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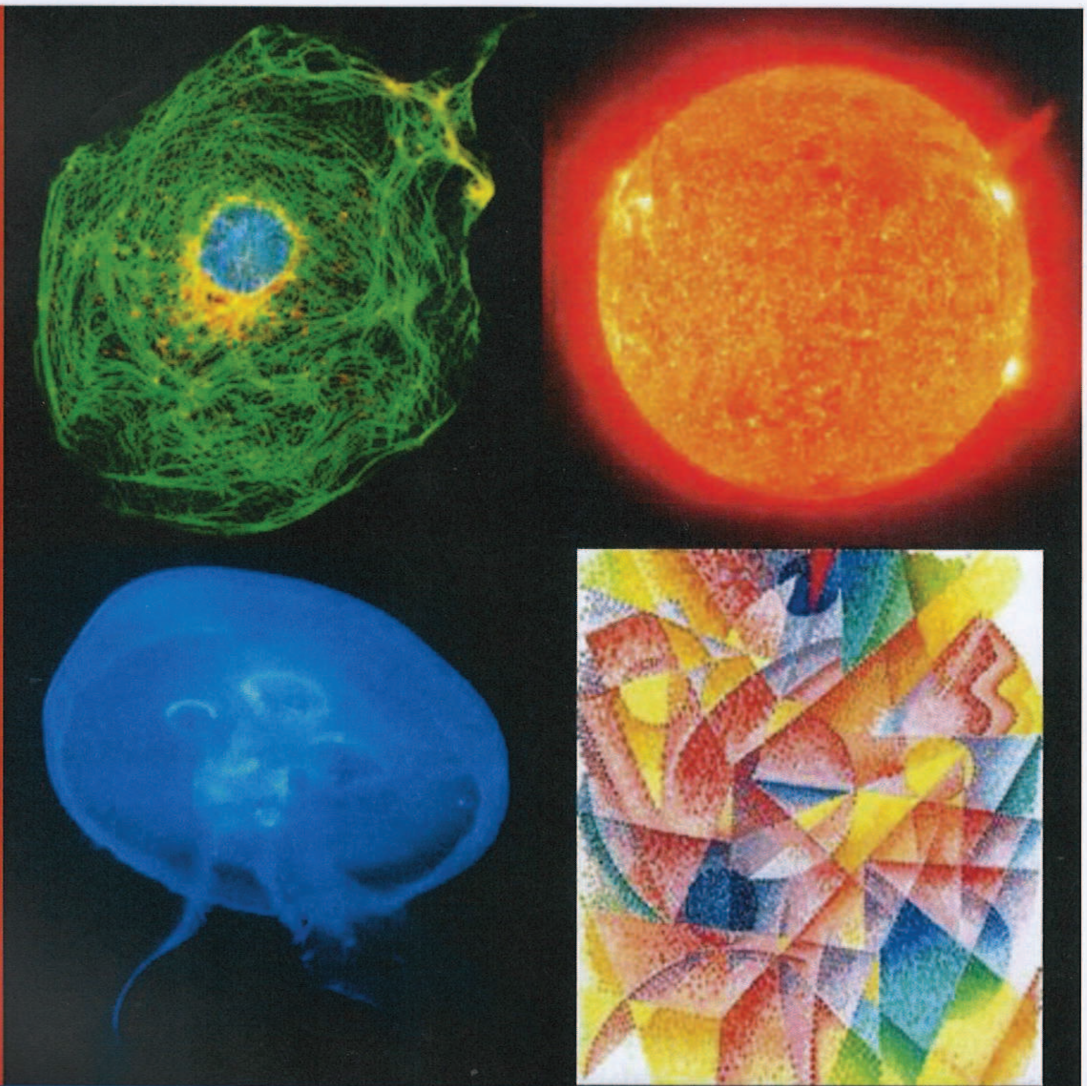

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Heterogeneous photocatalysis: a promising tool for green organic syntheses

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Heterogeneous photocatalysis by polycrystalline semiconductor oxides is an unconventional technology that has been applied mainly to degrade organic and inorganic pollutants both in vapour and liquid phase. It is generally accepted that TiO_2 is the most reliable photocatalyst, due to its low cost and (photo)stability under irradiation. Applications of heterogeneous photocatalysis for synthetic purposes are rare especially by using water as the solvent. The reasons can be found in the fact that the photocatalytic reactions are unselective processes and the presence of water, both as vapour and liquid phases, induces the production of OH radicals, highly oxidant species, under irradiation of the photocatalyst. Furthermore many organic molecules (reagents and/or products) are not very soluble in water or are virtually insoluble. The present work deals with a short review of some application of photocatalysis to green organic synthesis of valuable products in mild conditions and in water or green solvents media. For instance, various aromatic aldehydes (e.g. p-anisaldehyde,[1] vanillin,[2] hydroxymethylfurfurale,[3] piperonale,[4] etc.) have been obtained from the corresponding alcohols or from related substrates in aqueous media and valuable oxygenated products were selectively produced through partial oxidation of phenanthrene[5] in the green solvent dimethylcarbonate. In some cases pervaporation has been coupled with photocatalysis in a so-called pervaporation reactor to recover the product, thus avoiding its degradation. These reactions can be seen as paradigmatic examples so that photocatalysis may be doubtless considered a sustainable technology for green organic syntheses.

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