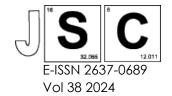
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Effect of Urea Concentration on The Formation of g-C₃N₄ Modified Titania Nanotubes

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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 CO₂. 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-C₃N₄) and then studying the physical and chemical properties of these modified TNTs (g-C₃N₄/TNT). In this study, urea was used to create g-C₃N₄/TNT, and variations in urea were explored to understand how they affect the structure and appearance of g-C₃N₄/TNT.

Methods: Firstly, Ti foil underwent anodization at 40 V in the mixture of 0.5 wt% NH₄F, 90% vol% of ethylene glycol and 10 vol% DI water for 60 minutes to form TNTs. Then, the deposition of g-C₃N₄ 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-C₃N₄/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-C₃N₄/TNT did not show any additional peaks of g-C₃N₄ at $2\theta = 15.81^{\circ}$ and $2\theta = 27.57^{\circ}$ due to the very low concentration of C₃N₄ present in the samples. Furthermore, FESEM was conducted and demonstrated that the TNTs has a tube-like morphology and was highly ordered. For g-C₃N₄/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-C₃N₄/TNT.

Conclusion: In conclusion, the findings showed an alternative approach to modify TiO_2 nanotube with g-C₃N₄ and the morphology of g-C₃N₄/TNT is influenced by different concentration of urea. The prepared g-C₃N₄/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: TiO₂, g-C₃N₄, urea, nanotubes