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Name of the Scholar : **Amir Mehtab**
Name of the Supervisor : **Prof. Tokeer Ahmad**
Name of the Department/Centre : **Chemistry**
Topic of Research : **Development of Graphitic Carbon Nitride and its doped analogue Nanostructures for Photo/Electro/Photoelectro-Catalytic Applications**

Findings

In my doctoral studies, I focused on harnessing the potential of semiconductor photocatalysis and electrocatalysis for sustainable energy conversion and environmental remediation. The research began with a comprehensive introduction to photo/electro-catalysis, highlighting the significance of Graphite-like carbon nitride (g-C_3N_4)-based materials for H_2 generation and their impressive properties as photocatalysts and electrocatalysts. Strategies to effectively utilize g-C_3N_4, such as fabrication of hybrid and heterostructures, electronic structure tuning, and geometric structure manipulation, were explored. One of the significant achievements in my previous work was the successful fabrication and characterization of metal-free and non-toxic highly porous N-rich g-C_3N_4 through polycondensation and acidic exfoliation. This achievement highlighted the potential of g-C_3N_4 as an efficient and stable electrocatalyst for hydrogen production with 100% faradaic efficiency and leading to reach 12% of apparent quantum yield (AQY). Moreover, the research delved into the development of advanced heterostructures, including type-II Cu_2O/g-C_3N_4 and $CuFe_2O_4$/g-C_3N_4 heterostructures. These heterostructures demonstrated lower overpotentials for the hydrogen and oxygen evolution reactions, leading to significantly enhanced photocatalytic and electrocatalytic activities. The as calculated AQY was found to be 23% and 25% for Cu_2O/g-C_3N_4 and $CuFe_2O_4$/g-C_3N_4 heterostructures respectively. Additionally, my previous work focused on the fabrication of CdSe and CdS Quantum dots/g-C_3N_4 heterostructures through the SILAR method, showcasing improved photo-and-electrocatalytic activity for oxygen and hydrogen evolution reactions. These heterostructures exhibited remarkable catalytic performance, emphasizing the potential of g-C_3N_4-based heterostructures as promising materials for sustainable energy conversion. Furthermore, my research efforts explored the fabrication of MoS_2/g-C_3N_4 heterostructures, revealing precise electron-transfer pathways at the Z-scheme heterojunction interface. The resulting heterostructures demonstrated enhanced catalytic efficiency with an AQY of 34% and improved photo/electrochemical performance.

Collectively, my previous research has contributed to a comprehensive understanding of semiconductor photocatalysis and electrocatalysis, particularly with the development and characterization of advanced heterostructures. These significant achievements offer promising solutions for renewable energy generation and environmental restoration, positioning me as a valuable contributor to sustainable energy research.