Hydrothermal synthesis of TiO_2 nanotube/Graphene oxide composite and its application in photocatalytic purification of water

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The degradation of organic pollutants in water such as detergents, dyes, pesticides, herbicides and pharmaceuticals by the photocatalytic semiconductor TiO_2 has attracted extensive attention in recent decades [1,2]. TiO_2 nanotube (TNT) is considered as a modified structure in photocatalysis owing to its special electronic and mechanical properties, high photocatalytic activity, large specific surface area and high pore volume [3,4]. The aim of this study is to increase the photocatalytic efficiency of TNTs in combination with Graphene to purify water and wastewater. Graphene and graphene oxide (GO) are showing promise to turn into an alternative photocatalyst support material due to their planar structure, having functional groups, large surface area, and high transparency [5,6].

In the present work TNTs were prepared via hydrothermal method from commercial TiO_2 P25 as a starting material. 3 g of P25 was introduced to a Teflon-lined autoclave containing 70 cm^3 10M NaOH and heated at 130 °C for 24 h. After the heat treatment the obtained precipitate was washed several times with 0.1M HCl and distilled water. TEM image of as synthesized TNTs are shown in figure 1. The as-received TNTs were dispersed in graphene oxide aqueous solution, produced from graphite via modified Hummer's method and were ultrasonicated for 1 hour. The post-treatment of TNT/GO composite was carried out by at temperatures of between 300– 600 °C. Pure TNTs and TNT composites has been characterized by Fourier transform infrared spectroscopy, Raman spectroscopy, UV-vis diffuse reflectance spectroscopy, scanning and transmission electron microscopes, X-ray diffraction and BET analysis. Famotidine and Amoxicillin were chosen as sample pharmaceutical pollutants and their concentration was measured using HPLC techniques after certain UV exposure intervals in a UV immersion well reactor shown in figure 2.

The Photocatalytic experiments data show that this composite has a higher photocatalytic activity than bare TNT and commercial TiO_2. The advantage of using graphene is the ability to remove hazardous compounds containing benzene rings in water and wastewater through strong π-π interaction and high affinity to functional groups such as oxygen epoxies, carbonyl (=CO), hydroxyl (-OH) and phenols attached to both sides.

Keywords: Graphene oxide, Graphene, Adsorption, pharmaceuticals, HPLC

References

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Figures

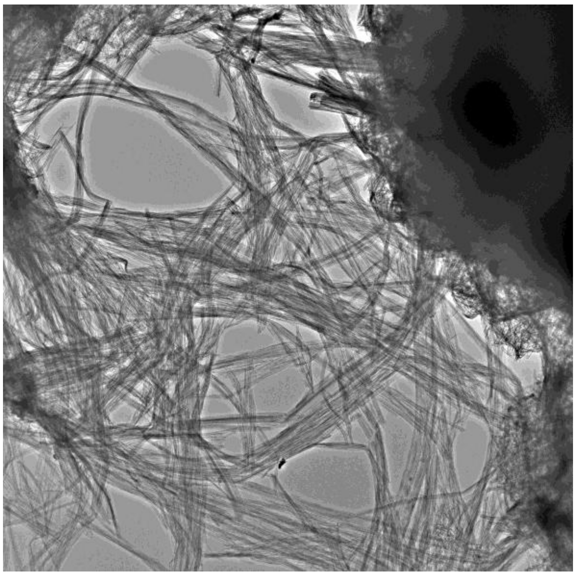

Figure1. TEM image of TiO_2 nanotubes synthesised hydrothermally at 130 °C for 24 hours

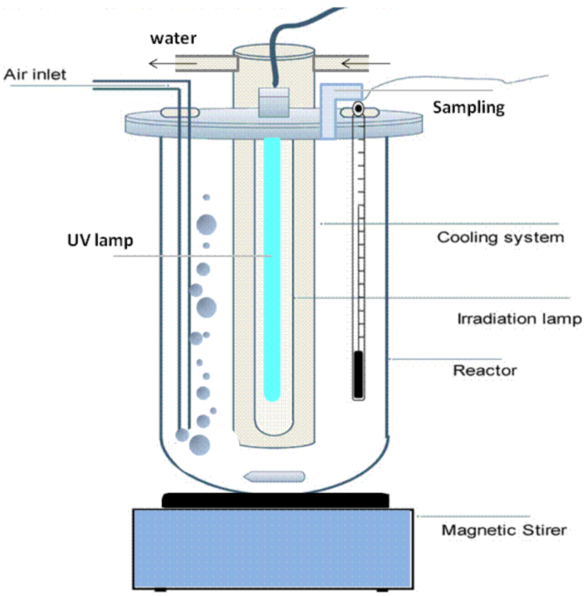

Figure 2. Schematic view of the Photocatalytic reactor used for photocatalytic water treatment