

TiO₂ photocatalysis for water treatment

A. Fujishima, T. Nakashima and Y. Kubota

Kanagawa Academy of Science and Technology,
KSP West 614, 3-2-1 Sakado, Takatsu-ku,
Kawasaki-shi, Kanagawa 213-0012, Japan

TiO₂ photocatalysis is becoming an increasingly interesting oxidation process for the air cleaning as well as water treatment. The advantage of photocatalysis in water purification is the complete mineralization of organics caused by the photogeneration of OH radicals originating from water via the OH groups of the TiO₂ surface.

Natural estrogens of 17 β -estradiol (E2) and estron (E1) are basic female sex hormones, and they are well-known to exhibit estrogenic activities potently even at a very low concentration. They are present at a considerable concentration in aquatic environments because they are excreted in the urine of females. They have been problematic because they were detected at high concentrations in a discharged water from a sewage treatment plant.

We have been studying TiO₂ photocatalysis in order to decompose EDCs (1-4). An immobilized TiO₂ system is required in order to avoid the need to remove TiO₂ nanoparticles from the treated water. We used TiO₂-modified PTFE mesh sheets, because PTFE has long-term stability against TiO₂ photocatalytic oxidation.

Sheets of the PTFE mesh modified with TiO₂ were arrayed horizontally in glass beaker, as shown in Fig. 1. The solution was illuminated with black fluorescent lamps. The TiO₂-modified PTFE mesh sheets were reciprocated.

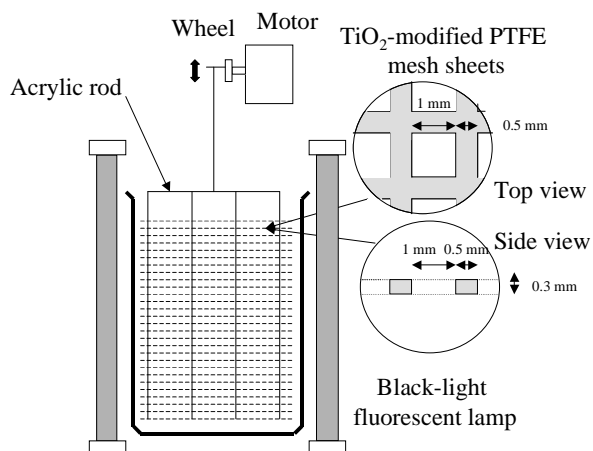


Figure 1. Schematic illustration of reactor with TiO₂-modified PTFE mesh sheets.

Estrogens in aqueous solution were decomposed relatively quickly by use of the TiO₂-modified PTFE

mesh sheets under relatively weak UV illumination. The semi-logarithmic plots of the concentration of estrogens as a function of the UV illumination time showed a nearly linear slope, indicating the mass-transfer limited condition caused by the low concentration of estrogens in the aqueous solution.

Discharged water from Todoroki sewage treatment plant in the Tama River near Tokyo was successfully treated by this method. By reciprocation technique of the PTFE mesh sheets, estrogens in a practical discharged water were decomposed with good reproducibility under the existence of the other organic compounds.

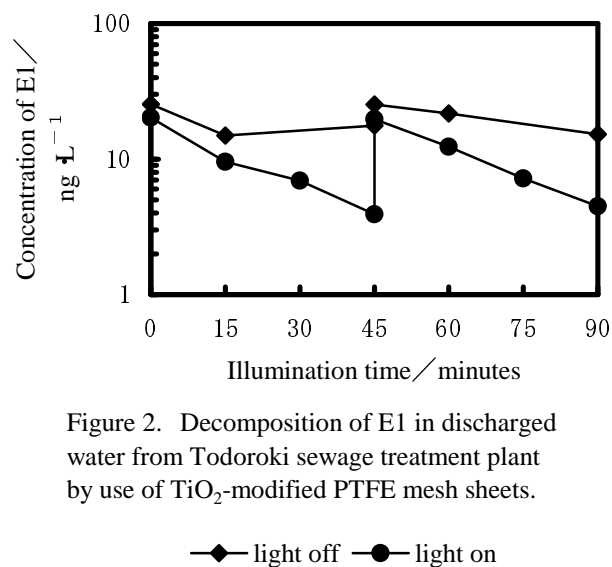


Figure 2. Decomposition of E1 in discharged water from Todoroki sewage treatment plant by use of TiO₂-modified PTFE mesh sheets.

◆ light off ● light on

We have developed new reactor with stand attached TiO₂-modified ceramics. We used filter of ceramics as supports for immobilizing the TiO₂. Estrogens were decomposed quickly under UV illumination by use of the filters of TiO₂-modified ceramics.

References

1. Y. Ohko, I. Ando, C. Niwa, T. Tatsuma, T. Yamamura, T. Nakashima, Y. Kubota and A. Fujishima, *Environ. Sci. Technol.*, 35 (2001) 2365.
2. Y. Ohko, K. Iuchi, C. Niwa, T. Tatsuma, T. Nakashima, T. Iguchi, Y. Kubota, and A. Fujishima, *Environ. Sci. Technol.*, 36 (2002) 4175.
3. T. Nakashima, Y. Ohko, D. A. Tryk, and A. Fujishima, *J. Photochem. Photobiol. A: Chemistry*, 151 (2002) 207.
4. T. Nakashima, Y. Ohko, Y. Kubota, and A. Fujishima, *J. Photochem. Photobiol. A: Chemistry*, 160 (2003) 115.