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Low energy multiphoton semiconductor photocatalysis

It is well known that photogenerated carriers in semiconductor particles initiate up-hill chemical reactions. The process is single photon mediated (*i.e.* Each electron transfer to a

chemical species, utilizes only one photon) and only high band gap (BG) semiconductors could be used, because the low BG materials are susceptible to photocorrosion. A multiphoton catalytic process based on stable high BG semiconductors and capable of creating high chemical potential is most desirable for photochemical utilization of solar energy.

In this note we describe for the first time a model semiconductor particulate system possessing the ability to drive uphill chemical reaction via a multiphoton process consuming low energy (even IR) photons. Niobium pentoxide particles in contact with platinized titanium dioxide particles are found to photoproduce hydrogen from water in the presence of a hole scavenger (*e.g.* ethanol) when irradiated with visible, red and IR light.

The mechanism involved is explained as transfer of electrons from the valence band (VB) of Nb_2O_5 to an inter band trap site in Nb_2O_5 and then (directly or via another trap site) to the conduction band (CB) of a Nb_2O_5 . The transfer of electrons from the CB of Nb_2O_5 to the lying CB of a TiO_2 particle separates the charges suppressing the capture of electrons by the traps or the holes in VB.