Junior Science Communications
Faculty of Applied Sciences, UiTM Shah Alam
https://journal.uitm.edu.my/ojs/index.php/JSC

E-ISSN 2637-0689
Vol 38 2024

Colloquium on Applied Sciences 2024
Faculty of Applied Sciences, UiTM Shah Alam, Malaysia

Effect of Urea Concentration on The Formation of g-C_3N_4 Modified Titania Nanotubes

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Structured Abstract

Background: Titania nanotubes (TNTs) are getting a lot of attention because of their impressive features such as a large surface area, strong ability to speed up photocatalysis, and stability in chemicals. They are also safe and abundant, making them widely used in different areas, especially in industries for treating wastewater, catalyzing hydrogen, and reducing CO_2. However, TNTs face challenges due to their broad bandgap (3.2 eV) and the quick recombination of electron-hole pairs, limiting their effectiveness in visible light. To tackle these issues, researchers are working on improving the photocatalytic abilities of TNTs by modifying them with graphite-carbon nitride (g-C_3N_4) and then studying the physical and chemical properties of these modified TNTs (g-C_3N_4/TNT). In this study, urea was used to create g-C_3N_4/TNT, and variations in urea were explored to understand how they affect the structure and appearance of g-C_3N_4/TNT.

Methods: Firstly, Ti foil underwent anodization at 40 V in the mixture of 0.5 wt% NH_4F, 90% vol% of ethylene glycol and 10 vol% DI water for 60 minutes to form TNTs. Then, the deposition of g-C_3N_4 onto TNTs was conducted by using in-situ growth method, where the TNTs was immersed in different concentration of urea solution ranging from 0.1 – 1.5 g/L. The physicochemical characterization of g-C_3N_4/TNTs involved the use of X-Ray diffraction (XRD), Field Emission Scanning Electron Microscope (FESEM), and Energy Dispersive X-ray Spectroscopy (EDX).

Results: The XRD analysis shows that TNTs has anatase structure. However, for all g-C_3N_4/TNT did not show any additional peaks of g-C_3N_4 at $2\theta = 15.81°$ and $2\theta = 27.57°$ due to the very low concentration of C_3N_4 present in the samples. Furthermore, FESEM was conducted and demonstrated that the TNTs has a tube-like morphology and was highly ordered. For g-C_3N_4/TNT, shrinkage of tube mouth was observed with increasing of the urea concentration. The shrinkage could be highly beneficial for photocatalysis reaction as this could possibly increase the roughness and surface area of samples. From EDX analysis, Ti, O, C and N could be detected, thereby confirming the formation of g-C_3N_4/TNT.

Conclusion: In conclusion, the findings showed an alternative approach to modify TiO_2 nanotube with g-C_3N_4 and the morphology of g-C_3N_4/TNT is influenced by different concentration of urea. The prepared g-C_3N_4/TNTs has the potential to be used in wastewater treatment, thereby making a valuable contribution to the sustainable development goal of ensuring access to clean water.

Keywords: TiO_2, g-C_3N_4, urea, nanotubes

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