Beyond hydrogen production: exploring the multiple facets of photocatalysis

Dr Anabel Lanterna

School of Chemistry, University of Nottingham, University Park, NG7 2RD, UK

Heterogeneous photocatalysis offers competitive and sustainable chemical processes, aligning with the principles of circular economy. While its industrial implementation is not widespread yet, the processes are getting the chemical industry's attention due to the milder reaction conditions compared to thermal catalysis. Heterogeneous photocatalysts are attractive due to their ability to facilitate separation processes and enable reusability. Although still in its early stages industrially, heterogeneous photocatalysis will lead to promising technologies that promote sustainable practices in the chemical industry, reducing the economic & environmental impact of manufacturing processes once fully implemented.

The functional properties of heterogeneous photocatalysts are determined at the nanoscale and expressed ultimately by their interactions with molecules (reactants, products, solvents) and different forms of energy (heat, light) at the molecular level. Here I will show the development of hybrid catalysts based on inorganic semiconductors (particularly TiO_2) decorated with noble metal or metal oxide nanoparticles that can produce green hydrogen, but most importantly can trigger different organic transformation under mild conditions. The presentation will focus on past and present challenges encountered when using these materials for hydrogenations and C-C couplings, our efforts to replace precious metals by inexpensive and earth-abundant materials, different aspects of the processes' selectivity and the role of the photon energy or photon flux in the reaction outcomes.