

ABSTRACT

Extensive researches have been devoted on visible light response photocatalysts towards degradation of organic pollutants and dye solutions present in the industrial effluents. Apart from the conventional TiO_2 and ZnO photocatalyst, the copper based CuO and CuS have been explored largely as photocatalysts due to their high visible light absorption and less recombination but their industrial applications were limited due to the poor structural stability. In the recent past years, As an alternate to the simple copper oxide and sulphides the copper based spinel and thiospinel systems were developed. These ternary transition metal oxides and sulfides AB_2X_4 ($\text{X} = \text{O}, \text{S}$) referred as spinels and thiospinels have attracted interest among the researchers owing to its interesting optical, electrical and magnetic properties. Owing to the presence of mixed oxidation state in the system it provides more stability, electronic conductivity and enhanced photo response than simple metal oxides and sulphides. Especially copper based spinels and thiospinels such as CuCr_2O_4 , CuFe_2O_4 , and CuCo_2S_4 were developed and very sparsely utilized in the process of photocatalysis. In this work, we prepared different types of copper based spinel and thiospinel composites and evaluated its photocatalytic activity for various pollutants removal in visible light range.

In this work we synthesized copper based spinel and thiospinel nanocomposites by simple synthesis methodology for improved structural and chemical stability for superior photocatalytic performance. The various synthesized composites were subjected to basic characterization studies such as XRD, FT-IR, SEM, TEM, UV-DRS, XPS. The model pollutants such as

methylene blue, rhodamine B, tetracycline were degraded by the copper spinel and thio spinel composites to evaluate its photocatalytic activity.

First, We have developed $\text{CuCo}_2\text{S}_4/\text{g-C}_3\text{N}_4$ nanocomposite using D-penicillamine as sulphur source by simple hydrothermal method and evaluated its photocatalytic activity towards methylene blue(MB) dye degradation and to enhance few commercial aspects we constructed magnetically recoverable $\text{CuCo}_2\text{S}_4/\text{GO}/\text{Fe}_2\text{O}_3$ and Fe_3O_4 ternary composites by a simple hydrothermal method and applied as a fenton type catalyst towards rhodamine-B (RhB) dye degradation. In copper spinel system, We synthesized metal organic framework (MOF) derived $\text{CuCr}_2\text{O}_4/\text{CuO}$ composite as an efficient photocatalyst towards the pharmaceutical effluent tetracycline and then prepared porous magnetic type CuFe_2O_4 cubes from metal organic framework for the photocatalytic degradation of RhB dye.

All the four different copper based spinel and thiospinels were successfully synthesized and the composites showed enhanced photocatalytic degradation under the visible light irradiation owing to facile synthesis methodology, structural modification and morphological feature compared with earlier available reports. These copper spinels and thiospinels prepared by various synthesis methodologies proved to be very efficient for water treatment and might be helpful for various other environmental remediation purposes also.