photocatalytic activity of prepared MWCNT/ ZnO nanocomposite

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Abstract

The photocatalytic decomposition of Brilliant green (BG) dye under several conditions was studied using MWCNT/ZnO nanocomposite. Nanocomposite were prepared via utilizing a hydrothermal process the properties of the MWCNT/ZnO nanocomposite were studied using techniques (FESEM, and EDX). The most important factors affected the photocatalytic process were studied, like mass of MWCNT/ZnO nanocomposite, concentration of Brilliant green (BG) dye, light intensity. The results showed that the photolysis process was low at first and then increased with time. From the results, the photocatalytic decomposition efficiency increased with the surface weight MWCNT/ZnO nanocomposite of (0.1-0.4) g. also showed that with an increase BG dye concentration, the photolysis efficiency decreased, and showed that the photolysis efficiency was improved by increasing the light intensity.

Keyword: Dye, Brilliant green, Nanocomposite, Photocatalytic, light intensity.

Introduction

The decolonization of textile water is an important issue during the past two decades, not because of its toxicity as dyes, but also its effect on the life of marine organisms and its impact on the beauty of the aquatic environment. As most of the industrial waste pours into the water and wastewater plants, and the most dangerous of them is liquid waste, which constitutes 50% of the dyes in the liquid waste, and this is considered one of the most important problems resulting from industries that threaten the environment [1-3]. Therefore, the photocatalytic process that involves semiconductor particles and semiconductor photo catalyst under illumination Ultraviolet light may be useful and useful in the treatment of industrial waste discharged into water and wastewater plants [4, 5].

Textile dyes, which contain inorganic and organic compounds, and all these dyes are toxic and dangerous and constitute a major concern for the ecosystem, aquatic life, microorganisms, and humans. Therefore, many methods have been used to remove these dyes from wastewater[3, 6-11]. The most important of these are Methods, advanced oxidation processes (AOPs) are of great interest in the purification of water from dyes. Dyes are usually destroyed in the presence of semiconductor photo catalysts (ZnO , Co3O4, TiO2, CdS, WO3) an active light source and an oxidizing agent like air or oxygen[12-15].

In this research, a surface MWCNT/ZnO nanocomposite was prepared by the hydrothermal method, and several factors were studied, including BG dye concentration, surface mass, and effect of light intensity.

Experimental Part

Preparation of MWCNT/Zinc Oxide Nanocomposite

Nanocomposite were prepared via utilizing a hydro-thermal process (Scheme (1)). 5 g of Oxalic acid , 5 g of zinc acetate, and MWCNT was acquired from the refinery of bakery factories , added about 0.05 g were maxed for 15 minute, then completed to distills water 100 mL then mixed for 20 minute to get a slurry solution. The resultant mixtures were kept for 24 hr at 160 oC in autoclave. The obtained grayish white precipitate was filtered, washed several times with DW, and dried at 60 oC for 12 hr to yield a fine powder [16].

Experiments of the photo catalytic:

The photocatalytic activity of the MWCNT/ZnO nanocomposite catalyst was estimate via the degradation of BG dye. All experiments carry out in a 250ml beaker. The reaction beaker was placed under ultraviolet light, taking into account the distance between the surface of the solution and the light source. Before each test, to obtain accurate results, the lamp is heated for ten minutes. Therefore, a weight of 0.3 g of MWCNT/ZnO nanocomposite was added to BG dye solution with a capacity of 200 ml , and the experiment was initially conducted for (10) minutes known as the so-called adsorption.

Effect of several factor like quantity of (0.1–0.4 g L^{-1}), BG dye concentration (20–80 mgL^{-1}) , The PDF% of BG and apparent rate first order constant were estimation in equation 1:

$$PDE\ (\%) = (A_0 - A_t)/A_0\ x\ 100 \qquad (1)$$

Where, A^o : Primary Concentration and At concentration of photolysis (mgL^{-1}) .

Results and discussion:

Characterization

Image FESEM shows ZnO NPs in a pattern of small balls lined with each other as shown in Figure 1 (a). Micrographs of MWCNT show that the surface is rough and contains irregular clusters as in the Figure1 ((b)) and the MWCNT/ZnO nanocomposite surface It has large, coarse, irregular particles, and also results from spherical clusters resulting from zinc oxide loading as show in Figure 1 (c). EDX of MWCNT/ZnO nanocomposite as show in Figure 1 (d) [17-19].The nano-composite having C, O, and Zn, which indicates the existence of zinc oxide on to MWCNT/ZnO nanocomposite. highest and lowest values of the elements that existed in the modified MWCNT /ZnO by 76.0 wt.% and10.8 wt.% [20, 21].

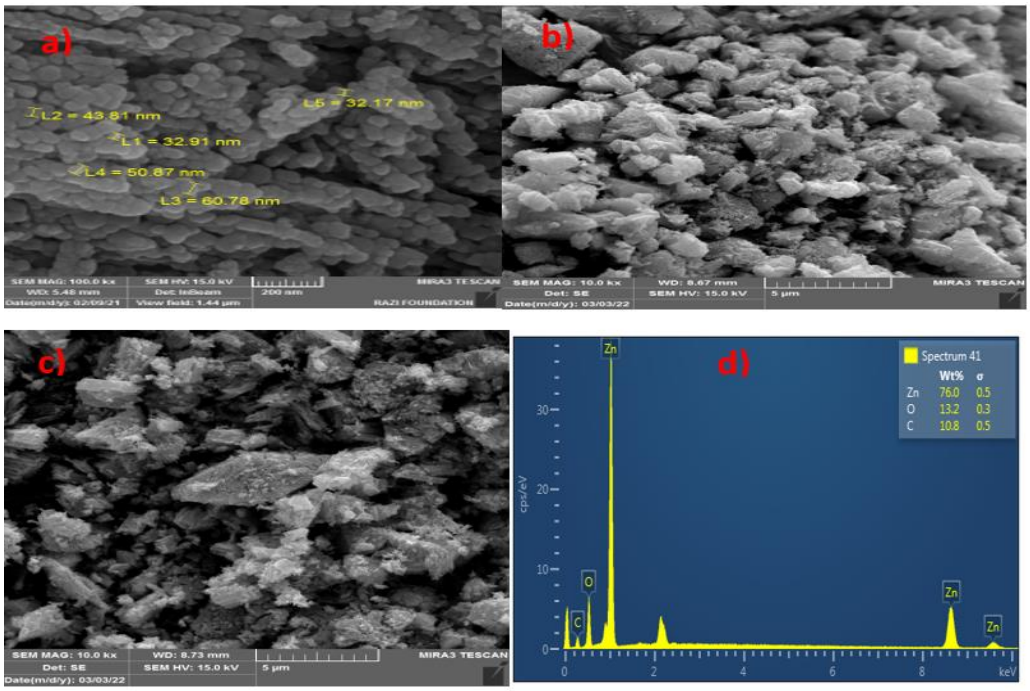

Figure 1: FESEM a) ZnO NPs , b) MWCNT ,c) MWCNT/ZnO nanocomposite ,d) EDX of MWCNT/ZnO nanocomposite.

Effect of mass dosage

The effect of the photo catalyst about (0.1-0.4 g) on the photo catalytic degradation of BG dye was studied at primary concentration of BG dye 50 mg/L, light intensity (1.7 mW/Cm2), and pH 6.8 . The experimental result could be analyzed assume-first order kinetic[22, 23] as appear in Fig. 2.

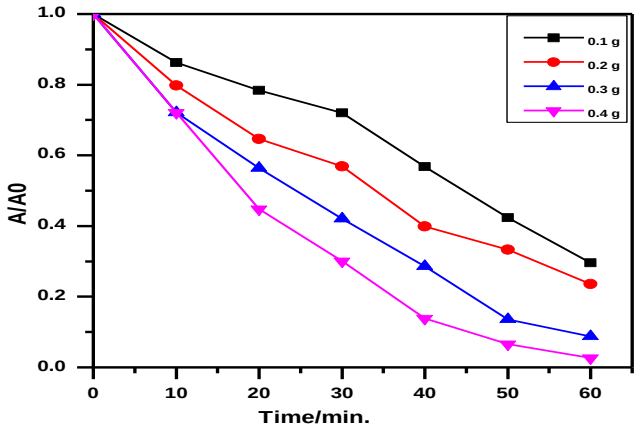

Figure 2: Photo catalytic degradation of BG at several weight MWCNT/ZnO nanocomposite.

Effect of BG dye concentration

The influence of concentration of BG dye has been studied at pH 6.8, mass of MWCNT/ZnO nanocomposite 0.3g , light intensity 1.7 mW/cm2 , and concentrations of BG dye (20- 80 mg/L) [24]. The investigational result could be analyzed to assume-first order kinetic as appear in Fig. 4

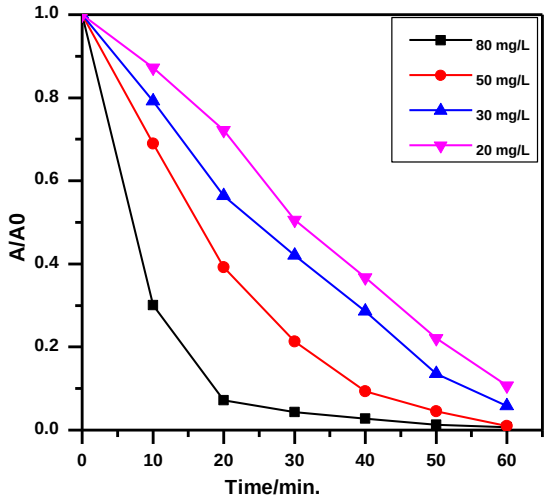

Figure 4: Effect Photo catalytic degradation by MWCNT /ZnO at several concentration

light intensity (L.I.)

The light intensity effect about (2.3-1.3 mW/cm2) was observed via variable of distance among source light and exposed MWCNT/ZnO nanocomposite surface. Photo degradation of BG dye via the light intensity effect was investigation in the presence of 0.3 g of MWCNT/ZnO nanocomposite, concentration of BG dye 50 mg//L, and pH 6.8 .It was that found wholly reactions still follow the first order kinetics as appear in Fig. 6. The photo degradation capacity rise when light intensity increase. It probably deduced, the rise of light intensity caused to excited particles of MWCNT/ZnO nanocomposite to lead to hole pair electron. and photo catalysis at low light intensities (1.3 mW.cm-2), decrease because of low light intensity reactions involving formation hole electron are predominant and hole electron re-combination is negligible [25, 26].

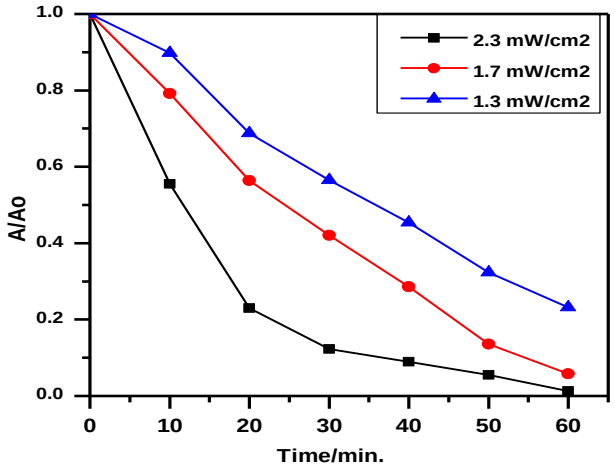

Figure 6: Effect Photo catalytic degradation at different light intensities (L.I.).

Conclusion

1- MWCNT/ZnO nanocomposite was prepared by the hydrothermal method.

2- The best Photo degradation of BG dye via the light intensity effect was investigation in the presence of 0.3 g of MWCNT/ZnO nanocomposite , concentration of BG dye 50 mg//L ,and pH 6.8 .

3- The photocatalytic decomposition efficiency increased with the surface MWCNT/ZnO nanocomposite and the best rate of photocatalytic degradation at 0.3 g from MWCNT/ZnO

4- The photocatalytic decomposition efficiency decreased with the increase BG dye concentration.

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