Titanium hydroxyapatite coating on glass plates and its photocatalyst activity

Ryo Ijichi, Tsutomu Nakazato* and Takami Kai

Abstract

Substances commonly used as solid photocatalysts are titanium oxide TiO_2. However organic adsorption property is generally low. In order to overcome this problem, hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$, referred to as HAp) composite[1)] and titanium hydroxyapatite, in which a part of the Ca sites of HAp was replaced with Ti ($Ti_xCa_{10-x}(PO_4)_6(OH)_2$, referred to as TiHAp)[2)] had been developed to enhance adsorption capacity of TiHAp. As a feature of TiHAp, it is known to have a stronger organic adsorption capacity than TiO_2. Rare earth element containing TiHAp[3)], TiHAp and $CaSO_4 \cdot 2H_2O$ with mass ratio 1:1 mixture improved photocatalytic function[4)]. Further, as practical examples, a pellet including TiHAp which does not peel off from the pellet surface for water purification application[5)], a panel that allows to form a coating layer of easily uniform film thickness that makes it possible to improve the living environment indoors[6)].

However, there are limited reports available for water purification using TiHAp as a wall material. The purpose of this study was to clarify the application and hydrophilicity of various powder samples generally exhibiting photocatalytic action, including TiHAp, as wall materials for water purification.

In order to compare the photocatalytic activity under the same conditions, three types of particles were used, namely Titanium Next 21 (TiO_2 0.85%, water 99.15%, Marutomi Co., Ltd.), TiHAp (PHOTHAP PCAP-100, Taihei Chemical Industry Co., Ltd.), TiHAp (Hautoform TA, Fuji Chemical Industry Co., Ltd.) and calcium sulfate dihydrate (Kanto Chemical Co., Ltd.), which does not have photocatalytic function but enhance the photocatalytic effect of TiHAp[4)], and using methylene blue (MB) as an adsorbent. Further, ethylsilicate hydrolyzate HAS-1 (SiO_2: 20 wt%, solvent: alcohol, Colcoat Co., Ltd.) was used as a photocatalytic coating agent. Photocatalytic activity was used by photocatalytic evaluation checker. A simple spin coater was used for thin film production. MB solution 400 mg/L (1 mM) was prepared as a standard solution.

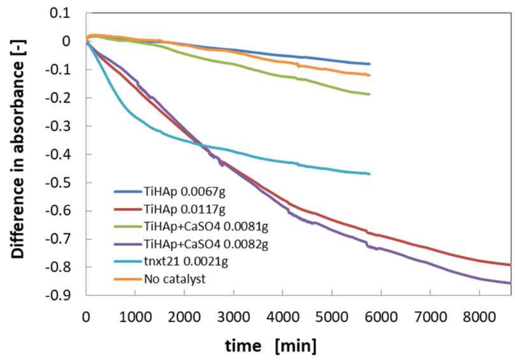

Fig. 1. Results of absorbance measurement of each photocatalyst spin coater coating

Fig. 1 shows the absorbance measurement results of each photocatalyst. TiHAp rapid photocatalytic reaction was observed, titanium next 21 rapid photocatalytic reaction was observed. TiHAp activity was lower than titanium next 21. Titanium next 21 is most active, TiHAp and $CaSO_4 \cdot 2H_2O$ mass ratio 1:1 mixture also showed slightly improved photocatalytic activity. Dependence of photocatalytic activity by the mass of TiHAp was not observed. This is considered to be affected by variations in TiHAp due to spin coaters. Further, it is also conceivable that the accuracy of TiHAp adhesion to the slide glass is not constant in the spin coater. Fig. 2 shows the absorbance measurement results of each photocatalyst. Compared to spin coaters, the difference in changes in the photocatalytic effect was small and stable. From these figure s, the wall material of the photocatalyst coater coating is considered to be excellent.

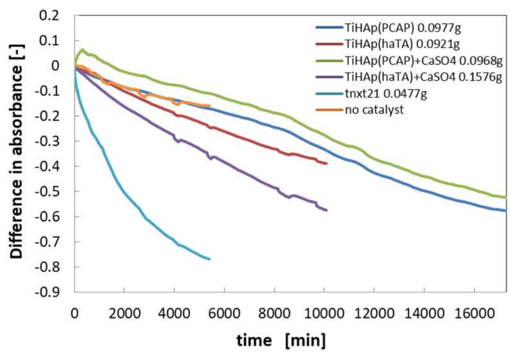

Fig. 2. Results of absorbance measurement of each photocatalyst coater coating

References

(1) S. Ji *et al.*, *Mater. Res. Bull.*, **44**, 768-774 (2009)
(2) M. Wakamura *et al.*, *Langmuir*, **19**, 3428-3431 (2003)
(3) Y. Naganuma *et al.*, Japanese Patent Disclosure 2007-153707 (2007)
(4) T. Nakazato, Japanese Patent Disclosure 2017-189718 (2017)
(5) K. Watanabe *et al.*, Japanese Patent Disclosure 2015-174045 (2015)
(6) H. Yoshida, Japanese Utility Model Registration No. 3202480 (2016)

Department of Chemical Engineering, Kagoshima University, Kagoshima 890-0065, Japan