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Photocatalytic Hydrogen Production, Effect of Metal Particle Size and Their Electronic/Optical Properties on the Reaction

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Abstract : Hydrogen production from water is one of the most promising methods to secure renewable sources or vectors of energy for societies in general and for chemical industries in particular. At present over 90% of the total amount of hydrogen produced in the world is made from non-renewable fossil fuels (via methane reforming). There are many methods for producing hydrogen from water and these include reducible oxide materials (solar thermal production), combined PV/electrolysis, artificial photosynthesis and photocatalysis. The most promising of these processes is the one relying on photocatalysis; yet serious challenges are hindering its success so far. In order to make this process viable considerable improvement of the photon conversion is needed. Among the key studies that our group has been conducting in the last few years are those focusing on synergism between the semiconductor phases, photonic band gap materials, pn junctions, plasmonic resonance responses, charge transfer to metal cations, in addition to metal dispersion and band gap engineering. In this work results related to phase transformation of the anatase to rutile in the case of TiO2 (synergism), of Au and Ag dispersion (electron trapping and hydrogen-hydrogen recombination centers) as well as their plasmon resonance response (visible light conversion) are presented and discussed. It is found for example that synergism between the two common phases of TiO2 (anatase and rutile) is sensitive to the initial particle size. It is also found, in agreement with previous results, that the rate is very sensitive to the amount of metals (with similar particle size) on the surface unlike the case of thermal heterogeneous catalysis.

Keywords : photo-catalysis, hydrogen production, water splitting, plasmonic
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