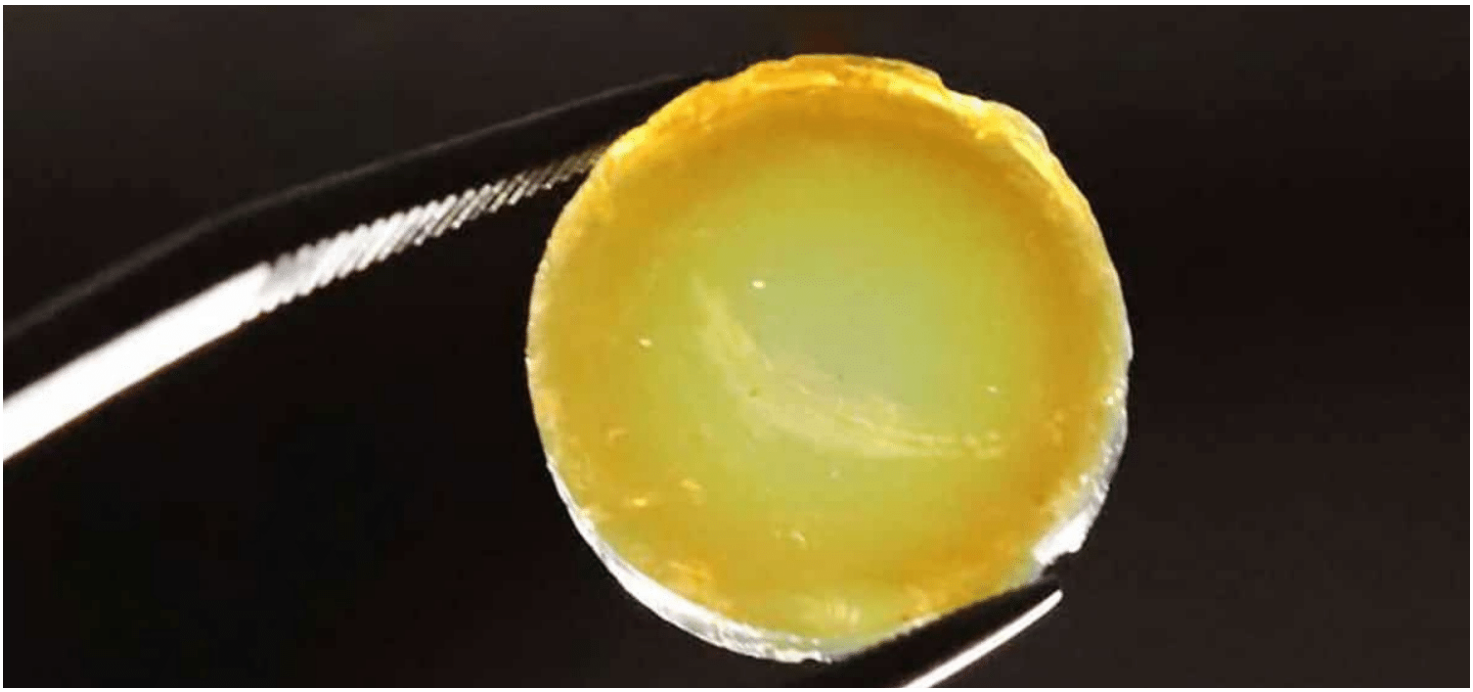

Tweezers holding a tablet-shaped aerogel composed of palladium and nitrogen-doped TiO2 nanoparticles | Photo source Markus Niederberger/ETH Zurich

A NEW AEROGEL SHOWS POTENTIAL FOR CLEAN HYDROGEN PRODUCTION

AGRICULTURE & ENERGY

Researchers have developed an aerogel photocatalyst that could offer a new clean method for producing hydrogen fuel

Spotted: Aerogels are solid materials with extremely low density. They are typically produced by removing the liquid component from a conventional gel. This gives them the structural properties of a solid while remaining 97 per cent air. They are commonly used in insulation, for oil spill clean-up, and to capture space dust – among other uses. Now, researchers at ETH Zurich's Laboratory for Multifunctional Materials have devised an aerogel that can help with hydrogen production.

The researchers have previously been working with aerogels composed of nanoparticles of the crystalline semiconductor titanium dioxide (TiO2). These aerogels are used as photocatalysts, to accelerate chemical reactions with the aid of sunlight. One such reaction is the production of hydrogen. But a key disadvantage of TiO2 is that it only absorbs UV light – which only makes up around 5 per cent of the spectrum.

To create an aerogel photocatalyst that absorbs a wider range of the spectrum, doctoral student Junggou Kwon came up with the idea of doping the TiO2 nanoparticles with nitrogen. This replaced individual oxygen atoms with nitrogen atoms, absorbing a greater range of light while keeping the aerogel's porous structure intact.

Kwon then made further changes to the aerogel, including adding small amounts of palladium—a noble gas—and infusing it with ammonia gas.

Hydrogen is important as it can be used as a fuel for applications such as vehicles and boilers. Hydrogen fuel releases only water at point of use. However, at present, most of the world's hydrogen is derived from natural gas—a fossil fuel—in a very carbon intensive process. The race is therefore on to scale up more sustainable hydrogen production processes.

The first aerogel was created in 1931, from silica. Since that time, these amazing materials have found a large number of new uses. In addition to their use in insulation and space research, we have seen them used in a number of innovations, including in solar-powered medical sterilisation and solar-powered desalination pumps for communities that lack electricity.

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Takeaway:

Another hydrogen production method that could be sustainable going forward is electrolysis – a process where an electric current is run through water to separate the hydrogen and oxygen atoms. If the electricity comes from renewable sources, then carbon emissions can be eliminated from the process. Because they use light rather than electricity, aerogels offer a completely different method for hydrogen production. However, it's still unclear whether the aerogel will ever be ready to use on an industrial scale. Before that can happen, the researchers will need to find a way to accelerate the gas flow through the aerogel. Currently, the small pores in the gel slow down the flow of gas. However, as photocatalysts, aerogels could improve the efficiency of other useful reactions – not just hydrogen production.