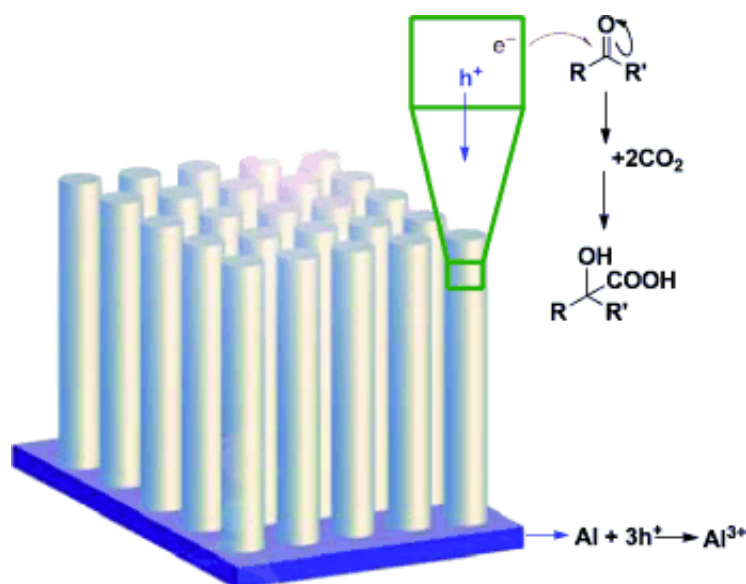


Selective and effective: silicon nanowires as photoelectrodes for carbon dioxide fixation

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(Phys.org) -- During photosynthesis, plants capture solar energy and use it to drive chemical reactions. Their carbon source is the CO_2 in air. In the journal *Angewandte Chemie*, American scientists have now proposed a new reaction mechanism that binds CO_2 and strongly resembles photosynthesis. In this process, light energy is captured by silicon nanowires. It was successfully used to synthesize two precursors of the anti-inflammatory, pain reducing drugs ibuprofen and naproxen.

Natural photosynthesis involves two processes, the light and dark

reactions. In the light reactions, photons are captured and their energy stored in the form of [chemical compounds](#) like NADPH (nicotinamide adenine dinucleotide phosphate) and ATP (adenosine triphosphate), which subsequently are used to bind CO₂ for the synthesis of complex [sugar molecules](#). At the heart of the dark reactions is the binding of CO₂ to a sugar phosphate (ribulose-1,5-bisphosphate). This results in formation of a β -keto acid, which gets converted to a central building block for sugar synthesis.

A team led by Kian L. Tan and Dunwei Wang at Boston College (Chestnut Hill, USA) has been inspired by the mechanisms of the dark reactions. To capture sunlight, the scientists used p-doped silicon nanowires as a photocathode. These very effectively convert solar energy to electrical energy, are easy to produce, and are amazingly stable under the reaction conditions needed. Captured photons release electrons from the atoms in the [nanowires](#). These electrons can easily be transferred to organic molecules to trigger chemical reactions. The researchers chose aromatic ketones as their starting materials. Transfer of electrons from the photocathode “activates” these molecules so that they can attack and bind CO₂. Over several steps, the reaction produces an α -hydroxy acid. This allowed the team to produce precursors of ibuprofen and naproxen with high selectivity and in high yield.

This reaction sequence closely resembles natural photosynthesis and is completely different from previous approaches to binding CO₂ with the aid of sunlight. This finally solves a problem: The very poor selectivity that automatically accompanies all traditional attempts at the direct photoreduction of CO₂ has limited previous methods to the production of fuels. This new strategy delivers the selectivity required for the production of complex organic intermediates for the production of pharmaceuticals and high-value fine chemicals.

More information: by Dunwei Wang, Silicon Nanowires as

Photoelectrodes for Carbon Dioxide Fixation, *Angewandte Chemie International Edition*, Permalink to the article:

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