

LESGO advances hydrogen storage with graphene-based materials

After three and a half years, the LESGO team has demonstrated that graphene-based materials, such as graphene oxide, can securely store hydrogen using an energy-efficient loading process based on a flow cell electrolyzer and recover it by thermal, photon-induced and fuel-cell means.

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Funded in 2020 under the European Union's Horizon 2020 research and innovation program, the project LESGO - Light to Store Energy in Reduced Graphene Oxide - finished in May. After three and a half years, the team has successfully shown that hydrogen can be securely stored in graphene-based materials, such as graphene oxide, using an energy-efficient process involving an electrolyser.

The overall goals set at the beginning of the project were to achieve an effective mechanism not only binding the hydrogen molecules to the carbon of the graphene oxide, but also achieving the desorption of the hydrogen in an alkaline fuel cell to obtain electricity.

Enhancing hydrogen binding and desorption

In the first phase, researchers successfully developed a method to enhance hydrogen binding to graphene oxide. The team created a hybrid anode using iron-nickel nanoparticles on reduced graphene oxide and nickel foam. This new anode outperformed traditional, expensive materials, maintaining high efficiency over extended use.

After building a lab-scale flow cell that effectively reduced graphene oxide to its hydrogenated form, the team assembled the LESGO prototype in June 2023. Equipped with real-time monitoring and solar cells, the prototype allowed the demonstration of the process feasibility and the validation of the system under different irradiation and temperature conditions.

In the third phase, they explored how to release hydrogen from the hydrogenated graphene oxide to generate electricity. Both theoretical calculations and experimental measurements using pulsed lasers showed promising results, indicating that the hydrogen absorption/desorption cycle would be energetically favourable. Initial tests in an alkaline fuel cell also showed potential for generating electricity, but further research is needed to optimize this process.

Contributing to a greener future

Throughout the project, the team also focused on building an ecosystem around the technology and gaining societal acceptance for potentially reduced graphene oxide fuels, gathering direct feedback from participants in focus groups that highlighted the willingness of citizens to switch to better - and greener - alternatives.

Through these comprehensive efforts, LESGO is paving the way for advancements in hydrogen storage, with the potential to revolutionize energy systems and contribute significantly to sustainable energy solutions, especially for the electric vehicles industry, finding that it could enhance the prospects of mobility based on the fuel cell technology.

Looking ahead, the team plans to continue exploring how to obtain an energy-dense liquid fuel from graphene oxide, and potentially bring the LESGO technology to the market.



Part of the team posing with the prototype at the

Hysytech facilities in Torino, on April 2024