

CO₂ REDUCTION

Hydrogen bonding boost

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Photocatalytic reduction of CO₂ allows storage of solar energy in the form of chemical bonds. Molecular transition metal complexes have been widely studied in systems for CO₂ reduction as they can act as both photosensitizers and catalysts. The role of the photosensitizer is to be excited by light absorption, become reduced by a donor molecule and to transfer electrons to the catalyst, which then facilitates the reduction of CO₂. One design approach has been to connect the photosensitizer and catalyst through covalent linkages, which leads to improved performance due to the enhanced intramolecular electron transfer between the components. Now, Clifford Kubiak and colleagues at the University of California San Diego and University of Southern California show that performance can also be boosted through non-covalent, hydrogen bonding interactions between the photosensitizer and catalyst.

The researchers use a rhenium bipyridine complex containing amide functional groups as the catalyst. They run the reaction using two different photosensitizers based on ruthenium bipyridine that largely differ in their ability to hydrogen bond: one photosensitizer has amide substituents — allowing strong hydrogen bonds to form with the catalyst — and one does not. The researchers find that the system with strong hydrogen bonding between the catalyst and photosensitizer is around three times better than the non-hydrogen bonding system in terms of turnover number and quantum yield — key metrics for photocatalytic performance. They also observe that changing the solvent to one that disrupts hydrogen bond formation hampers the performance, providing further evidence for the important role of non-covalent interactions in such systems.

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