Quo vadis artificial photosynthesis?

Thomas Nann

The Ian Wark Research Institute, University of South Australia

Abstract:

In less than two hours, the surface of the earth receives more solar energy than the entire human population consumes within one year. Plants convert a small fraction of this energy into hydrocarbons and oxygen by oxidising water and reducing carbon dioxide:

$$6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$$

Even though this process has a relatively low efficiency of about 1 %, it enables life on earth. If it were possible to mimic this process efficiently, we could solve the global energy problem.

Natural photosynthesis can be described by the so called z-scheme, where two pigments P680 and P700 are excited by absorption of photons, and subsequent transfer of the excited electrons (excitation energy transfer, EET). The resulting cation-radical P680+ is used for water oxidation, whereas P700* is employed to reduce carbon dioxide (via nicotinamide adenine dinucleotide phosphate hydride, NADPH). Artificial photosynthesis seeks to mimic the natural blueprint by combining artificial light antennas or antenna systems with catalysts for water oxidation, and water or carbon dioxide reduction respectively.

A typical system for artificial photosynthesis is composed of three components: one or more light harvesting antennas or antenna-systems, an electron source (mostly a catalyst for water oxidation), and a catalyst for hydrogen or carbon dioxide reduction. In this presentation, we will discuss new strategies and results for the assembly of artificial photosynthesis systems. In particular, we will present results of Quantum Dot based photoelectrodes for water splitting.
Biography:
Professor Thomas Nann is Associate Director of the Ian Wark Research Institute and Director of the South Australian node of the Australian National Fabrication Facility. A chemist by training, Thomas' career began at the University of Freiburg, Germany, where he completed his PhD in electrochemistry. He then commenced his independent work on the synthesis, characterisation and functionalisation of nanomaterials in Freiburg, where he was awarded his habilitation in 2004. In 2006 he accepted an appointment to the Chair of Nanosciences at the University of East Anglia (UEA), UK which he held for almost four years. Since June 2010, Thomas has been a Research Professor at the Ian Wark Research Institute at UniSA. In 2011 he was awarded one of the prestigious ARC Future Fellowships.

Thomas' current research interests are focussed on the synthesis, characterisation and application of functional nanomaterials and their application in the areas of energy, health and catalysis. He has a track record of fundamental research on these topics which is documented by numerous publications in high ranking journals. Furthermore, he has successfully supervised PhD and PostDoctoral students, concluded many industrial collaborative projects, holds several patents and is a member on editorial boards of scientific journals.