Understanding hydrogen electrocatalysis

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Electrocatalysis will play an increasingly important role in future in the transition to more sustainable energy. Thanks to chemist Isis Ledezma Yanez, we now know more about the hydrogen evolution process. PhD defence on the 9th of June.

Slowly but surely Western countries are converting to more sustainable sources of energy. If the government has its way, by 2023 the energy for around 8 million households will be generated by windmills.

Storing energy

There are a number of obstacles that first have to be overcome before this will be possible. One such obstacle is that it is difficult to store energy. That needs to be resolved, because windmills also turn at night, when energy consumption is low.

Electrocatalysis may play a role in finding a solution in the future. Using the excess energy for splitting water into hydrogen and oxygen in electrolyzers is a potential way of storing this energy in the form of chemical bonds. When the bond between the protons is broken, the stored energy is released again and can be used in hybrid vehicles.

Role of the solvent

In recent years chemists have carried out a lot of research on electrocatalysis, focusing in particular on the role of the catalyst, which sets off the chemical reaction by lowering the energy barrier for the

reaction to occur. The most effective electrocatalyst known to date is based on platinum. However, little is known about the role of the solvent in the catalytic process.

Ledezma Yanez says in her dissertation that it is very difficult to compare the effectiveness of different molecular electrocatalysts in non-aqueous solvents because of the presence of water traces. The image is disturbed by the water in which the protons are preferentially dissolved. These protons bind to the water more easily than to the other solvent, which makes it impossible to measure 'pure' protons, affecting the accuracy of the measurement. This shows that the role of the solvent is much more important than it was previously thought.

Cost-effective electrolyzers

She also developed a new kinetic model which explains how the energy for the water reorganization impacts on the speed of the hydrogen evolution, which is of paramount importance for the development of cost-effective electrolyzers, which can use earth-abundant elements such as nickel and iron. This method would avoid a lot of unnecessary energy loss and solves a long-known puzzle in electrochemistry.

Provided by Leiden University

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