DEVELOPING NEW PHOTOSENSITIZERS BASED ON TRANSITION METAL IONS FOR GREEN ENERGY APPLICATIONS

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Rising global population and increased CO_2 levels in the atmosphere have focused attention on developing alternative and widely available carbon-free energy sources [1, 2]. Our research focuses on harnessing the unique properties of excited states in metal complexes to drive self-assembly processes and develop innovative energy applications. By leveraging the photophysical and photochemical behaviors of these complexes, we explore how light-induced excitations can be utilized to control molecular organization and energy transfer at the nanoscale. The parallels with Natural Photosynthesis are evident: light energy is captured by self-assembled Light Harvesting Complexes and is channeled to a reaction centre which induces electron transfer and the eventual production of chemical energy [3].

Our approach involves the synthesis of polypyridyl-based metal complexes, which are known for their stability and tunable electronic properties. By manipulating the excited states of these complexes, we demonstrate how light can act as a stimulus to induce self-assembly (Figure 1), leading to the formation of well-defined nanostructures with potential applications in catalysis, sensing, and optoelectronics [4]. Additionally, we extend our approach to the development of photoactive molecular devices capable of storing and transferring electrons, offering insights into the design of next-generation photosensitizers for chemical energy production [5].

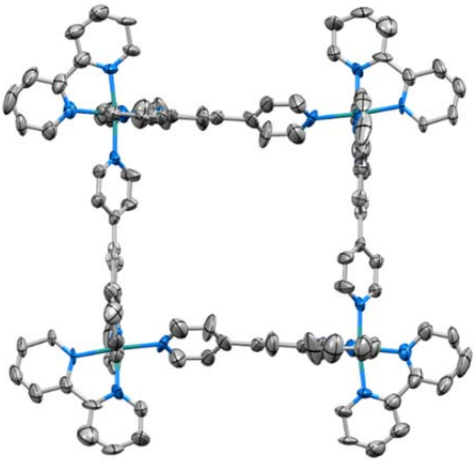

Figure 1. X-Ray crystal structure of a tetraruthenium square assembled by light. Solvent, hydrogen atoms, and anions removed for clarity.[4]

[1] https://ourworldindata.org/world-population-growth (01-03-2026).

[2] https://www.iea.org/world (01-03-2026).

[3] V. Balzani, A. Credi, M. Venturi, *Chem Sus Chem* 2008, *1*, 26.

[4] B. Laramée-Milette, F. Puntoriero, F. Nastasi, S. Campagna, G. S. Hanan, *Chem. Eur. J.*, 2017 *23*, 16497.

[5] G. M. Mercier, E. Rousset, I. Oubaha, K. Bandyopadhyay, A. K. Pal, I. Ciofini, L.-M. Chamoreau, V. Marvaud, G. S. Hanan, *Chem. Commun*. 2025 *61*, 14911-14914.