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{2-phases 2-reactions 1-catalyst} concept for the sustainable performance of coupled reactions

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PURPOSE OF THE ABSTRACT

In the family of nanometric ions, some polyoxometalate anions have recently been exploited for photocatalytic properties to reduce or oxidize organic functions in liquid phase. At the ICSM and in collaboration with the University of Regensburg, we have proposed an economical {2-phase, 2-reaction, 1-catalyst} REDOX process concept, using a judicious choice of immiscible solvents, a biphasic system in which each of the oxidised and reduced forms of a single catalyst is distributed, thus separating the reduction an oxidation reactions. A number of examples have been studied such as the very demonstrative one of a double reactions: i) the oxidation of an environmentally toxic dye, the red coloured DR-13, in the organic phase and ii) the reduction of an ionic silver solution in the aqueous phase. The photocatalyst is commercially available phosphotungstic acid. It is an inorganic, nanoscale, fully oxidised and 3 times negative ionic cluster in its natural form. Its low charge density makes this molecule liposoluble and therefore rather distributed in the organic phase. Once activated under UV radiation, it will be able to oxidise the dye to degrade it and thus reduce itself, this charge transfer making it 4 times negative. It then becomes water-soluble and thus migrates into the aqueous phase and makes the medium reductive for metal ions in solution. Once the ions have been reduced to metal, precipitating at the bottom of the reactor, the catalyst is once again oxidised (3-form) and therefore once again liposoluble, migrating in the opposite direction towards the organic phase, where it can be photoactivated once again and bring the double reaction to a conclusion.

This methodology, using a single reactor that can be fed with organic and metallic compounds independently, is a sustainable and economical approach to performing coupled redox reactions.

ref: https://doi.org/10.1039/D1GC04265C

FIGURES

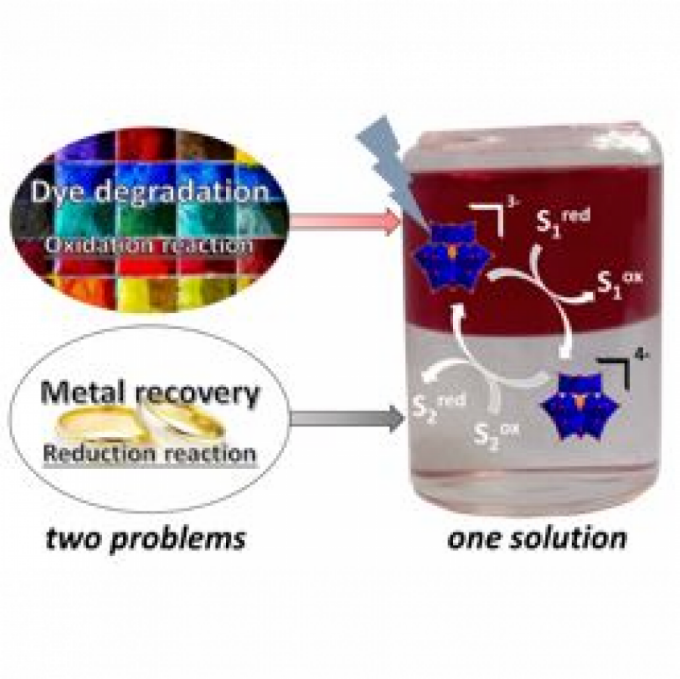

FIGURE 1

{2-phases 2-reactions 1-catalyst} concept

{2-phases 2-reactions 1-catalyst} concept using polyoxometalate nano-ions.

FIGURE 2

KEYWORDS

catalysis | liquid/liquid interface | nano-ions | photoredox chemistry

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