# Photocatalytic Degradation of Diclofenac by Nitrogen-Doped Carbon Quantum Dot-Graphitic Carbon Nitride (CNQD)


## ABSTRACT

In this study nitrogen-doped carbon quantum dots/graphitic carbon nitride nanosheet (CNQD) composites with different contents of nitrogen-doped carbon quantum dots (NCQDs; 2, 4, 6, and 8 wt%) were synthesized. The morphological, physicochemical, and photoelectrochemical properties were investigated using complementary methods such as scanning electron microscopy (SEM), powder X-ray diffraction (pXRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FTIR), UV/Vis spectroscopy in diffuse reflectance (DRS), photoluminescence (PL), nitrogen physisorption (BET), photocurrent response, and electrochemical impedance spectroscopy (EIS). The photocatalytic activity of the synthesized materials was assessed during diclofenac (DCF) degradation in an aqueous solution under visible light irradiation. As a result, improved photocatalytic efficiency in DCF degradation was observed for all the CNQD composites compared with bulk graphitic carbon nitride (bCN) and nanosheet g-$C_3N_4$ (CNS). The fastest DCF degradation was observed for the 6 wt% NCQD on the surface of CNS (CNQD-6), which removed 62% of DCF in 3 h, with an associated k value of $5.41 \times 10^{-3}$ $min^{-1}$. The performance test results confirmed the contribution of NCQDs to enhancing photocatalytic activity, leading to an improvement factor of 1.24 over bCN. The morphology of the CNS and the synergistic interaction between NCQDs and CNS were essential elements for enhancing photocatalytic activity. The photoelectrochemical data and photoluminescence analyses showed the efficient migration of photoexcited electrons from NCQDs to the CNS. The reduced charge recombination rates in CNQD photocatalysts might be due to the synergistic interaction between NCQDs and CNS and the unique up-conversion photoluminescence properties of NCQDs. Further investigations revealed that the photogenerated superoxide radicals ($\bullet O2^-$) predominated in the degradation of DCF, and this photocatalyst had good reusability and toxicity reduction abilities. This work provides insight into the effects of NCQDs on the CNS surface to enhance its potential to remove emerging organic pollutants from water and wastewater.