Antibacterial activity of titania nanotubes prepared from hydrothermal method under UV-A irradiation

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Introduction

In public water supply, the water must be disinfected to kill microorganism before delivery for household use. The disinfection using chlorine are very effective and popular in Vietnam. However, this method produces disinfection by-products (e.g. THMs) which are toxics and carcinogens. Among various alternative processes, photocatalytic disinfection appears to be an emerging technology because of its high oxidation activity for harmful microbial degradation without toxic by-products.

Titania nanotubes (TNTs) has attracted great attention in the research due to its special tubular structure with high surface area, high activity and can be applied in many field of study (Bavykin *et al.*, 2006; Ou and Lo, 2007; Bavykin and Walsh, 2009; Wong *et al.*, 2011; Liu *et al.*, 2014). However, little information was reported on the use of TNTs for deactivation of Escherichia coli and Staphylococcus aureus for water supply.

Material and Methods

In this study, titania nanotubes (TNTs) were synthesized by hydrothermal method and applied for bacteria disinfection. The TNTs materials were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), UV–vis absorption, Raman spectroscopy, and BET analyses. The antibacterial activity of the prepared samples was evaluated through antibacterial experiments against both Escherichia coli and Staphylococcus aureus. These experiments were conducted under the dark (without light) and under the UVA irradiation using an available commercial UVA light. The antibacterial activity using TNTs were then compared with those using raw commercial anatase particles (Degussa P25).

Results and Conclusions

The morphology and structure of TNTs are displayed in Figure 1 and Figure 2, respectively. These figures reveals that TNTs had rod-like and tube-like structures, which could have high photocatalytic activity. Figure 3 demonstrates the antibacterial activity of P25 and TNTs. The results indicated that antibacterial activity of TNTs were significantly enhanced compared to pristine P25, which may be due to the high surface area of TNTs materials. The synthesized TNTs demonstrated significant potential in antibacterial ability using an available, less dangerous, and commercial UVA lamp.

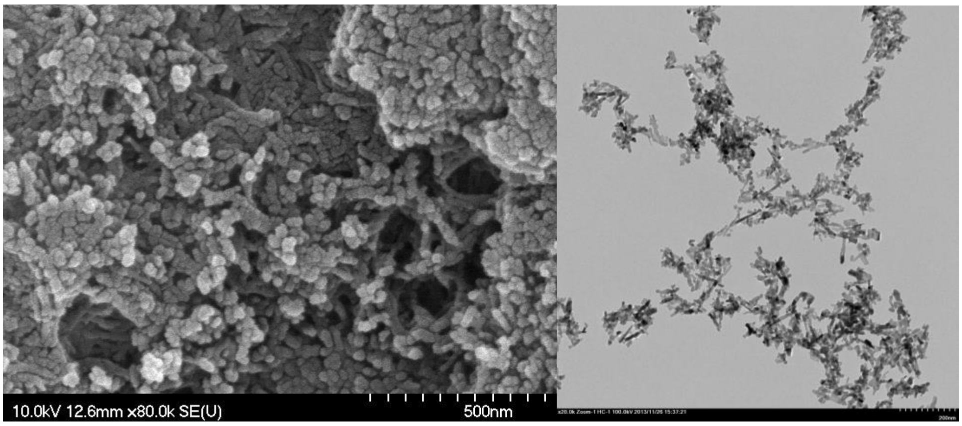

Figure 1. SEM (left) and TEM (right) images of TNTs

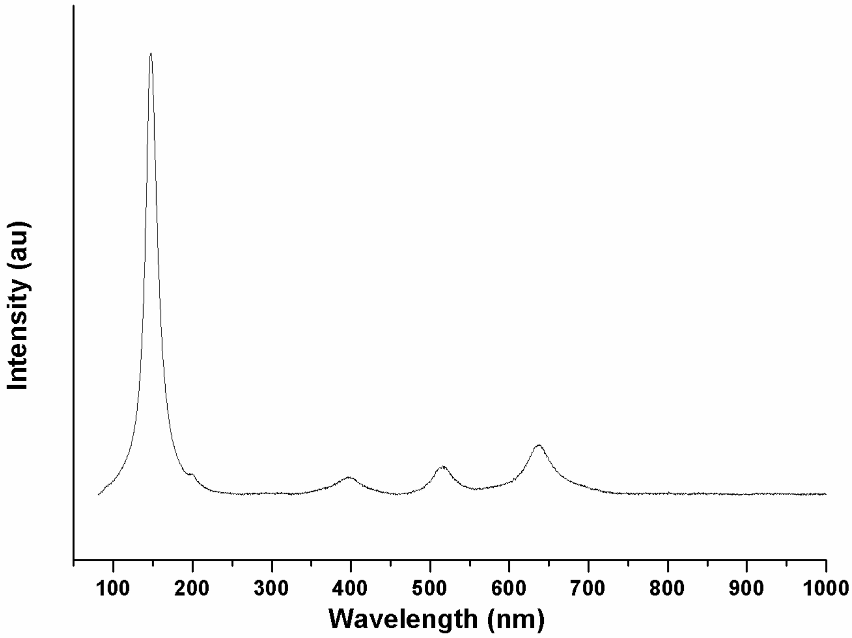

Figure 2. Raman spectrum of TNTs

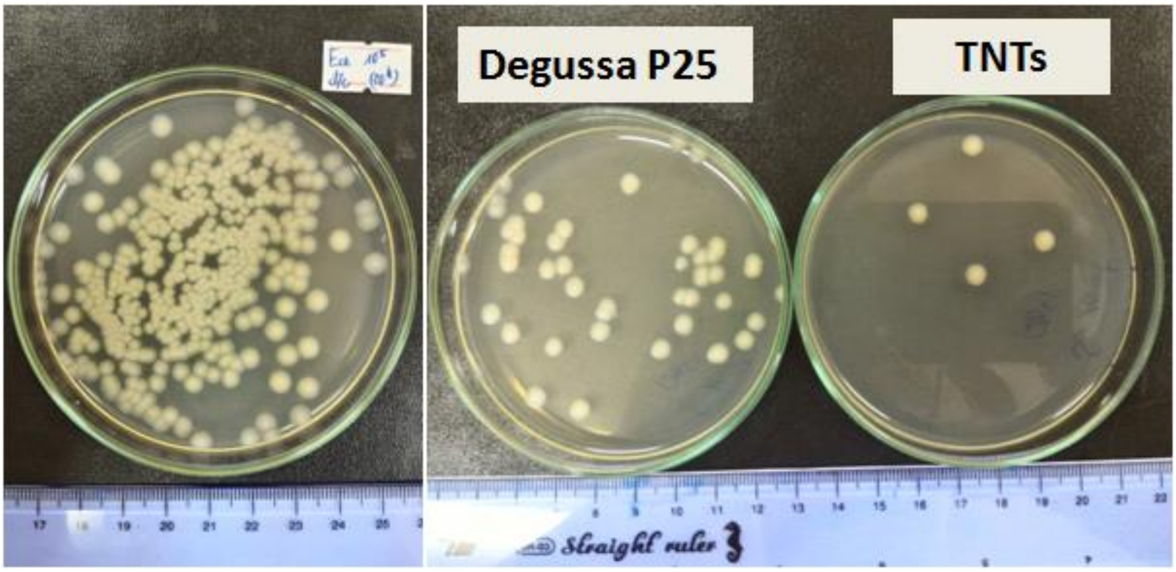

Figure 3. Results from antibacterial experiments using P25 and TNTs

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