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CHEMISCHE ENERGIEKONVERSION

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Press release

Progress in catalysis research
A breath of fresh air: O_2 stable hydrogenases for applications

A team of researchers from the Max Planck Institute for Chemical Energy Conversion and the MPI für Kohlenforschung in Mülheim an der Ruhr have succeeded in optimizing naturally occurring catalysts (hydrogenases) for application.

Hydrogen as an energy vector. Hydrogen gas (H_2) has been proposed as an ideal energy vector. It can be produced from water, ideally using renewable energy sources and using an efficient catalyst to split water into H_2 and oxygen (O_2). The H_2 produced can then be stored as a fuel and consumed in a fuel cell to produce electricity on demand generating harmless water as a waste product. This technology is already available and can reach high efficiencies. Unfortunately, the catalysts required are based on rare and expensive metals like platinum.

Bio-hydrogen. Nature also employs H_2 as a fuel, but instead of using precious metals, living organisms utilize enzymes as catalysts, and the catalyst of choice for H_2 cycling are the hydrogenases. The active center of these enzymes contains earth-abundant metals like nickel and/or iron and can operate as efficiently as platinum. However, hydrogenases are very sensitive to oxygen and cannot be handled under air, complicating manipulation of them and therefore limiting their use in technological applications.

Producing “easy-to-handle” hydrogenases. Very recently, a team from the Mülheim-based Max Planck Institutes (*Mülheim Chemistry Campus*) have discovered a way to protect these sensitive enzymes from oxygen damage. Treating the purified hydrogenase with strong oxidizing agents in the presence of sulfide converted it to an oxygen stable form. Spectroscopic and electrochemical methods were used to characterize the oxygen-stable state obtained. The oxygen stable enzyme can then be stored and handled under air making it easy to employ in fuel cells or water splitting devices. This research provides a step forward towards the use of these enzymes in technological applications as well as in understanding the mechanism of inactivation by oxygen. It also provides clues for protecting synthetic molecular catalysts designed for hydrogen conversion and production.

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