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Challenging fine chemical synthesis: a photocatalytic approach

Abstract

The cost-effective and environmental-sustainable production of pharmaceutical ingredients, agrochemicals, nutrition components, flavors and fragrances gains increasingly importance in the present economy. In general, heterogeneous photocatalysis has been appointed as a promising alternate route for chemical synthesis of base chemicals for those applications. Compared to conventional processes, it has the enormous advantage of operating under mild temperature, exempted of using hazardous reagents and with the prospect of using new low energy consumption irradiation sources.

In the domain of semi-conductive carbon materials with photocatalytic activity, the graphitized carbon nitrides, with general formula g-C_3N_4 composed of C, N (and some minor H content), can be synthesized through solvent-free routes starting from C and N rich compounds. Due to its polymeric nature, it is possible to exert control over the surface chemistry via molecular-level modification and surface engineering. This material attracted attention of several authors since can be effectively activated by visible light excitation. The main bottlenecks for the application of g-C_3N_4 in photocatalytic processes are the low surface area and the fast recombination of electrons and holes upon photo-excitation [1].

In the present work, several strategies for boosting the photocatalytic performance of g-C_3N_4 will be described namely by noble metal loading, exfoliation (Fig. 1), heteroatom doping and combination with carbon materials. The obtained materials were used as catalysts for the oxidation of benzhyl alcohol and vanillyl alcohol into the respective aldehydes (benzhaldeyde and vanillin), due to the great importance of such chemicals in pharmaceutical and fragrance industries, and agriculture. UV-LEDs were used as high-efficient and low-cost radiation sources.

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References

[1] M.J. Lima, P.B. Tavares, A.M.T. Silva, C.G. Silva, J.L. Faria, Catalysis Today (2016), doi: 10.1016/j.cattod.2016.11.023

Figures

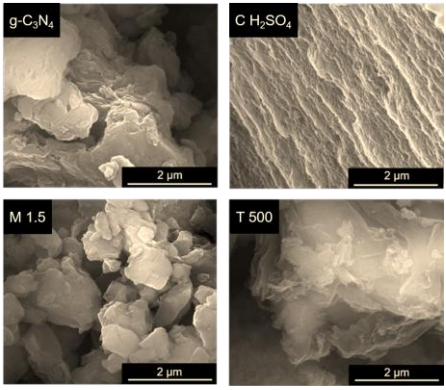

Figure 1: SEM images of bulk carbon nitride (g-C_3N_4) and the respective materials obtained after exfoliation by **C**hemical treatment using H_2SO_4, (C H_2SO_4), or **M**echanical with 1.5 h of ball milling (M 1.5), or **T**hermal at 500 ºC, (T 500).