Great strides for carbon capture using earth-abundant elements as photocatalytic system

04.12.2018 - Researchers at Tokyo Institute of Technology have designed a CO2 reduction method based only on commonly occurring elements. Achieving a 57% overall quantum yield of CO2 reduction products, it is the highest performing system of its kind reported to date, raising prospects for cost-effective carbon capture solutions.

Although metal-complex photocatalytic systems have been reported for CO2 reduction, many of them used noble- and/or rare-metal complexes. Compared to these approaches that utilize rare metals (such as ruthenium and rhenium), the use of earth abundant metals is “greener” and inexpensive, and has thus attracted much interest.

A copper complex (CuPS) proved to be a stable and efficient redox photosensitizer, as decomposition was only 2% after 12 hours of irradiation. In addition, CuPS exhibited a much stronger reduction capability compared to other photosensitizers investigated to date.

The team reported that the total quantum yield of CO2 reduction products was 57%, the turnover number based on the manganese catalyst was over 1300 and the selectivity of CO2 reduction was 95%.

In particular, the figure of 57% is remarkable, as the researchers comment: "To the best of our knowledge, this is the highest quantum yield for CO2 reduction using abundant elements and the yield would be comparable to that obtained with rare metals."

The study highlights the way that incremental advances in chemistry may have a large impact on the wider goal of working towards a fossil-fuel-free future.
Original publication:

Hiroyuki Takeda, Hiroko Kamiyama, Kouhei Okamoto, Mina Irimajiri, Toshihide Mizutani, Kazuhide Koike, Akiko Sekine, and Osamu Ishitani; "Highly Efficient and Robust Photocatalytic Systems for CO2 Reduction Consisting of a Cu(I) Photosensitizer and Mn(I) Catalysts"; JACS; 2018