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Chemical Tuning of Nanostructured Titania for Visible-light Responsible Photochemical Functionalization

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Nanostructured titania has attracted much attention due to its excellent photochemical properties among wide-bandgap oxides. Titania nanotubes (TNTs) [1,2] have large specific area with unique one-dimensional morphology, and thus exhibit excellent photocatalytic properties. However, pure TNTs is responsive only to UV light. In this research, visible light responsive peroxo functional group modified titanates (PTNT) having nanotubular or nanoribbon shaped morphology with a width of 10 – 20 nm have been successfully synthesized by different chemical processing routes: simple chemical modification of pristine TNT using hydrogen peroxide solution, and the direct and facile one-step bottom-up synthesis from peroxo-titanium complex solution as a starting material[3,4].

Both synthesis methods produced yellowish nano-tubular powers with energy band gap values around 2.6 ~ 2.8 eV that was lower than that of pristine TNT (~3.4 eV) and TiO_2 crystal (3.0~3.2 eV). This is considered due to the variation of band gap structure according to the introduction of peroxo functional groups to the crystal structures. Synthesized PTNT thus exhibited photocatalytic performances under both ultraviolet (UV) and visible (Vis) light irradiation conditions. In addition, further materials tuning of PTNT by incorporation of various transition metals exhibited enhanced photocatalytic functions.

Detailed photocatalytic degradation investigation using organic dye molecules such as Rhodamine B were carried out to clarify the role of modification of TNTs and to understand redox characteristics in relation to the energy band structures. It was found that the photo-induced electrons acted more dominantly in the photocatalytic organic dye degradation under the visible light. These facts imply us that the peroxo-modified nanostructured titania and their derivatives are attractive materials that can be applicable to multi-purposes such as energy, environmental and biomedical application. In this paper, design concept, synthesis processes, nanostructures and function of peroxo-modified TNTs will be discussed.

References

1. Kasuga, T.; Hiramatsu, M.; Hoson, A.; Sekino, T.; Niihara, K. *Langmuir*, 1998, *14*, 3160-3163.

2. Sekino, T. *Bull. Ceram. Soc. Japan*, 2006, *41*, 267-271.

3. Park, H.S.; Goto, T.; Cho, S.; Nishida, H.; Sekino, T. *ACS Omega*, 2020, *5*, 21753–21761.

4. Park, H.S.; Goto, T.; Han, D.H.; Cho, S.; Nishida, H.; Sekino, T. *ACS Applied Nano Materials*, 2020, *3*, 7795–7803.