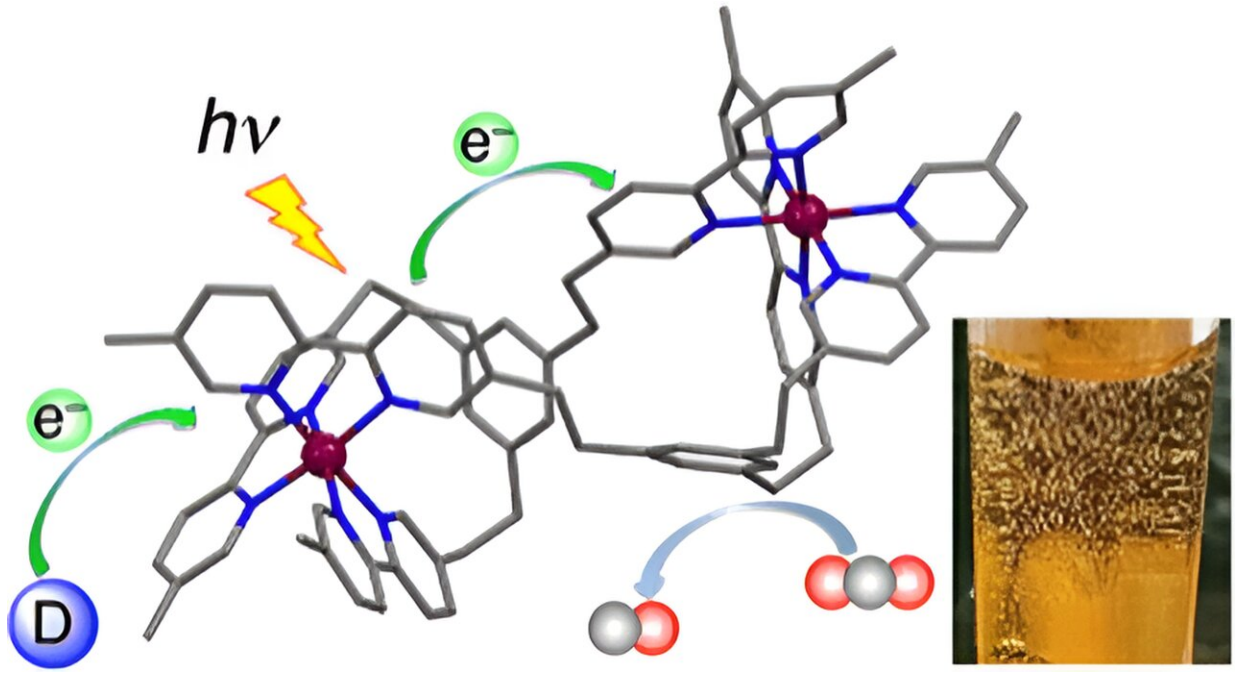
Dinuclear ruthenium complex as a photocatalyst for selective CO2 reduction to CO

October 20 2023



Graphical abstract. Credit: *Journal of the American Chemical Society* (2023). DOI: 10.1021/jacs.3c07685

Similar to the process of photosynthesis in plants, the conversion and storage of solar energy into chemical energy hold significant promise for addressing critical energy and environmental challenges, including the depletion of fossil fuels and threat of global warming. One promising

avenue in this pursuit involves harnessing light energy to convert CO_2 into value-added chemicals.

In a recent study, University of Tsukuba researchers harnessed the potent photocatalytic properties of a ruthenium (Ru) dinuclear complex with self-photosensitizing capabilities to achieve a remarkably efficient CO_2 reduction reaction. This process yields a high selectivity for carbon monoxide (CO). Their research has been published in the *Journal of the American Chemical Society*.

When a dimethylacetamide/H_2O mixture containing the Ru dinuclear complex as a photocatalyst and a sacrificial reducing agent was exposed to light with a central wavelength of 450 nm in 1 atm CO_2 atmosphere for 10 h, all the sacrificial reducing agent was consumed, and the substrate CO_2 was converted into CO with a selectivity exceeding 99%.

The maximum quantum yield at 450 nm was determined to be 19.7%. Furthermore, even when the initial CO_2 concentration in the gas phase was reduced to 1.5%, the photocatalytic CO_2 reduction by the Ru complex proceeded with remarkable efficiency, indicating that nearly all the introduced CO_2 could be converted into CO.

In this newly developed Ru dinuclear complex, the two Ru complex moieties engage in photosensitization, enhancing the stability of the complex catalyst under reaction conditions. This enhanced stability is attributed to the extraordinarily strong chelating effect of the ligand employed.

The researchers have future plans for further enhancing the catalytic activity to create a reaction system capable of efficiently driving the CO_2 reduction process, even at a lower CO_2 concentration equivalent to that of the Earth's atmosphere, which is approximately 420 ppm.

More information: Tomoya Ishizuka et al, Self-Photosensitizing Dinuclear Ruthenium Catalyst for CO2 Reduction to CO, *Journal of the American Chemical Society* (2023). DOI: 10.1021/jacs.3c07685

Provided by University of Tsukuba