

Improves Photocatalytic Activity and Elimination of ZnO Photocorrosion by ZnO@GO Nanoparticles Formation

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Extended Abstract

The synthesis of catalysts modified for photocatalytic applications has been extensively studied. There are several preparation techniques, the main one being the sol-gel technique [1], others such as doping by calcination [2] or graphitizing by calcination [3,4], supported on activated charcoal [5,6], also are important in the synthesis of photocatalysts. All with the objective of improving photocatalytic properties such as expanding the range of photon absorption, adding surface acid groups or reducing the effect of photocorrosion, among others.

Three core-shell catalysts of zinc oxide coated with graphene oxide (ZnO@GO) were prepared and characterized from graphitized ZnO nanoparticles prepared by the technique described by Zhu et al. [3], from ZnO and glucose according to the 1:1; 1:2 and 1:3 mass ratio ZnO / glucose ratio. Graphene oxide (GO) exfoliated from graphite oxide (GtO) was obtained by strong oxidation using a strong mineral acid (conc. H₂SO₄) in the presence of an oxidizing agent (KMnO₄) (Hummers method) [7].

The characterization of the catalysts obtained was performed using various techniques such as XPS, SEM, X-ray diffraction, IR spectroscopy, as well as the determination of the isoelectric point, BET surface, among others. The photocatalytic efficiency and the percentage of ZnO photocorrosion were evaluated according to the film size of GO from the photocatalytic degradation of phenol.

As GO content increases in the samples, the ZnO surface area gradually increases. This fact can be noticed in the SBET values obtained (Table 1). The particle size of ZnO (~ 50nm) has not been affected by the hydrothermal process or by the subsequent impregnation method. There is no significant change in the band gap values as the content of GO increases (Table 1), this indicates that the presence of GO does not affect the electronic structure of ZnO.

Table 1. Surface and structural characterization for ZnO@GO composites.

Sample	BET (m ² /g)	Crystallite Size (nm)	Band gap (eV)
ZnO	4.391	51.2	3.25
ZnO@GO 1:1	10.25	51.2	3.28
ZnO@GO 1:2	17.09	50.9	3.24
ZnO@GO 1:3	23.11	51.6	3.27

From TEM images it can be inferred that the GO aggregates cover the large ZnO particles forming core-shell particles (Fig. 1). In addition, the contrast difference of the particles clearly confirms the presence of GO in a smaller amount with respect to ZnO. On the other hand, it can be observed that the ZnO aggregates are formed by small rounded particles of approximately 50 nm with a very homogeneous size distribution (Fig. 1). This fact is in agreement with the crystallite size calculated from XRD (Table 1).

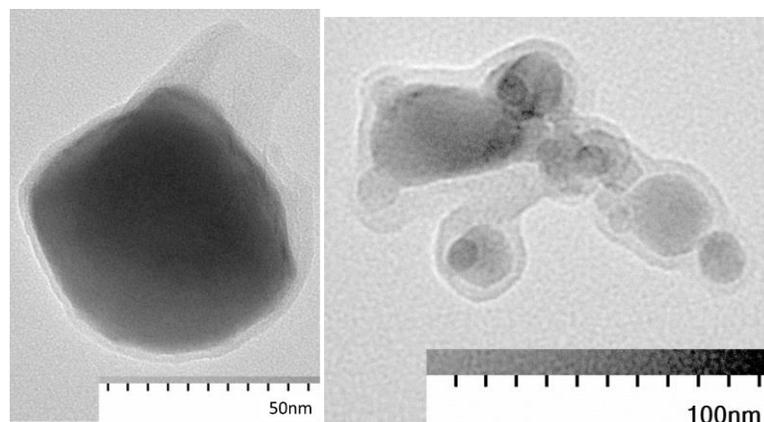


Fig. 1: TEM images ZnO@GO.

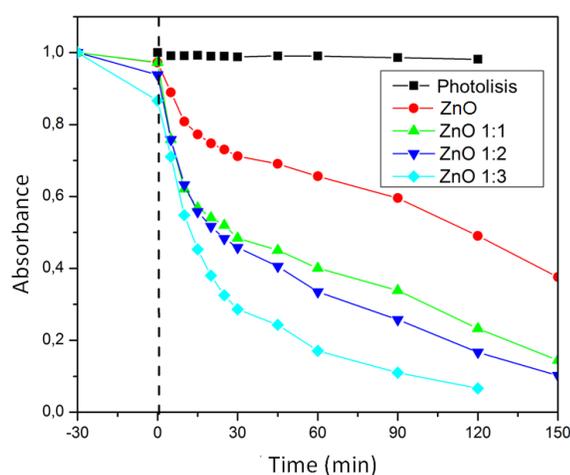


Fig. 2: ZnO@GO Photocatalytic profile.

The photocatalytic activity was determined by measuring the degradation of methylene blue (5ppm) in aqueous solution under UV irradiation. Figure 2 shows the increase in photocatalytic efficiency as the content of GO increases in the composition. By using 0.25 g of the ZnO 1: 3 catalyst, dye degradation achieve in solution was more than 80% after 60 min of irradiation.

The presence of GO layers could significantly suppress the ZnO photocorrosion under UV light irradiation, as well as the ZnO susceptibility to easy dissolution at low pH values. The photocatalytic activity of ZnO can also be improved because of improved adsorption capacity and the presence of hydrophilic functional groups. The photocatalytic activity is also increased by the effect of the increase in the rate of charge distribution in the crystalline structure of ZnO. The nanometric structure of ZnO was well conserved even after high temperature calcination due to the layer of carbon layers.

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