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Preparation and Photocatalytic Application of F-MWCNTs/Ag-Co nanoparticles

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Abstract: This The MWCNTs/Ag-Co oxide nanoparticles are employed for photodegradation of Congo red dye in aqueous medium. Morphological study shows that nanoparticles are well deposited upon F-MWCNTs surface and EDX conform the specific bimetallic NPs on MWCNTs surface. The photodegradation study shows that the fresh MWCNTs/Ag-Co degraded about 90% dye within 75 min while the recovered photocatalyst degraded 64.01% within the same irradiation time. The effect of other parameters like catalyst dosage, and dye concentration was also studied.

Keywords- *Nanoparticles, Congo Red, Mwcnts, Photodegradation*

I. INTRODUCTION

The coloring materials (dyes/pigments) are the chief pollutants in waste water come from leather, textile and other industries. These pollutants from waste water or environment can be removed by different methods like electrochemical method, ozone oxidation, coagulation by chemical agent, adsorption and chemical precipitation. The various problems that associated with a fore mentioned methods are high cost, some procedure may generate secondary waste materials which are harmful to aquatic lives. Hence, efficient other methods are required for removal of pollutants from waste water [1, 2]. Recently, photodegradation technique is commonly which not only remove the toxic substances but also convert them into simplest molecules. During photodegradation, the breakdown of hazardous materials take place into simple and non-toxic fragments because of the presence of photocatalyst and light exposure. When photocatalysts (semi-conducting materials) is expose to light, they activated by the absorption of photon and as a result photodegradation reaction [3]. The semi-conductor photocatalysts (mainly metallic particles) are efficiently decomposes the pollutants into biodegradable compounds and then converts them into CO2 and water [4].

Various types of metal and metal oxides nanoparticles used as photocatalysts for the degradation of toxic materials like TiO2 nanoparticles for methyl orange [5], graphene/cobalt-manganese oxides for neutral red chloride dye [6], TiO2/ZrO2 nanocomposites for methyl orange [4], γ-Bi2MoO6 nanoplate for rhodamine B and methylene blue [7], divanadium pentoxide nanoparticles for toluidine blue O [8].

In this study, MWCNTs/Ag-Co nanoparticles were synthesized by reduction method. MWCNTs/Ag-Co was used for degradation of Congo red dye in aqueous medium. The MWCNTs were used as a support for nanoparticles material because nanotubes have the capacity to store and carry e− in order to separate h+/e− pairs [9].

II. METHODOLOGY

A. *Synthesis of MWCNT/Ag-Co NPsT*

100 mL of AgNO3, CoCl2.6H2O and nanotubes were taken in flask and then NaOH added drop wise and refluxed at 70 oC for 2 h. The mixture was cooled, filtered, washed with water and dried. The obtained MWCNTs/Ag-Co NPs were stored.

B. *Photodegradation study Methodology*

The MWCNTs/ Ag-Co are added separately to 10 ml of congo red dye (80 ppm) in vial. The samples were placed under UV-light light and stirred for specific irradiation time. The photocatalyst is separated from dye solution using centrifugation. The degradation study of dye was carried out by UV–Vis spectrophotometer.

III. RESULTS AND DISCUSSION

Figure 1 shows the SEM image of MWCNTs/ Ag-Co NPs, which depict that the both metals are synthesized succuflly. Both types of nanoparticles are found on the nanotube surfaces. The synthesis of Ag-Co nanoparticles were also verified by EDX. Figure 2 shows the EDX spectrum of CNTs/Ag-Co nanoparticles, which show that Ag, Co and Carbon present in large amount.

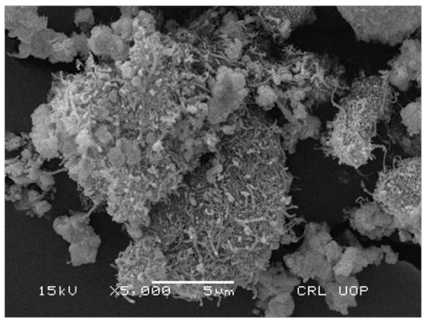

Fig. 1. SEM image of CNTs/Cu-Ti nanoparticles

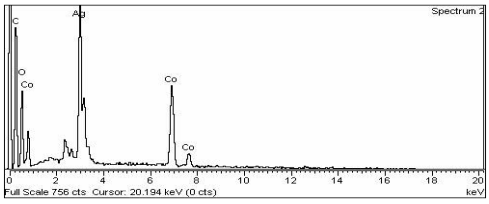

Fig. 2. EDX spectrum of MWCNTs/Ag-Co

Figure 3 shows the UV/vis spectra of Congo red before and after UV-irradiation using MWCNTs/Ag-Co. The UV-Vis spectra depicted that the degradation of congo red increases as increasing the irradiation time. Figure 4 demonstrates the %degradation of dye in aqueous medium. The results show that more than 80% of dye degraded in 1 h using MWCNTs/Ag-Co photocatalyst. The degradation of Congo red occur b/c when the photocatalyst expose to UV light,

electrons (e−) in photocatalyst (metal) get excited from the valence band to conduction band, and create positive hole (h+). The e− in the conduction band might be trapped by O2 molecule and thus create the reactive superoxide anion radical. While h+ might react with water molecule & present hydroxyl radicals (·OH). Both these radicals are very reactive to photodegradation of pollutants [6].

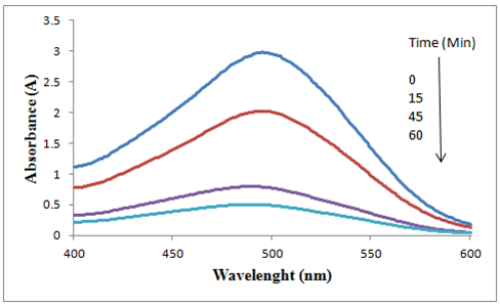

Fig. 3. EDX UV-Visible absorption spectrum of Congo red vs. time using MWCNTs/Ag-Co

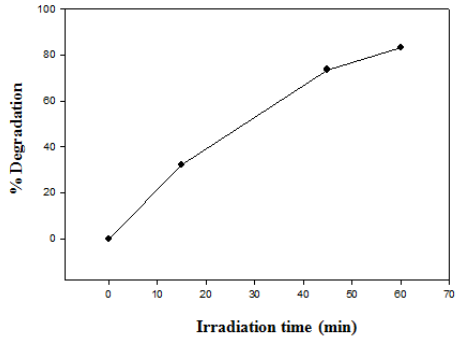

Fig. 4. UV-Visible %degradation of Congo red vs. time using MWCNTs/Ag-Co

Figure 5 presents the %degradation of Congo red, which was photodegraded by MWCNTs/Ag-Co. The %degradation study shows that 0.07-0.35 g photocatalysts degrades about 54 to 90%. The increase photodegradation with increase the quantity of MWCNTS/Ag-Co may be due to absorption of high quantity of photons. As by additional increase in photocatalyst quantity, the solution opacity leadings increases, which decrease the photon penetration, and as result the rate of photodecomposition decreases [10].

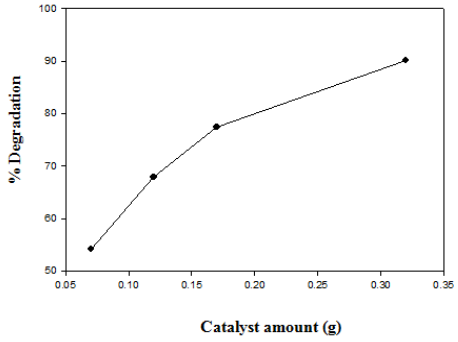

Fig. 5. Effect of photocatalyst dosage on the degradation Congo red dye

The concentration effect of dye (60, 80, and 100 ppm) on photodegradation rate at fixed catalyst amount, temperature and irradiation time was also studied. Figure 6 illustrate the % degradation of congo red as degraded by CNTs/Ag-Co particles. The data present that at low initial congo red concentration photodegradation rate are high while at higher congo red concentration the degradation of dye is decreased. The result also depicted that at 100 ppm CNTs/Ag-Co degraded about 85 % dye while the degredation was decreased to 83 and 73% as increased the congo red concentration (80 and 100 ppm, respectively).

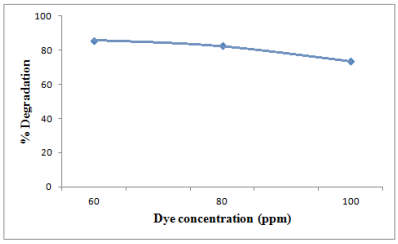

Fig. 6. Effect of dye concentration on the degradation Congo red dye

CONCLUSION

It is concluded that the nanoparticles were appeared/synthesized on the surfaces of nanotubes. The SEM micrograph presented that the nanoparticles were present in dispersed as well as agglomerated form. The photodegradation study presented that the synthesized catalyst is effective against the congo red degradation and about 90% of dye was degraded within 1 hour. The basic pH is more favorable for the congo red photodegradation.

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