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P72

Photocatalytic degradation of tartrazine using C-doped Cu-/Mo-based catalysts under solar irradiation

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Introduction

Considering the high potential of Cu- and Mo-based materials in optoelectronic applications [1,2], the objective of this study was to obtain C-doped Cu- and Mo-based catalysts for the degradation of tartrazine (*aka* yellow 5) -a dye commonly found in food derivatives- and then to optimize the catalyst load necessary for the total conversion of the dye. To attain this goal, a series of photocatalytic tests were performed with increasing catalysts loadings.

Experimental

The catalysts were prepared using a solvothermal method, and were calcined and pyrolyzed before its use. A kinetic adsorption study of the dye (Y5) was initially carried out in dark conditions until equilibrium was reached. Afterwards, the suspension was exposed to irradiation for 6 hours. The photocatalytic tests were carried out using an initial dye concentration of 5 ppm, and catalysts loading of 0.25, 0.5, 0.75 and 1 g/L.

Results, Discussion and Conclusions

The Cu-based catalysts showed up to 40% conversion of Y5, even for the low loadings; in contrast, the Mo-based ones displayed lower activity (ca. 10-20%) and presented an important lixiviation. The bimetallic Cu-Mo photocatalyst showed similar activity to that observed on Cu-based catalysts, but also suffered the lixiviation issues observed for the Mo-derived ones. The pyrolysis treatment enhanced the photocatalytic activity of the Cu-based materials, compared to calcination. The pyrolyzed Cu-based sample was the most active catalyst. For this material, total photodegradation of the dye was obtained after 5 hours irradiation for a loading of 1 g/L, and with an apparent constant rate of 7.3×10^{-3} min^{-1}. For the lowest loading, the apparent constant rate was 2.5×10^{-3} min^{-1}. Summarizing, it can be concluded that carbon-doped copper-based photocatalysts displayed good activity under solar irradiation for the degradation of yellow 5, whereas those based on molybdenum showed lower photocatalytic activity and a high lixiviation under our experimental conditions.

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