A NOVEL PHOTOCATALYST FOR THE PHOTOREDUCTION OF WATER TO HYDROGEN AND NITROGEN TO AMMONIA

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Photoreduction of H_2O to H_2 and N_2 to NH_3 are two important photochemical processes taking place on irradiated aemiconductor. Although the yields observed in these light driven reactions are small, their practical utility is significant.

$MnO(OH)_2$ is a Mn(iv) which is obtained by oxidizing hydrous manganous oxide with H_2O_2. photochemical properties of this interesting compound have not been previously reported. with our previous observations of efficient nitrogen reduction to NH_3 combined with the reduction of H_2O to H_2 on certain hydrous metal oxides [1,2]. We have now investigated the above compound for possible photocatalytic activity. Although $MnO(OH)_2$ by itself is only feebly active for N_2 fixation, its activity can be enhanced considerably upon loading with hydrous ferric oxide. At an optimum loading concentration of 15% of $Fe(OH)_3$ on $MnO(OH)_2$ nearly 80 μ mol l^{-1} of NH_3 are obtained after 6h of irradiation. This is far greater than the yields of NH_3 with individuals hydrous oxides or iron and manganese (ca.15 μ mol l^{-1}) After 6h, the yields initially decrease, but continues to increase after about 12h of irradiation.

Photoreduction of water to hydrogen under N_2 and Ar shaw that around 883μl of H_2 are evolved after 12h of irradiation under Ar while 800 are evolved under N_2. Under sacrificial conditions in the presence of ethanol nearly 25,000 μl of H_2 are evolved under irradiation.

Possible reasons for the enhanced activity of this composite catalyst are (a) increased adsorption of N_2 on the hydrous Mn(IV) oxide and (b) separation of oxidation and reduction sites of H_2O manganese and iron centers respectively.

References: 1. Tennakone K., Wickremanayake, S., Fernando, C.A.N. Illeperuma, O.A., & Punchihewa S. J.C.S. Chem, Commun. (1987) 1278.
2. Tennakone K., Illeperuma, O.A., Bandara, J.M.S., Thaminimulla, C.T.K. (submitted for publication).