Fastest hydrogen battery ever stepping stone to hydrogen car?

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Credit: Arne Olivier

Can cars run on formic acid? They just might one day, after what physical chemist Georgy Filonenko discovered in his dissertation. He developed a catalyst in which hydrogen and carbon dioxide (CO_2) can form formic acid in no time, faster than had ever been measured before. And the reverse reaction is just as quick. It seems to be the start of a hydrogen battery for use in hydrogen cars of the future, for example. He received his PhD degree yesterday, cum laude.

Hydrogen is one of the foremost candidates in the running towards

becoming the energy carrier of the future. It's the world's most common element, and no harmful substances are released upon combustion. Unfortunately, storing pure hydrogen is an issue: getting enough hydrogen in a fuel tank requires several hundred bars of pressure. These practical concerns impede the use of hydrogen as a fuel for cars or buses.

It's been known for several years that hydrogen and CO2 can be combined to form liquid formic acid, which enables us to store much more hydrogen in the same volume. Up until recently, the bottleneck was the time it took for hydrogen to be absorbed and released again by the CO2, and how to control the process. During experiments, two bachelor students of Chemical Engineering who worked under the supervision of Georgy Filonenko accidentally stumbled upon a catalyst that speeded up the reaction immensely: a complex of an organic molecule and the noble metal ruthenium.

Ten times faster than ever before

Filonenko then managed to optimize the reaction, and so found a way to realize a reaction speed that was ten times higher than the fastest known system in the world, which also happens to require a much more expensive catalyst. "What's extraordinary, is that the reaction can be reversed easily as well", says Filonenko. "At 65 degrees, the formic acid is stable, but heating it to 90 degrees releases the hydrogen fast."

Storage density

The reaction speed and its stability make formic acid a potential candidate for hydrogen batteries in cars, for example. "But we must increase storage density first", says Evgeny Pidko. He is Filonenko's supervisor and the one who was awarded the Veni grant to finance this

research project. "So we're studying other molecules that can store hydrogen, like methanol. The initial goal of our research was to gather fundamental information, but then suddenly we found these unexpected results."

More information: "On the catalytic hydrogenation of CO2 and carboxylic acid esters." www.kncv.nl/on-the-catalytic-h … co2-and.178512.lynkx

Provided by Eindhoven University of Technology

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