Researchers show applied electric field can significantly improve hydrogen storage properties

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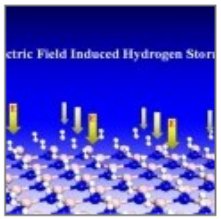

Image courtesy of Qian Wang, Ph.D./VCU.

An international team of researchers has identified a new theoretical approach that may one day make the synthesis of hydrogen fuel storage materials less complicated and improve the thermodynamics and reversibility of the system. Many researchers have their sights set on hydrogen as an alternative energy source to fossil fuels such as oil, natural gas and coal that contain carbon, pollute the environment and contribute to global warming. Known to be the most abundant element in the universe, hydrogen is considered an ideal energy carrier – not to mention that it's clean, environmentally friendly and non-toxic. However, it has been difficult to find materials that can efficiently and safely store and release it with fast kinetics under ambient temperature and pressure.

The team of researchers from Virginia Commonwealth University; Peking University in Beijing; and the Chinese Academy of Science in Shanghai; have developed a process using an electric field that can significantly improve how hydrogen fuel is stored and released.

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Science News

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ScienceDaily (Feb. 3, 2010) — An international team of researchers has identified a new theoretical approach that may one day make the synthesis of hydrogen fuel storage materials less complicated and improve the thermodynamics and reversibility of the system.

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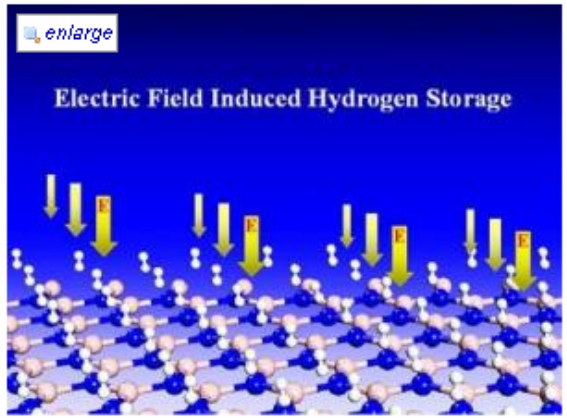

This image illustrates that an applied electric field polarizes hydrogen molecules and the substrate, inducing hydrogen absorption with good thermodynamics and kinetics. (Credit: Image courtesy of Qian Wang, Ph.D./VCU)

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Electric Field Could Improve Hydrogen Storage Systems

by Sathya Achia Abraham
Richmond VA (SPX) Feb 04, 2010

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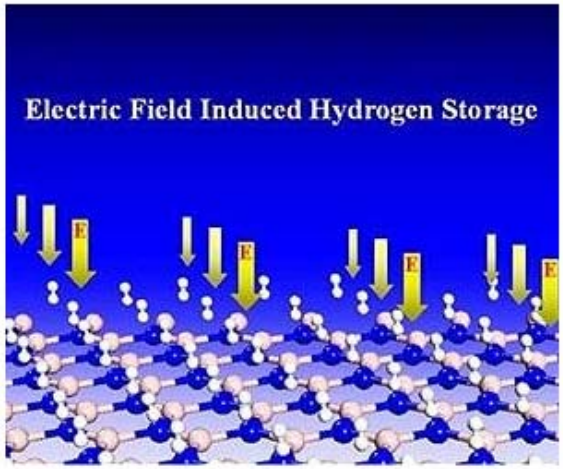

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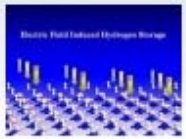
Hydrogen Storage Systems to Get Innovation

Applying electric fields can benefit the process

By **Tudor Vieru**, Science Editor
February 3rd, 2010, 11:52 GMT



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One of the main reasons why hydrogen-powered vehicles are not the norm in our world today is the fact that batteries and fuel cells are not yet efficient enough at delivering their charge. In addition, reloading them can be a very complicated and time-consuming process, and this is why physicists have been working on ways of improving the thermodynamics and reversibility of hydrogen-storing materials. There is also an ongoing effort to make them less complex, and therefore cheaper, and a team of scientists from the US and China may already be on to something, ScienceDaily informs.

The team developed a theoretical model that could lead to the creation of simpler, more efficient hydrogen-storage materials in the near future. The scientists argue that using an electric field on these materials could significantly improve the rate at which they store and release the chemicals. The main trouble with hydrogen fuels is getting the substances holding them to release it with fast kinetics under ambient temperature and pressure. At this point, these materials require a number of special conditions that cannot be satisfied within a personal vehicle, and need the controlled confines of a lab to work.

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Researchers show applied electric field can significantly improve hydrogen storage properties

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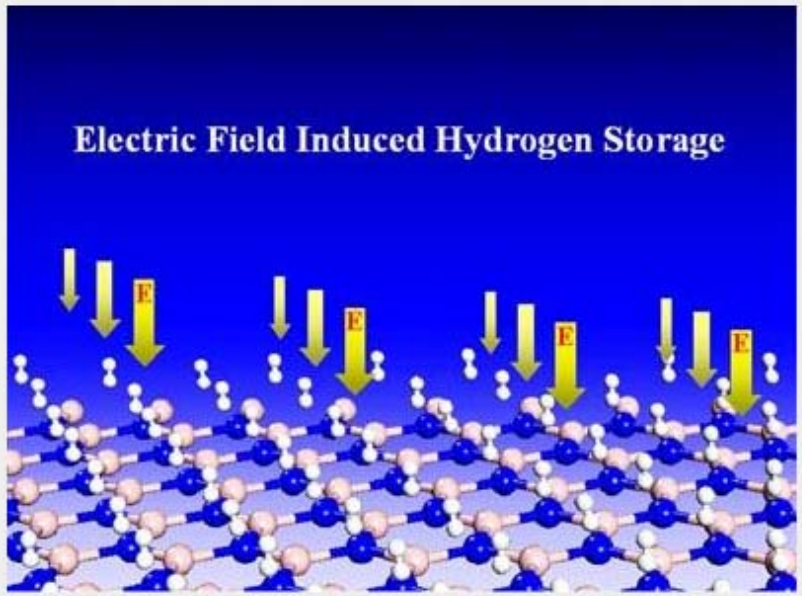
2/1/2010

Keywords: hydrogen storage, electric field, nanomaterials



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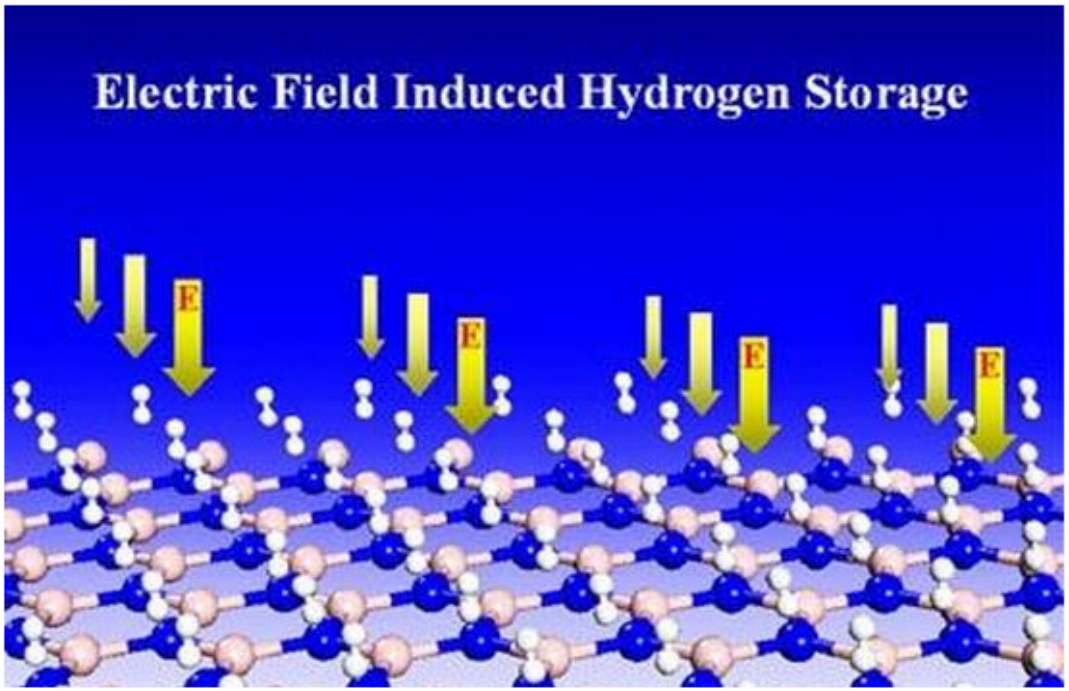
The team of researchers from Virginia Commonwealth University ; Peking University in Beijing; and the Chinese Academy of Science in Shanghai; have developed a process using an electric field that can significantly improve how hydrogen fuel is stored and released.



Eco Factor: Applied electric field to better hydrogen storage systems.

An international team of researchers from the Virginia Commonwealth University, Peking University in Beijing and the Chinese Academy of Sciences in Shanghai have developed a process using an electric field that can significantly improve hydrogen storage and release.

The team has identified a new principle for the design of hydrogen storage materials which involves low-coordinated, non-metal anions that are highly polarized in an applied electric field. Using this electric field, the researchers are hoping to bring hydrogen economy closer to reality.

According to the researchers an external electric field can be used to store hydrogen just as an internal field can store due to charge polarization caused by a metal ion. This technique would allow them to create entirely new ways to store hydrogen and find the materials that are most suitable for the process.

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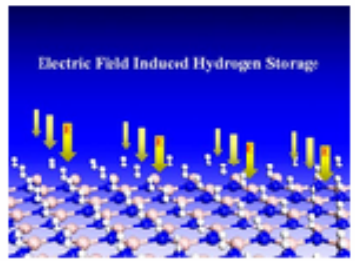
3 February 2010



An applied electric field polarizes hydrogen molecules and the substrate, inducing hydrogen absorption with good thermodynamics and kinetics. Image courtesy of Qian Wang, Ph.D./VCU. Click to enlarge.

Using density functional theory, a team of researchers from Virginia Commonwealth University; Peking University in Beijing; and the Chinese Academy of Science in Shanghai has shown that an applied electric field can substantially improve the hydrogen storage properties of polarizable substrates. The new approach could make the synthesis of hydrogen fuel storage materials less complicated and improve the thermodynamics and reversibility of the system.

They demonstrated their new concept by adsorbing a layer of hydrogen molecules on a number of nanomaterials. When one layer of H_2 molecules is adsorbed on a BN sheet, the binding energy per H_2 molecule increases from 0.03 eV/H_2 in the field-free case to 0.14 eV/H_2 in the presence of an electric field of 0.045 au (atomic units). The corresponding gravimetric density of 7.5 wt% is consistent with the 6 wt% system target set by Department of Energy for 2010.

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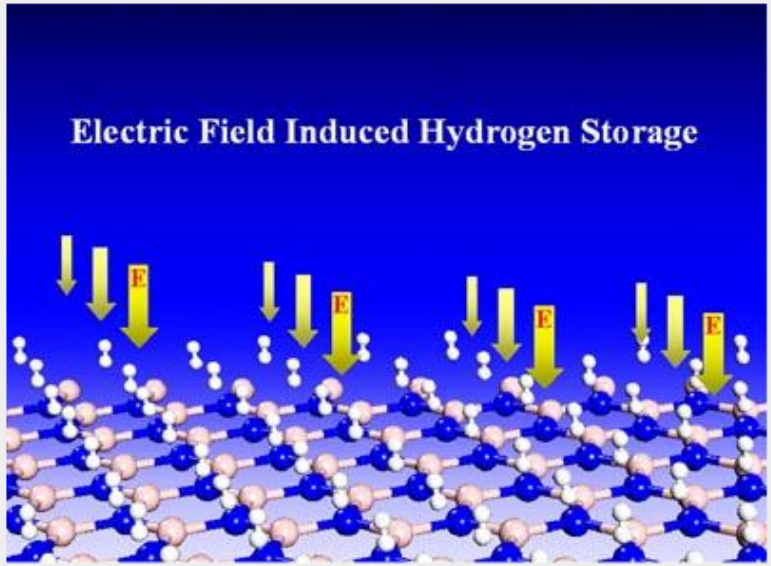

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The team of researchers from Virginia Commonwealth University (VNU); Peking University in Beijing; and the [Communist] Chinese Academy of Science in Shanghai; have developed a process using an electric field that can significantly improve how hydrogen fuel is stored and released. The research is based on a 1992 published polarization theory by Jena, the late B.K. Rao, a former professor of physics at VCU, and their student, J.Niu.

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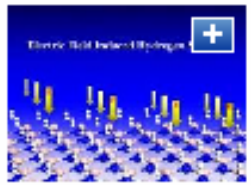

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Process may lead to less complex hydrogen fuel storage

Hydrogen is one of the alternative fuel sources that researchers are studying in an attempt to replace fossil fuels. Hydrogen is a combustible fuel source that produces no toxic materials when burned making it safe for the environment. The problem is that storing hydrogen in required quantities is a challenge.

In December 2009, Russian space program technology led to a breakthrough in storing hydrogen. The breakthrough involved storing hydrogen inside a capillary array constructed of long, thin tubes of extremely strong glass. A group of researchers from Virginia Commonwealth University, Peking University in Beijing, and the Chinese Academy of Science in Shanghai has shown a new breakthrough in hydrogen storage.

The international team was able to show that an applied electrical field can significantly improve the storage properties of hydrogen. The approach could one day lead to less complex synthesis of hydrogen fuel storage and improved thermodynamics and reversibility for the

Study leader Qiang Sun Ph. D said, "Although tremendous efforts have been devoted to experimental and theoretical research in the past years, the biggest challenge is that all the existing methods do not meet the Department of Energy targets for hydrogen storage materials. The breakthrough can only be achieved by exploring new mechanisms and new principles for materials design."

Sun and the team of researchers proposed a principal for the design of a new hydrogen storage system using materials with low-coordinated, non-metal anions that are highly polarizable within an applied electric field. The finding by the team showed that an external electrical field could be used to store hydrogen just as an internal field can store hydrogen due to charge polarization of a metal ion.

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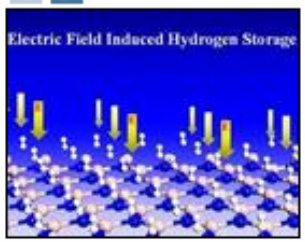

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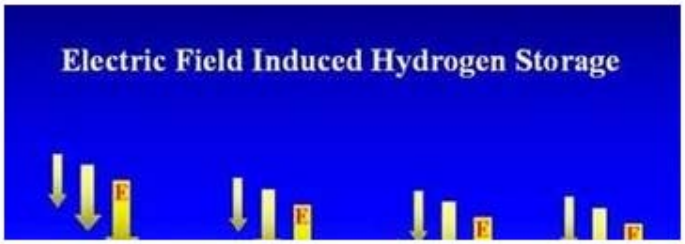

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