Data Article

Experimental data on synthesis and characterization of WO$_3$/TiO$_2$ as catalyst

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ABSTRACT

WO$_3$/TiO$_2$ is a composite photocatalyst that is being widely used in heterogeneous photocatalysis because it presents better photocatalytic properties than TiO$_2$. For example, the probability of recombination of the electron/hole pairs is diminished and a more range of the solar spectrum is used for its excitation. However, this depend of variables such as tungsten oxide concentration, calcination temperature and synthesis method. This work is focused in establish the effect of WO$_3$ on the morphological and structural characteristics of TiO$_2$. WO$_3$/TiO$_2$ was synthesized by sol-gel method at different calcination temperatures and at different concentrations of tungsten oxide. The surface area, the possible transition between valence band and conduction band, particle size, elemental analysis and crystallography were examined through the BET, DRS, SEM-EDS and XRD analysis.

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1. Data

Doping TiO$_2$ pretend to improve its photocatalytic performance, since even though it presents a great effectiveness in the degradation of recalcitrant compounds only it achieves its excite state by absorption UV energy, which correspond to 5% of solar spectrum. So more than 50% of visible radiation is being wasted [2,3]. Therefore, it is necessary the coupling of this catalyst with another compound or

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mixed oxides and characterize the properties of the new materials product of doping. In this case WO$_3$/TiO$_2$. Some physicochemical properties of titanium oxide and tungsten oxide are shown in Table 1.

2. Experimental design, materials and methods

Calcination temperature directly affects the crystalline structure of TiO$_2$. It was found that anatase phase presents a better photocatalytic performance than rutile phase [4], so in this work three calcination temperatures 500, 600 and 700 °C were evaluated. Another parameter for improving the photocatalytic activity of TiO$_2$ is the doping percentage by weight of WO$_3$, which favor the shift in the energy absorption toward visible light region. In this case it was varied in 1, 3 and 5% w/w.

2.1. General procedure

The synthesis of WO$_3$/TiO$_2$ photocatalyst was carried out by Sol-Gel methodology using Titanium (IV) n-butoxide, 98% ACROS (CAS RN 5593-70-4) and p-Tungstate ammonium, 99.99% Aldrich (CAS 11120-25-5) as precursors of the obtained materials [5].
In order to know the morphology and composition WO$_3$/TiO$_2$ photocatalyst samples, SEM and EDS analyzes were performed. The results are shown in Fig. 1 and Table 4 respectively.

XRD analysis was performed on samples calcined at 600 °C (Fig. 2) and 700 °C (Fig. 3) because at these temperatures the crystalline transition is achieved. JCPDS 21–1272 and JCPDS 21–1276 cards were used as patterns for the anatase phase and the rutile phase respectively.

The Fig. 4 shows the relationship between the Anatasa and Rutile phase on different catalysts synthesized.
Table 4
Elemental composition according to EDS analysis, given in percentage of element in the sample.

| Sample                  | O     | Ti    | W    |
|-------------------------|-------|-------|------|
| TiO₂ - 600 °C           | 43.27 | 56.73 |     |
| TiO₂ - 700 °C           | 47.28 | 52.72 |     |
| 1% WO₃/TiO₂ - 600 °C   | 44.29 | 54.82 | 0.89 |
| 1% WO₃/TiO₂ - 700 °C   | 43.07 | 56.05 | 0.88 |
| 3% WO₃/TiO₂ - 600 °C   | 43.09 | 54.27 | 2.64 |
| 3% WO₃/TiO₂ - 700 °C   | 38.76 | 58.54 | 2.71 |
| 5% WO₃/TiO₂ - 500 °C   | 51.08 | 44.08 | 4.84 |
| 5% WO₃/TiO₂ - 600 °C   | 41.91 | 52.95 | 5.14 |
| 5% WO₃/TiO₂ - 700 °C   | 36.77 | 58.46 | 4.78 |

Fig. 1. SEM for WO₃/TiO₂ materials. (a) TiO₂-600 °C, (b). TiO₂-700 °C, (c). 1% WO₃/TiO₂-600 °C, (d). 1% WO₃/TiO₂-700 °C, (e). 3% WO₃/TiO₂-600 °C, (f). 3% WO₃/TiO₂-700 °C, (g). 5% WO₃/TiO₂-500 °C, (h). 5% WO₃/TiO₂-600 °C, (i). 5% WO₃/TiO₂-700 °C.
Fig. 2. Diffractograms obtained from samples synthesized from WO$_3$/TiO$_2$ calcined at 600 °C (Anatase) and R (Rutile).

Fig. 3. Diffractograms obtained from samples synthesized from WO$_3$/TiO$_2$ calcined at 700 °C A (Anatase) and R (Rutile).
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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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