Converting CO2 to store renewable energy

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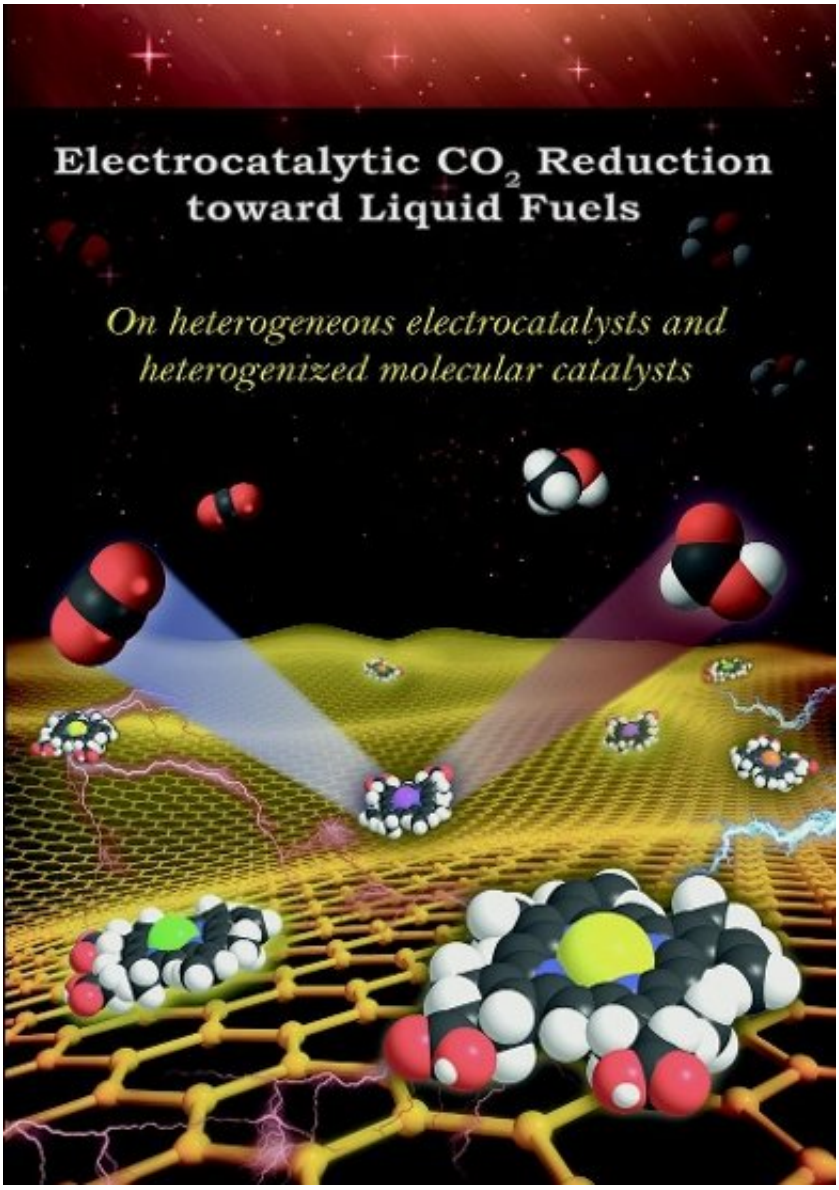

Yuvraj Birdja converted CO2 to formic acid to store energy in a sustainable way, with different catalysts. With this new knowledge, scientists are a step closer in industrially converting CO2 to chemicals and fuels. This can help reduce CO2 emission and the greenhouse effect.

Molecular catalysts

CO2 is an abundant gas and a cause of global warming due to its increasing amount in the atmosphere. Naturally, the conversion of CO2 to other compounds takes a lot of time. Birdja, Ph.D. student at the Leiden Institute of Chemistry, searched for solutions to enhance this reaction. "I have investigated the electrochemical CO2-reduction in order to convert CO2 into usable chemicals. Therefore I used catalysts to facilitate the reaction and I investigated which factors could influence the reaction, how the catalyst influences the formation of specific products and how this could work more efficiently."

Birdja used molecular catalysts which are comparable with a component of the protein haemoglobin in red blood cells. "The catalyst consists of a metal atom centre and a surrounding ring of primarily carbon and hydrogen atoms. It is already known that the catalyst can be fine-tuned quite precisely by placing chemical compounds on the carbon ring. But in my research, I have fine-tuned the catalyst by varying the metal centre. This gains new insights about the formation of specific products such as formic acid, carbon monoxide, and methanol and about its efficiency."

Formic acid as sustainable fuel

Eventually, Birdja focused his research on the production of formic acid. This liquid fuel is easier to use than, for instance, hydrogen, since storage and transport take place under simpler conditions. "My task is to

produce chemicals for the storage of sustainable energy. Formic acid is often used as a preservative in cattle feed, for the production of leather, rubber and textile, but also as a fuel; there are fuel cells that work on formic acid. However, the current production of formic acid is not sustainable, because it is based on fossil fuels. With my research we get a better picture of how green energy can be stored easily in formic acid, starting from the common CO2."

Birdja has attached his catalysts to a substrate. "The attachment of catalysts on a substrate is hot at the moment, because of the advantages of a large-scale industrial process. Carbon is often used as a surface for the attachment of catalysts. There are different kinds and variants of carbon, such as graphite and diamond. I have investigated how the substrate and its pre-treatment influence the performances of the catalyst ."

Birdja says that the received a lot of positive responses on his research. "One of my published articles was put in the spotlights in the journal *Science* under the heading Editor's choice. Last year, the Annual Meeting of the International Society of Electrochemistry took place in America, where I presented a part of my work during a symposium. My poster presentation came out on top."

More information: Yuvraj Birdja will graduate on the 19th of April on his thesis Electrocatalytic CO2 Reduction toward Liquid Fuels.

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