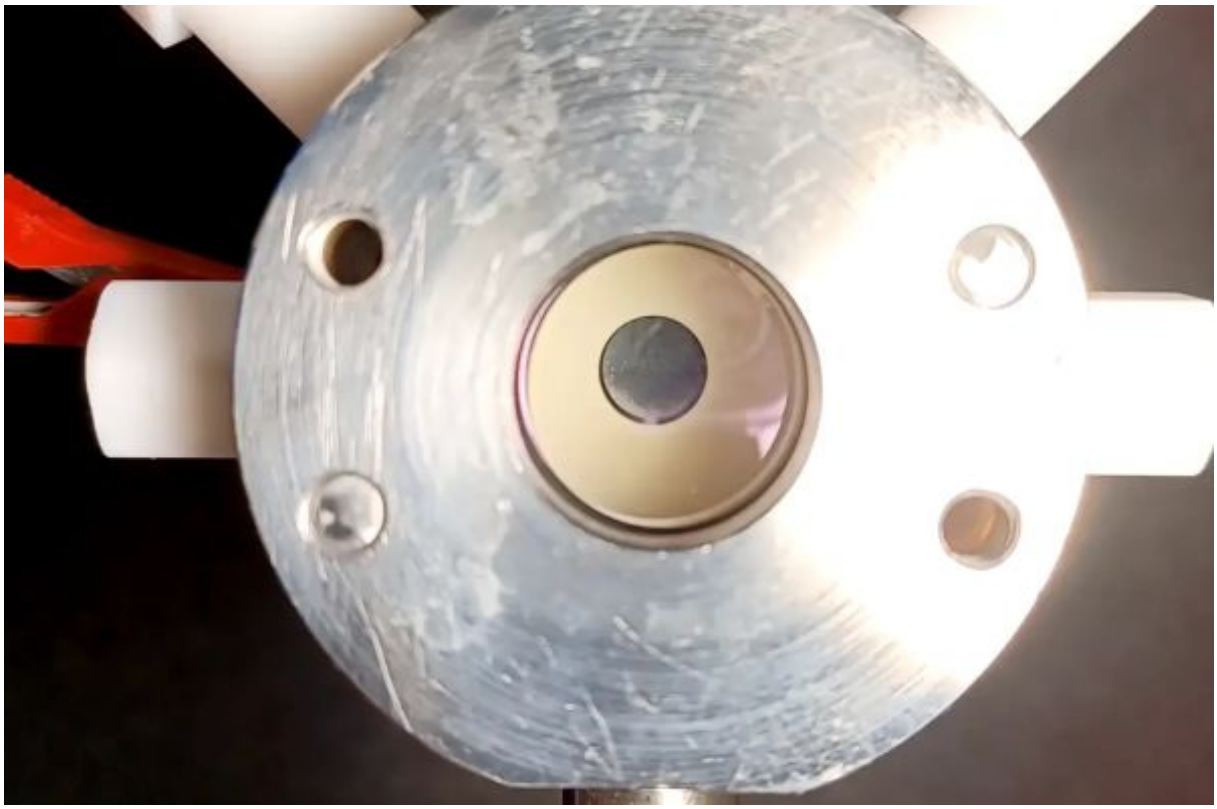


Controlling the hydrogen generation and storage in graphene oxide

Researchers determine, in a paper published in Carbon, the starting point of the electrochemical reduction and hydrogen storage in graphene oxide by using in-situ Raman spectroscopy.

December 09, 2022

One of the most promising alternatives to fossil fuels is hydrogen generated from electrochemical or photochemical water splitting. Even though there has been an exponential interest in using and exploiting hydrogen gas in industry, its widespread use is still limited by the fact that there is a lack of an efficient storage and distribution system and most of the time it itself is even generated from fossil fuels.?

Graphene oxide, a compound made of carbon, oxygen, and hydrogen, is one of the bes alternatives to produce graphene-derived materials. It contains some molecules, known a oxygen functional groups, that can be removed to obtain reduced graphene oxide, a materia with properties in-between graphene oxide and graphene. Past research has shown th adding and releasing of hydrogen from graphene oxide and recent studies hav demonstrated that splitting water on its surface and directly bonding the hydrogen on it i

potentially a viable solution for energy-efficient hydrogen storage

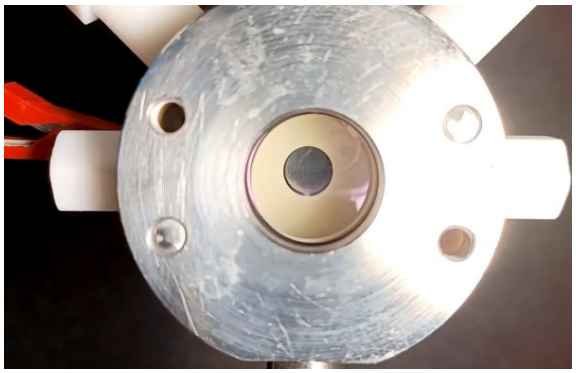
Now in a paper published in Carbon, LESGO researchers determined the starting point of the electrochemical reduction and hydrogen storage in different electrolytes, substances that, when dissolved in water disassociates into charged particles called ions. They further describe the influence of several parameters using in-situ Raman spectroscopy, a chemical analysis technique which provides detailed information about the chemical features such as the structure, phase and polymorphy, crystallinity and molecular interactions.

The team of scientists that carried out the study include ICFO researchers Adrian Pinilla-Sanchez, Sidney M. Palardonio, Jordi Martorell and Carles Ros, together with Sebastian Murcia-Lopez and Nina M. Carretero from IREC and ICN2 members Emigdio Chavez-Angel, Peng Xiao, Daniel Rueda-Garcia, Clivia M. Sotomayor Torres and Pedro Gomez-Romero.

Using graphene oxide to store hydrogen

The team applied an increasingly reductive potential to nanoflakes of graphene oxide. At the same time, they stimulated them with a laser and tracked the Raman spectra these flakes emitted. The signal allowed them to observe the typology and number of defects in the carbon structure, the attached oxygen functional groups and the hydrogen storage sites in terms of protons binding to the graphene. One of the things they found was that, when varying the electrochemical potential applied, the amount of stored hydrogen was higher. The researchers were able to track and control the starting point of the hydrogen storage phase, minimizing the energy needed to store it, in addition to also finding a way to increase the number of bonded hydrogens.

The results of the study define the precise electrical potential needed for electrochemical hydrogen storage in different electrolytes, allowing for better control of the energy storage in such systems based on graphene oxide. A further step will be to upscale the technology in order to fabricate the hydrogen-rich graphene in larger amounts in flow electrochemical cell conditions.



Link to the video