One of the long term goals of this work is to perform batch water splitting using two biphasic systems. One biphasic system for the photo production of hydrogen and the other for the photo production of oxygen. During the day, the former system consumes a sacrificial electron donor (D) which is oxidised and the latter a sacrificial electron acceptor (A) which is reduced. At the night, the idea is to mix the organic phases to reset these sacrificial species by the reaction (D+) + (A–) —> D + A.
In both biphasic systems, the gas formation reactions can be catalysed by the presence of nanoparticles straddling the interfaces as they involve 2 or 4 electron transfer reactions. We shall discuss the redox electrocatalysis of gold nanoparticles (NPs) at liquid-liquid interfaces. We shall discuss how the Fermi level of these “floating” NPs is fixed and involved in the catalysis of biphasic electron transfer reactions. Additionally, we shall discuss the optical properties of gold NPs films at liquid-liquid interfaces that can form mirrors or filters.

Finally, we shall present our pilot plant work on indirect water electrolysis where the concept of redox electrocatalysis is used to produce kilos of hydrogen using a 10 kW vanadium redox flow battery. In this case, an acidic solution of vanadium (II) is circulated on a bed of Mo2C particles that catalyse hydrogen evolution and the oxidation of vanadium (II).