Slit geometry microreactor for light induced photocatalysis with graphite carbon nitride thin films

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The rational synthesis of graphitic carbon nitride materials by supramolecular preorganization of monomers s a powerful tool for the design of their morphology, photophysical and catalytic activite. This work based on facile and scalable approaches for the synthesis of ordered graphitic carbon nitride ($g\text{-}C_3N_4$) materials with an excellent photoactivity, which consists of supramolecular interfacial preorganization of graphitic carbon nitride ($g\text{-}C_3N_4$) monomers at the interface of two non-miscible solvents.[1] The development of microfluidic reactors for photocatalytic applications presents valuable advantages like simultaneous and fine control of light and fluids, large surface area-to volume ratio and uniform distribution of light onto the photocatalyst. Several groups have used microfluidic chips for enhanced chemical reaction performance. We have made a synergy of combining microfluidics and photocatalysis by using some nitrogen-based materials for photocatalytic reaction, to increase the rates and yields. As a proof of concept, we show different properties behaviour of the graphitic carbon nitride ($g\text{-}C_3N_4$) materials before and after thermal condensation.[2,3]

The advantages of this research, is the methods which are demonstrated through the tunable morphologies and surface area. The formation of new electronic junctions and high activity as a photocatalyst have been useful for hydrogen evolution and pollutant degradation of the graphitic carbon nitride ($g\text{-}C_3N_4$) materials.[4,5]

In summary, we have demonstrated a facile, controllable, scalable and efficient new method for synthesizing carbon nitride materials with morphology and optimizing their catalytic performance in microreactor and cuvette. History and different structures and classification of carbon nitride materials also properly explained in this review. Different organic pollutant degradation and hydrogen generation performance are shown for carbon nitride materials, as per as their catalytic activities and properties.

References

1. Dolai, S.; Bhunia, S.K.; Kluson, P.; Stavarek, P.; Pittermannova, A. Solvent-assisted synthesis of supramolecular-assembled graphitic carbon nitride for visible light induced hydrogen evolution - a review. *ChemCatChem* **2021**, *13*, 1-22.
2. Dolai, S.; Karjule, N.; Azoulay, A.; Barrio, J. Monomer sequence design at two solvent interface enables the synthesis of highly photoactive carbon nitride. *RSC Adv.* **2019**, *45*, 26091-26096.
3. Parmar, J.; Jang, S.; Soler, L.; Kim, D.P.; Sanchez, S. Visible light induced photocatalytic degradation of organic pollutants. *J. Photochem. Photobiol. C: Photochem. Rev* **2005**, *6*, 186
4. Dolai, S.; Barrio, B. J.; Peng, G.; Grafmüller, A.; Shalom, M. Tailoring carbon nitride properties and photoactivity by interfacial engineering of hydrogen-bonded frameworks. *Nanoscale* **2019**, *12*, 5564-5570.
5. Lui, W.; Zhang, Z.; Zhang, D.; Wang, R.; Zhang, Z.; Qiu, S. Synthesis of narrow-band curled carbon nitride nanosheets with high specific surface area for hydrogen evolution from water splitting by low temperature aqueous copolymerization to form copolymers. *RSC Adv.* **2020**, *10*, 28848-28855.