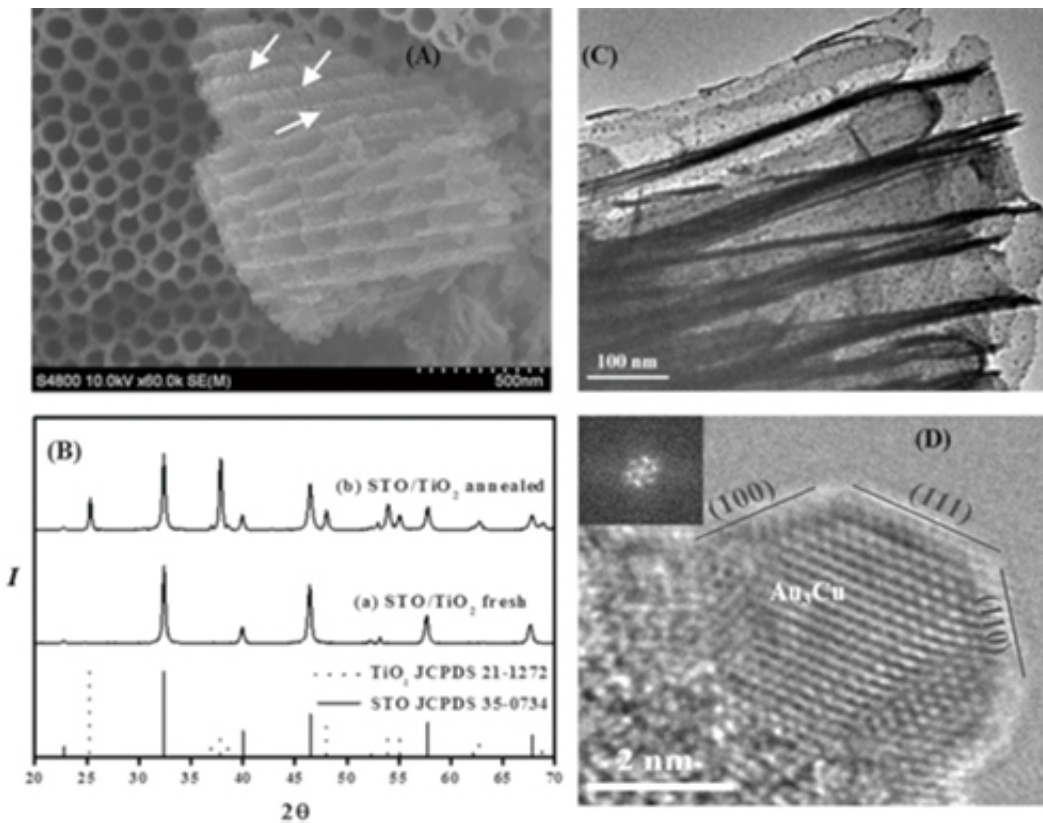


Hydrocarbon photocatalysts get in shape and go for gold

March 10 2015



A combination of semiconductor catalysts, optimum catalyst shape, gold-copper co-catalyst alloy nanoparticles and hydrous hydrazine reducing agent enables an increase of hydrocarbon generation from CO₂ by a factor of ten.

"Solar-energy-driven conversion of CO₂ into [hydrocarbon fuels](#) can simultaneously generate chemical fuels to meet energy demand and mitigate rising CO₂ levels," explain Jinhua Ye and her colleagues at the International Center for Materials Nanoarchitectonics in their latest report. Now the research team have identified the conditions and catalysts that will maximise the yield of hydrocarbons from CO₂, generating ten times previously reported production rates.

Carbon dioxide can be converted into a hydrocarbon by means of 'reduction reactions' - a type of reaction that involves reducing the oxygen content of a molecule, increasing the hydrogen content or increasing the electrons. In photocatalytic reduction of CO₂ light activates the catalyst for the reaction.

Ye and her team introduced four approaches that each contributed to an increased reaction rate. First, they combined two known semiconductor photocatalysts strontium titanate (STO) and titania (TiO₂) – which led to the separation of the charges generated by light and hence a more effective photocatalyst. Second, the [high surface area](#) of the nanotubes was made greater by holes in the tube surfaces, which enhances catalysis by increasing the contact between the gases and catalysts. Third, the tubes were decorated with gold-copper (Au₃Cu) nanoparticle co-catalysts to further enhance the catalysis, and fourth, they used hydrous [hydrazine](#) (N₂H₄•H₂O) as the source of hydrogen.

Although the high hydrogen content of hydrous hydrazine is widely recognised in the context of hydrogen storage there are no previous reports of its use for reduction reactions. The researchers demonstrated that the reducing properties of hydrous hydrazine were so great that oxidation of the co-catalytic [nanoparticles](#) – a problem when water or hydrogen are used - was avoided.

The researchers conclude their report, "This opens a feasible route to

enhance the photocatalytic efficiency, which also aids the development of photocatalysts and co-catalysts."

A combination approach increases the generation of hydrocarbons from CO₂ by a factor of ten. A) Scanning electron [microscope image](#), the white arrows indicate the holes in the tubewall; B) X-ray diffraction pattern of strontium titanate (STO)-titania (TiO₂) coaxial nanotube arrays; C) transmission [electron microscope](#) image of Au₃Cu@STO/TiO₂ nanotube arrays; D) High-resolution [transmission electron microscope](#) image and fast Fourier transform pattern of Au₃Cu nanoparticles.

More information: "Photocatalytic reduction of carbon dioxide by hydrous hydrazine over Au–Cu alloy nanoparticles supported on SrTiO₃/TiO₂ coaxial nanotube arrays", Qing Kang, Tao Wang, Peng Li, Lequan Liu, Kun Chang, Mu Li, Jinhua Ye, *Angewandte Chemie International Edition*, (2015), 54, 841 –845. [DOI: 10.1002/anie.201409183](#)

Provided by National Institute for Materials Science

Citation: Hydrocarbon photocatalysts get in shape and go for gold (2015, March 10) retrieved 27 April 2024 from <https://phys.org/news/2015-03-hydrocarbon-photocatalysts-gold.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.