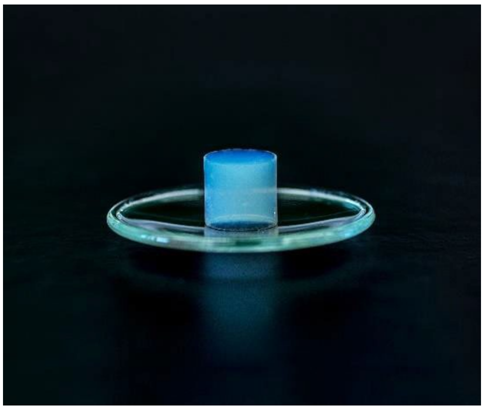
ETH zürich

Material Shapes the Ages Exhibition

Information, photographs, and video footage

A Modern Tree



Ultralight and highly porous. Aerogels enable the transformation of CO_2 into solar fuels.

RETHINK a future in which artificial trees perform photosynthesis. ETH Zurich's Laboratory for Multifunctional Materials fabricates aerogels – an ultralight and spongy material mainly composed of air enclosed in a 3-dimensional network of photocatalytically active nanoparticles that spark a chemical reaction in the presence of light). Inspired by Nature's photosynthesis, these materials enable the chemical reaction of CO_2 with water into solar fuels just with the aid of light.

Rethinking Energy

Aerogels are the lightest materials on earth. These spongy materials are mainly composed of air (up to 98%) enclosed in a 3-dimensional network of nanoparticles. Depending on the composition of the nanoparticles, aerogels offer a wide range of useful properties such as thermal insulation, electrical conductivity, photocatalytic activity or optical transparency.

In the ETH Zurich lab, aerogels are built up using titania (TiO_2) nanoparticles (a naturally occurring mineral) as photocatalytic material capable of accelerating a chemical reaction with the aid of light. Nature uses this concept in photosynthesis to transform CO_2 and water into energy-rich carbohydrates, the food for the plants, by simply using sunlight. Scientists of ETH Zurich adapt this strategy and work on artificial photosynthesis, in which the aerogels act as photocatalysts supporting the reaction of CO_2 and water into solar fuels.

Compared with natural photosynthesis, such photocatalytic conversion of CO_2 in the lab is extremely challenging and requires a careful rethinking of the photocatalyst design. The research team selected nanoparticles with an optimal composition and size, which were then assembled into a 3-dimensional structure. To improve the selectivity and the yield of the chemical reaction, the titania nanoparticles are typically combined with noble metal nanoparticles such as gold or platinum. To make sure that the gas flow through the photocatalyst is efficient and the contact between gas and photocatalyst is maximized, the structure of the photocatalyst has to be porous and finely branched, like in a tree. Aerogels provide such a structural design that seems to be ideal for photocatalytic gas phase reactions.

Nanoparticle-based Aerogel

Material:	Titania
Total size:	11 x 11 x 11 mm
Total surface:	42 m^2
Total weight:	75 mg
Preparation time:	2 days

Design team / bios / publications

Laboratory for Multifunctional Materials

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References

F. Rechberger, M. Niederberger, *Synthesis of Aerogels: From Molecular Routes to 3-Dimensional Nanoparticle Assembly,* Nanoscale Horiz. **2017**, *2*, 6

ETH Zurich Laboratory for Multifunctional Materials
http://www.multimat.mat.ethz.ch/

Images and video material

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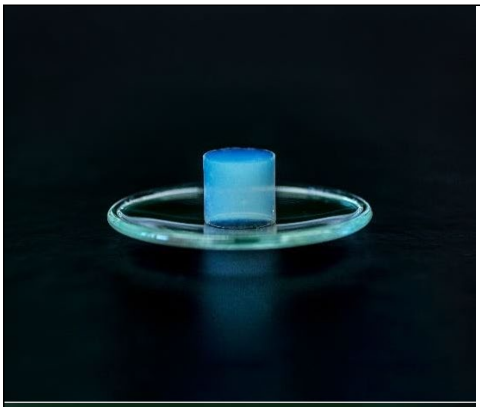
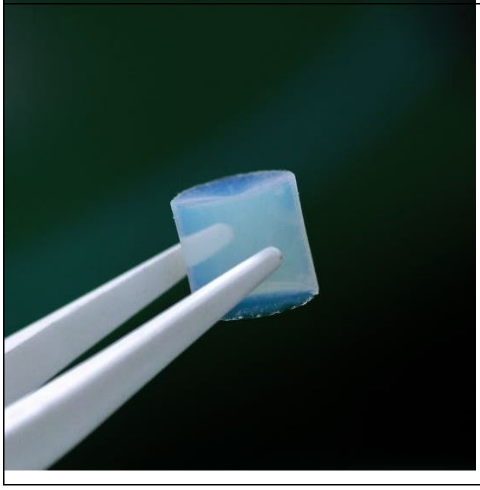


A Modern Tree
Aerogels enable the conversion of CO_2 into solar fuels with the help of light - a form of modern photosynthesis.



Aerogels
A highly porous and lightweight material: One gram of this aerogel has the same surface area as two tennis courts.