Abstracts

Chapter-1

The chapter includes the structural and chemical composition of bimetallic bismuth oxide compounds, as well as their adsorptive and photocatalytic properties. The behaviour and changes of BBOs have been addressed in relation to adsorption and photocatalysis. This chapter also covers the literature evaluation, research gaps, objectives, experimental procedures, and characterisation methodologies.

Chapter-2

Photocatalytic degradation has emerged as one of the most efficient methods to eliminate toxic dyes from wastewater. In this context, graphitic nitride (g-C_3N_4) loaded $BiVO_4$ nanocomposites (5wt.% g-CN@$BiVO_4$ and 10wt.% g-CN@$BiVO_4$) have been fabricated by the wet impregnation method, and their efficiency towards photocatalytic removal of rhodamine B have been investigated under visible light irradiation. These hybrid composites have been characterized by XRD, FESEM, HRTEM, EDS-mapping, UV-Vis DRS, DLS, XPS and BET, etc. The HRTEM images revealed that $BiVO_4$ has a decagonal shape covered by a layered nanosheet-like structure of g-C_3N_4. BET measurements suggest increasing the proportion of g-C_3N_4 results enhancement of the specific surface area. Among different photocatalysts, the 10wt.% g-C_3N_4@$BiVO_4$ hybrid possesses the best catalytic activity with 86% degradation efficiency after 60 minutes of reaction time. The LC-MS studies suggest that the degradation reactions follow the de-ethylation pathway. Even after five cycles, the heterostructure shows only a 14% decrease in photocatalytic activity, confirming its stability. As a result, the binary composite can be regarded as a promising catalyst for the degradation of pollutants due to its ease of preparation, high stability and superior catalytic activity.

Chapter-3

Because of unrestricted disposal, the concentration of reactive dyes in wastewater is gradually increasing. Owing to their eco-toxicity their removal becomes so crucial. In this regard, Bi (0)-doped g-C_3N_4/Bi_2WO_6 (g-C_3N_4/Bi@Bi_2WO_6) nanocomposites were prepared by wet impregnation followed by calcination. Remarkably, the Bi (0) doping occurs concertedly during the preparation of Bi_2WO_6 without the addition of any extra reducing agent. The efficacy of the photocatalyst for eliminating reactive orange 16 was evaluated under visible light irradiation. XRD, FESEM, HRTEM, DRS, XPS, BET, etc., were employed to characterize these hybrids. The presence of Bi (0) was confirmed by HRTEM and XPS. Increasing the g-C_3N_4 content enhances the specific surface and reduces the charge

transfer resistance. Among the various photocatalysts, the 20 wt.% g-C_3N_4/Bi@Bi_2WO_6 hybrid owned the highest degradation efficiency of 89 % after 300 min of reaction time. The controlled experiments confirm the participation of holes and superoxide anions during the reactions. The various reaction intermediates were detected by HRMS providing the necessary evidence about the mechanism. The heterostructure possesses excellent reusability and stability. Due to enhanced catalytic activity, high stability, and ease of synthesis, the reported composite can be considered as a promising catalyst for the degradation of pollutants.

Chapter-4

Water contamination is a result of the excessive use of antibiotics nowadays. Owing to this environmental toxicity, photocatalytic degradation is the primary approach to non-biological degradation for their removal. In this respect, Bi (0)-doped g-C_3N_4/Bi_2MoO_6 [g-C_3N_4/Bi@Bi_2MoO_6] ternary nanocomposite was prepared using the wet impregnation method. Surprisingly, the zerovalent Bi is generated simultaneously during the hydrothermal synthesis of Bi_2MoO_6 without any extra reducing agent. The performance of the synthesised catalyst for the removal of ofloxacin is measured using visible light radiation. Various techniques like XRD, XPS, DRS, HRTEM, FESEM etc characterise the nanocomposite. Additionally, XPS, DRS and HRTEM confirm the presence of zerovalent Bi. The degradation efficiency was recorded to be 82% after 180 min of reaction time for the optimised catalyst. The control experiments validate the role of holes and superoxide radicals in the reaction mechanism. HRMS was used to identify the intermediates and various fragments which support the suggested mechanism. The photocatalyst exhibits outstanding stability and reusability. Due to its stability, easy synthesis, excellent catalytic activity, and reusability, the reported photocatalyst is considered favourable for pollutant degradation.