Activation of TiO_2 nanoparticles with N-doped CQDs for photodegradation of Methylene Blue and reduction of H_2

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TiO_2 nanoparticles are regarded as highly promising photocatalysts due to their strong chemical stability and photocatalytic efficiency. However, their large band gap (3.0–3.2 eV) restricts their activation to UV light, which constitutes only a small fraction of sunlight. Additionally, the rapid recombination of electron-hole pairs and the limited absorption of visible light hinder their photocatalytic activity. A successful strategy to overcome these limitations is the formation of nanocomposites with carbon nanostructures, which enhances their photocatalytic performance in the visible light spectrum[1,,2].

Carbon Quantum Dots (CQDs) have emerged as a significant class of quantum dots owing to their unique characteristics and eco-friendly nature. Typically less than 10 nm in size, CQDs are known for their strong photoluminescence (PL) properties. They offer advantages such as water solubility, low toxicity, chemical stability, and easy surface modification, making them highly useful in fields such as biomedical research, targeted drug delivery, and therapeutic applications[3]. Incorporating nitrogen into CQDs enhances their electrical properties due to charge imbalance and electron distribution resulting from the differing electronegativities of the constituent elements[4].

Herein, we report the synthesis and characterization of nitrogen-doped carbon quantum dots and the creation of nanocomposites with TiO_2 in different ratios (5% and 50%). The photocatalytic activity of the nanocomposites was tested for the degradation of Methylene Blue (MB) under a visible light source (LED lamps, 20 W) and for hydrogen production under full light spectrum radiation (Xe lamp, 300 W).

References:

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