Artificial Photosynthesis: Creating fuel from sunlight

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Artificial photosynthesis could replace the use of fossil fuels

Researchers have made significant progress towards developing a process of Artificial Photosynthesis (AP) that could replace the use of fossil fuels in the future.

Artificial Photosynthesis is the industrial process of preparing fuels and chemicals from nothing more than carbon dioxide, water and sunlight. It is a vital process that would be the foundation of a world that would no longer need fossil fuels.

In the latest issue of *Advanced Energy Materials*, researchers at Monash University have got a step closer to developing an AP process and have discovered a new way of converting carbon dioxide to methanol. Methanol is an extremely useful liquid fuel that could be used to run cars, heat homes or generate electricity in a fuel cell.

Professor Douglas MacFarlane, leader of the Energy Program at the ARC Centre of Excellence for Electromaterials Science (ACES) and ARC Laureate Fellow in the School of Chemistry at Monash University, said that research groups across the world had been tackling the challenge of AP; understanding the fundamental processes that take place in photosynthesis and mimicking them in an industrial process.

"If an artificial photosynthesis process can be developed that is significantly more efficient than plant-based photosynthesis, then it is conceivable that much of our fuel needs could be supplied from 'solar fuel' factories that would develop wherever sunshine and water are plentiful," said Professor MacFarlane.

"The key to this process in chemical terms is the development of new catalysts – one to oxidise water and another to absorb and reduce carbon dioxide. When the catalysts are coupled with materials that can absorb light energy, efficient generation of fuels such as methanol become possible."

Professor MacFarlane said the process had been achieved by the research team.

"We have created a photo-catalyst based on copper oxide, the surface of which is decorated with tiny carbon dots of about 2 nano-metres in size. This nano-composite material can directly convert carbon dioxide dissolved in water to methanol using only sunlight as the energy source," he said.

"Methanol is directly useful as a fuel and can also be the building-block for many complex carbon compounds such as plastics and pharmaceuticals."

More information: Li, H., Zhang, X. and MacFarlane, D. R. (2014), "Carbon Quantum Dots/Cu_2O Heterostructures for Solar-Light-Driven Conversion of CO_2 to Methanol." *Adv. Energy Mater.*. doi: 10.1002/aenm.201401077

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