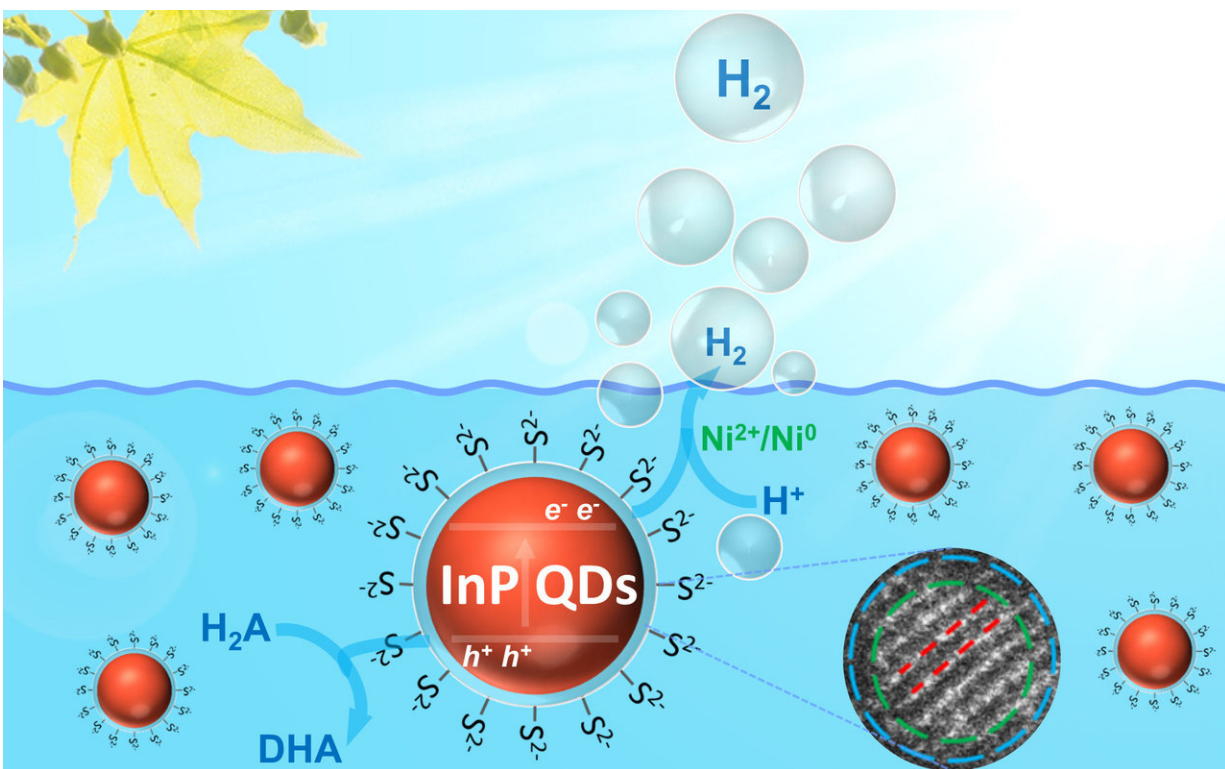


Eco-friendly nanoparticles for artificial photosynthesis

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Schematic representation of photocatalytic hydrogen production with InP/ZnS quantum dots in a typical assay. Credit: Shan Yu

Researchers at the University of Zurich have developed a type of nanoparticle by adding zinc sulfide to the surface of indium-based quantum dots. These quantum dots produce clean hydrogen fuel from

water and sunlight—a sustainable source of energy. They introduce new eco-friendly and powerful materials to solar photocatalysis.

Quantum dots are true all-rounders. These material structures, which are only a few nanometers in size, display a similar behavior to that of molecules or atoms, and their form, size and number of electrons can be modulated systematically. This means that their electrical and optical characteristics can be customized for a number of target areas, such as new display technologies, biomedical applications as well as photovoltaics and photocatalysis.

Fuel production using sunlight and water

Another current line of application-oriented research aims to generate [hydrogen](#) directly from water and solar light. Hydrogen, a clean and efficient energy source, can be converted into forms of fuel that are used widely, including methanol and gasoline. The most promising types of [quantum dots](#) previously used in energy research contain cadmium, which has been banned from many products due to its toxicity. The team of Professor Greta Patzke of the University of Zurich and scientists from Southwest Petroleum University in Chengdu and the Chinese Academy of Sciences have now developed a new type of nanomaterial for photocatalysis without toxic components.

The three-nanometer particles consist of a core of indium phosphide with a very thin surrounding layer of [zinc sulfide](#) and sulfide ligands. "Compared to the quantum dots that contain cadmium, the new composites are not only environmentally friendly, but also highly efficient when it comes to producing hydrogen from light and water," explains Greta Patzke. Sulfide ligands on the quantum dot surface were found to facilitate the crucial steps involved in light-driven chemical reactions, namely the efficient separation of charge carriers and their rapid transfer to the nanoparticle surface.

Great potential for eco-friendly applications

The newly developed cadmium-free nanomaterials have the potential to serve as a more eco-friendly alternative for a variety of commercial fields. "The water-soluble and biocompatible indium-based [quantum dots](#) can in the future also be tested in terms of biomass conversion to hydrogen. Or they could be developed into low-toxic biosensors or non-linear optical materials, for example," says Greta Patzke.

More information: Shan Yu et al, Efficient photocatalytic hydrogen evolution with ligand engineered all-inorganic InP and InP/ZnS colloidal quantum dots, *Nature Communications* (2018). [DOI: 10.1038/s41467-018-06294-y](#)

Provided by University of Zurich

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