

Category - Hydrogen Storage
Applications - Renewable Energy Storage
Industry - Energy Storage

Market - The global hydrogen storage market is projected to reach USD 6.3.billion in 2030, growing at a **CAGR of 21.5%** from 2023 to 2030.

TRL (Technology Readiness Level)

TRL - 4, Experimentally validated in lab.

Research Lab

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Intellectual Property

- IITM IDF Ref. **874**
- **IN 425481 - Patent Granted**

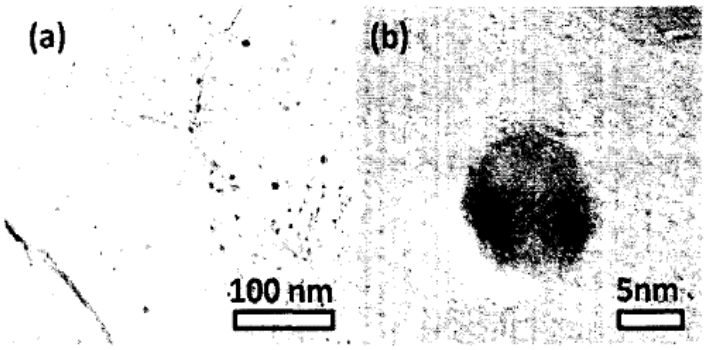

FIG. 1(a) & 1(b) depict that TM-NPs are highly dispersed over the surface of nitrogen doped graphene with a particle size of ~ 10nm.
a) TEM and (b) HRTEM image of TM-NG.

Technology

This invention relates to a method of manufacture of graphene-based hydrogen storage material, that is, transition metal decorated nitrogen doped graphene (TM/NG) hybrid material.

The method comprises steps of firstly, mixing 20% to 50% by weight of graphite oxide, transition metal precursor and 80% to 50% by weight of melamine in water medium, then drying at 50° C to 60° C in a vacuum oven, and then keeping the resulting nanocomposite under focused sunlight using a convex lens, to obtain transition metal decorated nitrogen doped graphene (TM/NG) hybrid material.

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Key Features / Value Proposition

1. **High Hydrogen Storage Performance:** The developed material exhibits exceptional hydrogen adsorption and desorption capabilities at room temperature, with a maximum storage capacity of **4.3 wt% at 25ºC and 4 MPa pressure**. This performance surpasses conventional materials and makes it highly suitable for hydrogen-based applications.
2. **Practical Applicability**: The ease of scaling up the production process ensures the feasibility of using this material in various applications, including hydrogen-fueled vehicles and portable electronics.
3. **Sustainability and Convenience:** Hydrogen storage materials with efficient adsorption and desorption properties contribute to sustainable energy solutions and offer the convenience of using hydrogen for different power needs.

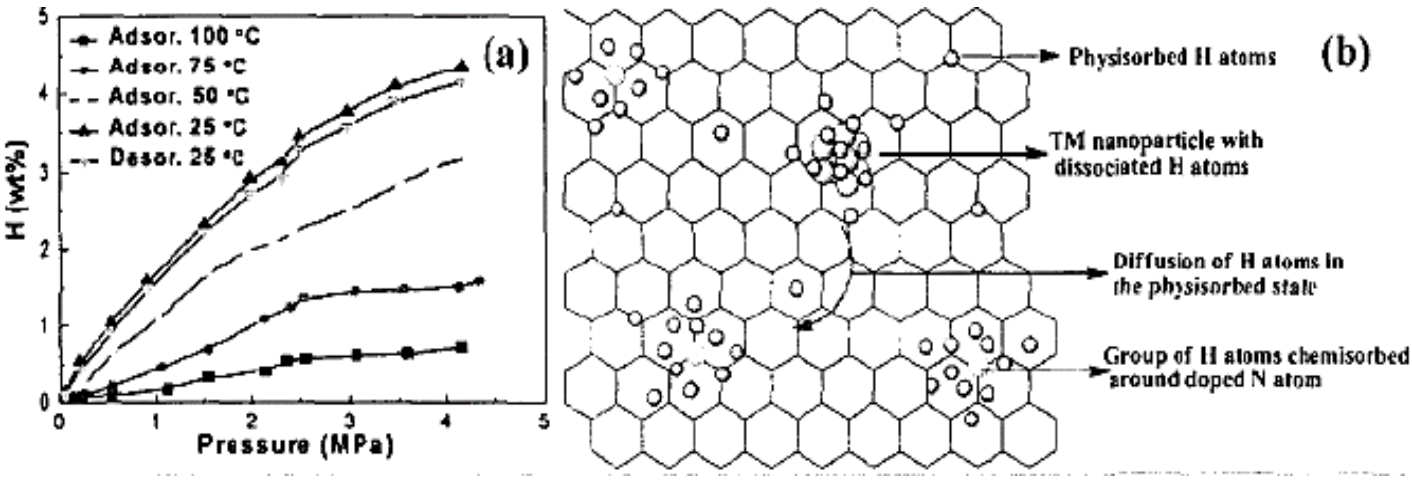

FIG. 2.(a) Hydrogen adsorption/desorption isotherm of TM-NG. (b) Spill-over mechanism in TM-NG.

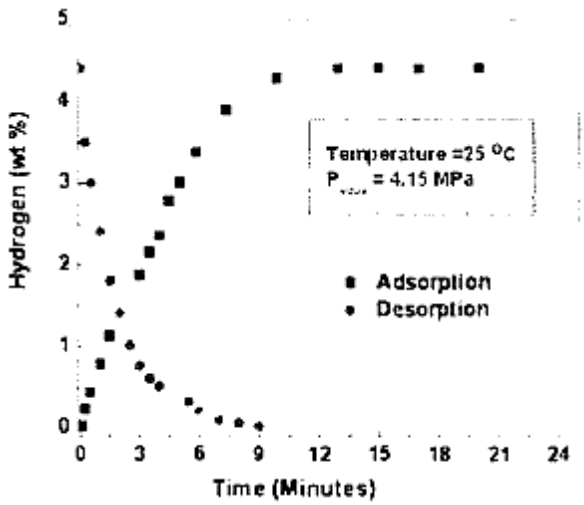

FIG. 3. Hydrogen adsorption/desorption kinetics of TM-NG.

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