# Synthesis of Titanium Dioxide Nanotubes from Titanium Dioxide Nanoparticles and Their Photocatalytic Activities

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## ABSTRACT

***Titanium dioxide nanotubes (TiNT) were prepared by treating titanium dioxide ($TiO_2$) nanoparticles with hot NaOH solution. The $TiO_2$ nanoparticles (anatase) used in this work were precipitated $TiO_2$, $SiO_2$-$TiO_2$ and commercial-grade (C02 and P25) nanoparticles. The diameters of the obtained nanotubes were nearly the same (~5-16 nm), regardless of the type of the starting nanoparticles. The photocatalytic actitivity of $TiO_2$ samples were dependent on their crystallinity, defects on the surface, photon absorptivity, particle size and surface area being exposed to UV radiation. TiNT had higher surface areas and more surface defects than the starting particles but the crystallinity, photon absorptivity and photocatalytic activities of the former were lower than those of the latter. The precipitated $TiO_2$ nanoparticles showed highest photocatalytic activity in KI oxidation, while TiNT from $SiO_2$-$TiO_2$ particles showed lowest activity. For an equal amount of absorbed photon, $SiO_2$-$TiO_2$ particles showed highest photon-to-product conversion efficiency.***

**Key words:** Titanium dioxide, Nanoparticles, Nanotubes, $SiO_2$-$TiO_2$, Photocatalysis

## INTRODUCTION

$TiO_2$ nanoparticles are used in many applications, including dye-sensitized solar cells (Kay and Gratzel, 1996; Adachi et al., 2003), photocatalytic reactions (Wilke and Breuer, 1999; Yang et al., 2002) and water purification systems (Horton and Garrett, 2002; Carmignani and Frederick, 2003) due to their high surface area and photocatalytic activity. $TiO_2$ nanoparticles can be obtained by various ways, including vapor deposition, precipitation and sol-gel method (Kasuka and Hiramatzu, 1998, 2000, 2003). It has been reported that surface area of the nanoparticles can be increased by treating with NaOH to form TiNT (Kasuka and Hiramatzu, 1998, 2000, 2003).The TiNT formation involves exfoliation of the crystalline particles into layered crystalline sheets and folding of the sheet-like structure (Tian et al., 2003; Yao et al., 2003). Both sides of the single-layer sheets have dangling bonds. Rolling of the sheets to form tubes reduces the number of dangling bonds and thus, the surface energy. The TiNT can also be synthesised using a template (Hoyer, 1996; Jung et