

Light-induced CO₂ reduction catalysis with urea-modified iron porphyrin

E. Pugliese,¹ A. Quaranta,² P. Gotico,² B. Boitrel,³ W. Leibl,² Z. Halime,¹ A. Aukauloo^{1,2}

¹ Institut de Chimie Moléculaire et des Matériaux d'Orsay, UMR 8182 CNRS, Université Paris-Saclay, 91405 – Orsay, France

² Institut des Sciences du vivant Frédéric Joliot/ Institut de Biologie Intégrative de la Cellule, UMR 9198, CEA, CNRS, Université Paris-Saclay, 91191 - Gif-Sur-Yvette, France

³ Université de Rennes, CNRS, ISCR (Institut des Sciences Chimiques de Rennes), UMR 6226, Rennes F-35000, France

Email: eva.pugliese@universite-paris-saclay.fr

Finding ways to valorize and transform CO₂ into fuel using renewable energies as an alternative to fossil fuels is crucial in the current scientific research. A possible approach is electro or light induced molecular catalysis. Iron porphyrins had been reported to be active catalysts for CO₂ electroreduction since the 80s¹. Our group has previously developed a highly active iron porphyrin catalyst bearing urea groups in the second coordination sphere (**UrFe**)². The use of the urea scaffold to stabilize the CO₂ adduct enabled the catalyst to display low overpotentials and high turnover frequency. These results lead us to investigate its catalytic activity in a light induced catalytic system. When using ruthenium tris-bipyridine as a photosensitizer, our study shows that the second coordination sphere effect can also be transposed to homogeneous photocatalysis for CO₂ reduction. Careful tuning of the photocatalytic reaction parameters and modification of second coordination sphere led to a great enhancement of catalyst durability, with one of the highest turnover numbers (TON>7000) reported in the literature, and excellent selectivity for CO (>99%)³.



Figure 1. Simplified scheme of CO₂-to-CO photocatalytic reduction using [Ru(bpy)₃]²⁺ as photosensitiser and FeUr as catalyst.

[1] Y. Mu et al., *Acta Chimica Sinica*, **1986**, 4(2), 133

[2] P. Gotico et al., *Angew. Chem. Int. Ed.*, **2019**, 58, 4504-4509

[3] E. Pugliese et al., *Angew. Chem. Int. Ed.*, **2022**, e202117530