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Interfaces Against Pollution

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BOOK OF ABSTRACT

INTERFACES AGAINST POLLUTION

Optimization of the photoctalytic properties of g-C_3N_4 for environmental applications

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Abstract

Graphitic carbon nitride (g-CN) is a metal-free semiconductor gaining interest within the scientific community for its simple preparation, low cost, and photo-electrochemical properties.[1] Noteworthy, there is no clear consensus on its optimal synthesis due to the several parameters affecting it.[2] In views of standardizing the synthesis of this heterogeneous photocatalysts and optimize its properties for environmental applications, in this work, we have calcinated melamine at different temperatures within the range 350 – 650 °C under anoxic controlled atmosphere and in presence and absence of an aluminium cover to reduce or enhance melamine sublimation, respectively. Obtained materials were characterised by several techniques, and their photocatalytic performance evaluated as H_2O_2 generation and phenol oxidative degradation under UVA and visible light, respectively. Results indicated that under UVA light, the best performance was obtained with the g-CN prepared at 425°C with the aluminium cover, leading to 6 mM production of H_2O_2 in 3 h, as well as a 3.4×10^{-2} min^{-1} phenol oxidation rate with an initial concentration of 100µM. To correlate the obtained data (21 variables analysed for 10 types of g-CN) a PCA was carried out, indicating that to maximize the photocatalytic performance under UVA light irradiation, employed temperatures should not exceed the 500 °C, contrarily to what is currently reported. On the contrary, for visible light experiments, reduction of band gap by doping the g-CN with nitrogen (employing higher temperatures, thus, observing a higher polymerisation degree and a C:N ratio close to stoichiometric 3/4 value) is required as usually observed in other works.

This work intends to shed light into the basic properties of g-CN and into the correlation between its photocatalytic properties and its physico-chemical features, as well as to promote the use of UVA light in views of saving synthesis costs of this semiconductor.

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References

[1] Homem, V. et al., J. Environ. Management 2011, 92, 2304-2347.

[2] Van der Bruggen, B. et al., J. Membrane Sci 1999, 156, 29-41.

[3] Hahn-Godeffroy, J.D. et al., Ganzheitsmed - Swiss J. of Integrative Med. 2011, 23, 291-296.

[4] Wainwright, M. J. Antimicrobial Chemotherapy 2001, 47, 1-13.