Chemistry driven by the sun, for a sustainable future

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A group of European chemists including Prof. Joost Reek of the University of Amsterdam's research priority area Sustainable Chemistry has recently published a whitepaper on Solar-Driven Chemistry. They show that it is possible, and even necessary for a sustainable future, to drive chemical reactions using solar energy.

In an overview of less than twenty pages the chemists identify the opportunities and challenges of this visionary concept that could in the long run replace fossil fuels as the main source of fuels, chemicals and materials.

The whitepaper results from presentations at a brainstorming workshop on Solar-driven Chemistry in Berlin organized by the Deutsche Forschungsgemeinschaft (DFG) and the European Association of Chemical and Molecular Sciences (EuCheMS). Prof. Joost Reek of the Van 't Hoff Institute for Molecular Sciences was among the international experts participating in this workshop.

Professor Reek is a leading researcher in the field of solar-driven chemistry, which was underlined earlier this year by the publication in *Science Advances* on a bio-inspired enzyme-mimicking catalyst for hydrogen production. More recently he acted as a guest editor of a special ChemPlusChem edition on Catalytic Systems for Water Splitting. He is the coordinator of the University of Amsterdam's Research Priority Area Sustainable Chemistry and headed the artificial photosynthesis research theme of the Dutch national research initiative

BioSolarCells.

According to professor Reek, the EuCheMS whitepaper identifies the much needed scientific breakthroughs that are crucial for making Solar-Driven chemistry a future reality. "It reflects the findings of our Sustainable Chemistry research at UvA where we combine the efforts of dozens of researchers in homogeneous and heterogeneous catalysis, molecular photonics and theoretical chemistry. We do make progress on both fundamental and technological levels, but much more effort is needed to establish a really meaningful European solar-driven chemical community in research as well as industry." Reek expects the whitepaper will enable EuCheMS to raise awareness with EU policymakers which will hopefully result in the allocation of future research funds.

Novel molecules

As an illustration of the relevance of research in this field Reek mentions the recent licensing of a patent on novel molecules for solar-driven hydrogen generation to the French company PorphyChem. Another example is a new project for developing a so-called molecular dye-sensitized photoelectrochemical cell (DSPEC) capable of reducing CO2 to methanol (or formic acid or even alkanes). The Netherlands Organisation for Scientific Research NWO has funded the research under Reek's supervision with half a million euros. It is being conducted in cooperation with the German chemicals company Merck and the Dutch research institutes ECN and FOM-AMOLF.

The latter two have teamed up with UvA and Vrije Universiteit Amsterdam in the Solardam consortium to harvest energy from the sun by generating electricity and fuel through combinations of photovoltaics, photocatalysis and photosynthesis. As professor Van Reek points out, this is an illustration of the multidisciplinary effort that is essential in the field of solar-driven chemistry.

Huge benefits

The EuCheMS whitepaper asserts that driving chemical reactions by the energy from the sun is crucial in order to guarantee the welfare of future generations.

Solar-Driven Chemistry entails a long-term innovative scientific and technological endeavour but it will enable the progressive substitution of fossil fuels. It will also have a large impact on the reduction of greenhouse gas emissions, with huge environmental, societal and economic benefits.

According to the whitepaper solar-driven chemistry can increase the competitiveness and sustainability of the European industrial system. It can create knowledge-driven competitiveness for Europe's industrial production, while preserving jobs and the environment.

However, it does require strong, concerted and unconventional support for basic and applied research. The whitepaper calls for a large, integrated and synergic approach encompassing catalysis, electrochemistry, photochemistry, and nanosciences, in concert with semiconductor physics, engineering, biosciences and social sciences.

More information: Solar-Driven Chemistry, A Vision for Sustainable Chemistry Production - White Paper. EuCheMS, September 2016. ISBN 978-2-9601 655-2-4

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