PUBLISHED: 9 MAY 2017 | VOLUME: 2 | ARTICLE NUMBER: 17081

research highlights

CO_2 REDUCTION

Boron in its element

Angew. Chem. Int. Ed.
http://doi.org/f9v5zk (2017)

Converting CO_2 into other molecules using artificial photosynthetic processes powered by solar energy is a route to produce fuels and fuel precursors. Photocatalytic approaches to CO_2 conversion typically rely on the use of semiconductors to absorb photons, generating electron–hole pairs to drive the reduction of CO_2. Now, Jinhua Ye and colleagues in Japan and China report a system in which the photothermal heating properties and catalytic activity of elemental boron are exploited to produce CH_4 and CO from CO_2 using only water and light irradiation in a photothermocatalytic process.

The researchers use largely amorphous boron particles, which, when irradiated with solar energy, are heated due to the photothermal effect, reaching temperatures of almost 380 °C. This causes localized heating that helps to activate CO_2 molecules and leads to hydrolysis of surface boron to produce H_2 and boron oxides. The H_2 reacts with CO_2 catalytically over the boron particles to form the reduced products CH_4 and CO. A control experiment using Al_2O_3 as a substrate, rather than boron, heated to comparable temperatures in a CO_2/H_2 gas stream yielded no CH_4, demonstrating the ability of boron to not only provide the necessary temperatures for reduction of CO_2 but also to catalyse the conversion of CO_2. Under visible light irradiation the system produces CO at a rate of 0.8 μmol h^{-1} and CH_4 at a rate of 1.9 μmol h^{-1}, which is competitive with other systems for photocatalytic CO_2 reduction. ❐

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