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ENHANCING SOLAR PHOTOCATALYTIC DETOXIFICATION BY ADSORPTION OF PORPHYRINS ONTO TiO_2

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ABSTRACT

Titanium dioxide (TiO_2) is a known photocatalyst for solar detoxification of water containing organic contaminants including PCB's and dioxins. Unfortunately, the UV light used by the photocatalyst only comprises about 4% of the solar spectrum. Metalloporphyrins strongly absorb in the visible and near infrared region. Using visible light, we have investigated Ni(II) uroporphyrin (NiUroP), Sn(IV)Cl_2 uroporphyrin (SnUroP) and Sn(IV)Cl_2 tetrakis(p-carboxyphenyl)porphyrin (SnTCPP) as possible enhancers of destruction of a model organic compound, salicylic acid (SA), by means of photosensitization of colloidal TiO_2 particles. All three porphyrins are found to adsorb reversibly onto the colloidal TiO_2 upon variation of pH. Adsorption of porphyrins results in the increased colloidal stability of fine TiO_2 particles in the pH range 5-8. While NiUroP on TiO_2 does not show any enhancement of photodestruction, the adsorption of SnUroP increases the destruction rate compared to that of the bare TiO_2 surface. The effect of ambient oxygen on the observed photolability of the Sn porphyrins and enhancement of photodestruction of SA was also investigated. SnTCPP does not photodecompose upon illumination either in the presence or absence of TiO_2, but neither does it bind to the photocatalyst at pH 6. At pH 4.5 it adsorbs onto TiO_2 but it also photodecomposes at this pH. We are attempting to stabilize the adsorbed porphyrins by adding suitable peripheral substituents onto the porphyrin macrocycle.