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Production of titanium-calcium Hydroxyapatite photocatalyst powders via drip thermal treatment using a fluidized bed

Masaru Ketoguchi, Tsutomu Nakazato and Takami Kai

Abtract

Recently, hydroxyapatite (HAp; $Ca_{10}(PO_4)_6(OH)_2$), which has been used as artificial bone, adsorbent and catalyst, is receiving attentions in application to photocatalyst. Nishikawa [1] reported that UV irradiation after heat treatment at 200ºC leads to changes in the surface of HAp followed by the generation of the reactive oxygen species. Moreover, Wakamura *et al*. [2] have reported that the photocatalytic activity of HAp is enhanced by doping of Ti (IV). Further, the Ti (IV) doped HAp (Ti-HAp) has a higher bacterial effect than titanium dioxide (TiO_2) owing to superior ability for adsorption due to HAp. Kandori *et al.* [3] have reported that the photocatalytic activity of Ti-HAp is enhanced by heat-treatment at more than 600ºC.

From our previous study [4], Ti-HAp can also be produced from a scallop shell by properly selecting the conditions of post-heat treatment. This finding gives us an indication that post-heat treatment can be a crucial procedure for the improvement of photocatalytic activity of Ti-HAp. Until now, no studies have been found in the literature concerning Ti-HAp synthesis via drip thermal treatment using a fluidized bed (DTFB). The advantages of DTFB are the rapid evaporation of the solvent, effective heat treatment of the fine particles by attaching to the hot fluidizing coarse particles, prevention of the formation of aggregates and selective elutriation of heat-treated fine particles. Additionally, we believe that porous powders can be produced via DTFB.

The aim of this study is to explore the properties and photo-catalytic activity of Ti-HAp powders produced via DTFB. Our results indicated that, when $Ti(SO_4)_2$ are used as titanium source, $CaSO_4{\cdot}0.5H_2O$ is generated selectively. Although the photocatalytic activity was lower than that of commercially available photocatalytic apatite, careful washing of the suspension before the thermal treatment gave comparable photocatalytic activity to the commercial one.

References

1. H. Nishikawa; "Surface changes and radical formation on hydroxyapatite by UV irradiation for inducing photocatalytic activation," *Journal of Molecular Catalysis A: Chemical*, **206**, 331-338 (2003)
2. M. Wakamura, K. Hashimoto and T. Watanabe; "Photocatalysis by Calcium Hydroxyapatite Modified with Ti(IV): Albumin Decomposition and Bactericidal Effect," *Langmuir*, **19**, 3428-3431 (2003)
3. K. Kandori, M. Oketani, Y. Sakita and M. Wakamura; "FTIR studies on photocatalytic activity of Ti(IV)-doped calcium hydroxyapatite particles," *Journal of Molecular Catalysis A: Chemical*, **360**, 54-60 (2012)
4. M. Ketoguchi, T. Nakazato and T. Kai; "Utilization of scallop shell for conversion to titanium-hydroxyapatite and its photocatalytic activity for acetaldehyde degradation," 10th International Forum on Ecotechnology, Kagoshima, Japan (2015)

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