Artificial photosynthesis moves a step closer

March 25 2008

Jülich scientists have made an important step on the long road to artificially mimicking photosynthesis. They were able to synthesise a stable inorganic metal oxide cluster, which enables the fast and effective oxidation of water to oxygen.

This is reported by the German high-impact journal *Angewandte Chemie* in a publication rated as a VIP ("very important paper"). Artificial photosynthesis may decisively contribute to solving energy and climate problems, if researchers find a way to efficiently produce hydrogen with the aid of solar energy.

Hydrogen is regarded as the energy carrier of the future. The automobile industry, for example, is working hard to introduce fuel cell technology starting in approximately 2010. However, a fuel cell drive system can only be really environmentally friendly, if researchers succeed in producing hydrogen from renewable sources. Artificial photosynthesis, i.e. the splitting of water into oxygen and hydrogen with the aid of sunlight, could be an elegant way of solving this problem.

However, the road to success is littered with obstacles. One of the obstacles to be overcome is the formation of aggressive substances in the process of water oxidation. Plants solve this problem by constantly repairing and replacing their green catalysts. A technical imitation depends on more stable catalysts as developed and synthesised for the first time by a team from Research Centre Jülich, member of the Helmholtz Association, and from Emory University in Atlanta, USA. The new inorganic metal oxide cluster with a core consisting of four ions of the rare transition metal ruthenium catalyses the fast and effective oxidation of water to oxygen while remaining stable itself.

"Our water-soluble tetraruthenium complex displays its effects in aqueous solution already at ambient temperature," enthuses Prof. Paul Kögerler from the Jülich Institute of Solid State Research, who synthesised and characterised the promising cluster together with his colleague Dr. Bogdan Botar. Catalytic measurements were carried out at Emory University. "In contrast to all other molecular catalysts for water oxidation, our catalyst does not contain any organic components. This is why it is so stable".

Botar explains the next step: "Now the challenge is to integrate this ruthenium complex into photoactive systems, which efficiently convert solar energy into chemical energy". So far, energy is still obtained from a chemical oxidant.

Citation: Yurii V. Geletii, Bogdan Botar, Paul Kögerler, Daniel A. Hillesheim, Djamaladdin G. Musaev, and Craig L. Hill; An All-Inorganic, Stable, and Highly Active Tetraruthenium Homogeneous Catalyst for Water Oxidation; *Angewandte Chemie*, DOI: 10.1002/ange.200705652.

Source: Research Centre Jülich