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Photocatalytic Degradation of Oxalic Acid in Water by the Synthesized Cu-TiO_2 Nanocomposites

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Abstract

TiO_2 is the most commonly used photo catalyst because of its high oxidation power, stability and non toxicity. Cu-TiO_2 nanocomposites were prepared using the solution impregnation method. After characterization for crystalline phase and particle size by XRD analysis, both the commercially procured TiO_2 and synthesized Cu-TiO_2 nanocomposites were used as photo catalyst in the photo- degradation of Carboxylic Acids (Oxalic Acid). The degradation of oxalic acid in the presence of pure TiO_2 and synthesized Cu-TiO_2 was done. The effective photo-degradation was found in case of oxalic acid in the presence of Cu-TiO_2 as compared to pure TiO_2.

Introduction

In many recent reports, the TiO_2 photo catalytic characteristics are to be greatly enhanced, which is largely due to the advent of nanotechnology and the progress made in the synthesis and characterization of nanostructured Titania. Nanoparticles of TiO_2 are mainly of interest for their, electrical optical and chemical properties.[1-8] At nanoscale not only the surface area of TiO_2 particles increases, but also it inhibits other effects on optical properties and size quantization.[9-12] An increased rate of photocatalytic reactions, when nanostructure Titania is used as photocatalysts, has been thus attributed to the increase in the redox potential as the size decrease.[13-15] TiO_2 is a excellent photocatalyst because the Photodegradation process occurs under ambient conditions, the oxidation of most organic substrates to CO_2 is complete and it is inexpensive and remain quite stable in contact with different substrates[16-17].

Methodology

Synthesis and Characterization

In this method suitable quantity of commercially obtained TiO_2 was dispersed in an alcoholic solution of Copper Acetate. The dispersion was agitated continuously for 4 hours at the elevated temp. (Just below the Boiling Point of Alcohol). After treatment the residue was sintered for 1 hour in air at 400°C. The obtain material was characterized by XRD for the phase and particle size determination.[18]

Photodegradation

In this study using TiO_2 and synthesized Cu-TiO_2 nanocomposites as photocatalyst. The photocatalytic degradation of oxalic acid was investigated. A solution of oxalic acid in water was prepared and in this solution suitable quantity of Photocatalyst was dispersed. The dispersion (reaction medium) was subjected to UV visible illumination for varying duration and residual concentration was determined by spectrophotometrically.[19-21]

Results and Discussion

In the XRD analysis shown in the figure1and 2 the observed peak is analyze phase whereas major peaks at 2 θ. Angle 25.2, 37.2, 48.3 and 55.4 corresponds to Anatase phase whereas major peak at 2 θ angle.

26.9, 28.2, 42.6 and 54.2 indicates the presence of rutile phase, and in Cu- TiO_2 decrease in peak inten-

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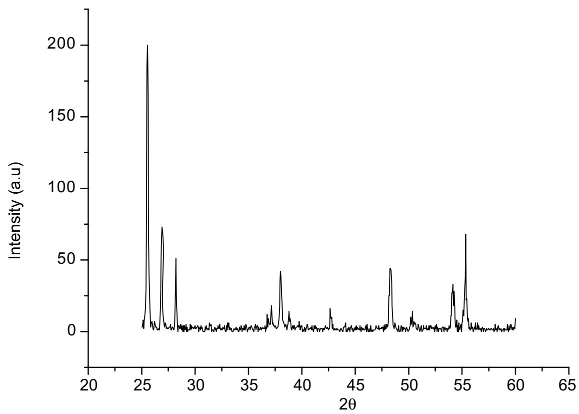

Fig. 1: Observed XRD pattern of TiO_2 (Merck)

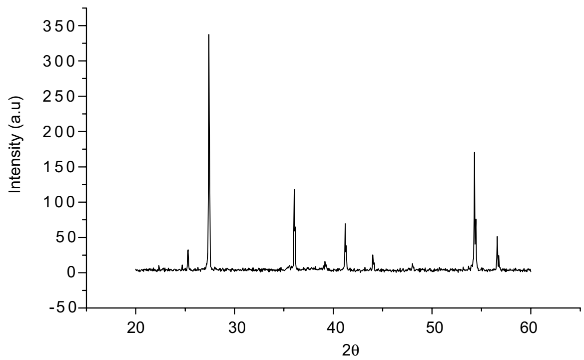

Fig. 2: Observed XRD pattern of Cu-TiO_2

Table 1: Photodegradation of oxalic acid using commercially and prepared photocatalyst

Reaction Time (min)	Oxalic acid concentration $\times 10^3$ (M)		
	†	*	**
0	**5.2**	**5.2**	**5.2**
60	**5.2**	**4.6**	**1.9**
120	**5.2**	**4.1**	**1.4**
180	**5.2**	**3.9**	**1.2**
240	**5.2**	**3.1**	**0.8**

*Without Photocatalyst
**Using TiO_2 as Photocatalyst
***Using Cu- TiO_2 as Photocatalyst

sity compared to TiO_2 but ever the observed some originally observed TiO_2 peaks.

The obtained yield of prepared nanocomposites of Cu- TiO_2 was more than 90% of the expected theoretical yield. This is due to decrease in crystallinity grain fragmentation and partial amorphization and particle size of TiO_2 and Cu- TiO_2 was 72 and 16 nanometer respectively.

Photodegradation of Oxalic Acid

The photodegradation of different concentration of oxalic acid are shown in Table 1. The prominent degradation of oxalic acid was found in two hours study in presence of Cu- TiO_2 in comparison to the commercially obtained TiO_2.

Conclusion

In this study, photocatalytic degradation of Carboxylic Acid namely oxalic acid was investigated. The measured values of residual concentration of Carboxylic Acid (oxalic acid) in the reaction mixture at different times of illumination (or reaction) have been shown in Table 1 and Fig. 1, 2. It is clear from the results shown that both TiO_2 and Cu- TiO_2 are proving as an effective photocatalyst for the degradation. However Cu- TiO_2 seems to be more effective as photocatalyst for the degradation of Oxalic Acid.

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