Controlled Synthesis of Graphitic Carbon Nitride (g-C_3N_4) via Melamine Polymerization Using Experimental Design

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Abstract

Graphitic carbon nitride (g-C_3N_4) is an emerging carbon-based polymer that exhibits semiconductor behaviour, notable for its stability under chemical and photonic stress and activation under visible light due to its 2.7 eV bandgap [1]. Structurally composed of triazine (C_3N_3) and more stable heptazine (C_6N_7 or tri-s-triazine) units, g-C_3N_4 forms a layered architecture with strong π-conjugation and van der Waals interactions, making it ideal for photocatalytic and energy applications [2].
In this study, we investigate the synthesis of g-C_3N_4 via thermal polymerization of melamine in a nitrogen atmosphere, as outlined by the mechanistic pathway involving melamine, melem, and melon intermediates [3]. To optimize the material properties, we employed a Central Composite Design (CCD) experimental strategy, focusing on three critical parameters: temperature, heating rat6 , and synthesis duration. Each experimental run was designed to reveal how these factors influence the structural and morphological features of g-C_3N_4, as characterized by X-ray diffraction, UV diffuse reflectance, fluorescence spectroscopy and complementary techniques. Finally, the photocatalytic properties of all synthesized materials have been investigated towards the degradation of phenol.

References

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Figures

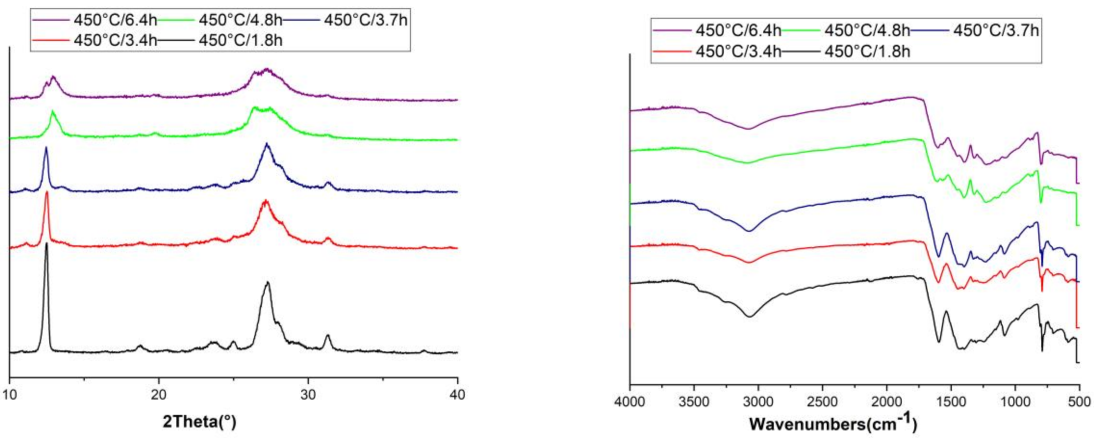

Figure 1: XRD and FTIR Characterization of g-C_3N_4 Synthesized at 450 °C