Synthesis, crystal structures and photocatalytic study of coordination polymers constructed from tetracarboxylate ligand.

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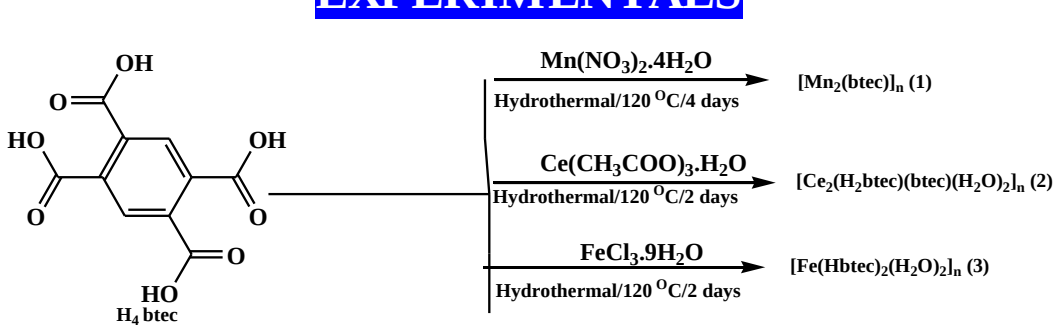
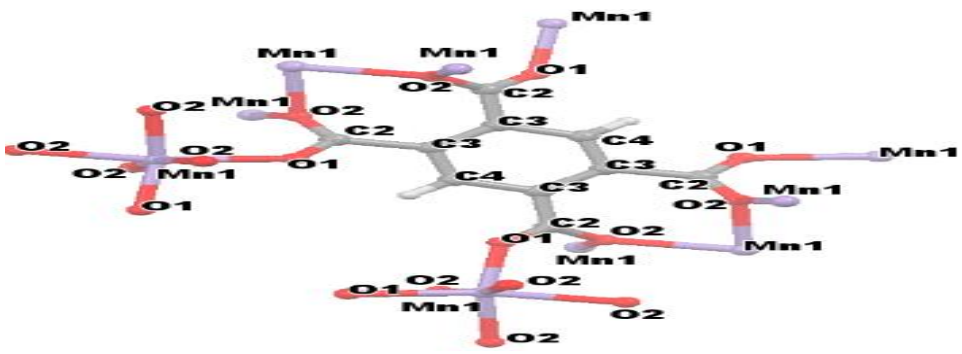
INTRODUCTION

Sustainable clean water supply is of great interest in the world as water is important to life and the whole ecology. Discharge of pollutants through wastewaters is a threat to wellbeing, and so efforts should be made for efficient remediation of pollutants after being produced from industrial activities. Advances in supramolecular chemistry with the development of coordination polymers (CPs) have opened up opportunities for diverse applications such as photocatalytic degradation of toxic pollutants. Coordination polymers are infinite arrays of metal centres connected via organic linkers. The LMCT transition obtainable as a result of the presence of organic linkers and transition metals has made CPs applicable in this area.

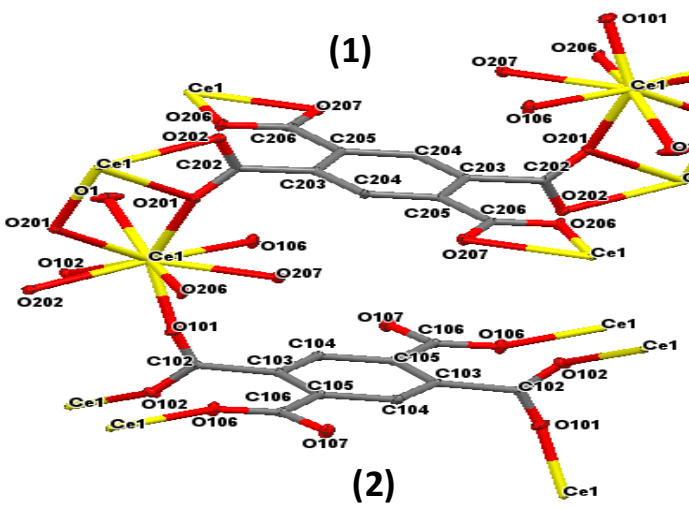
EXPERIMENTALS



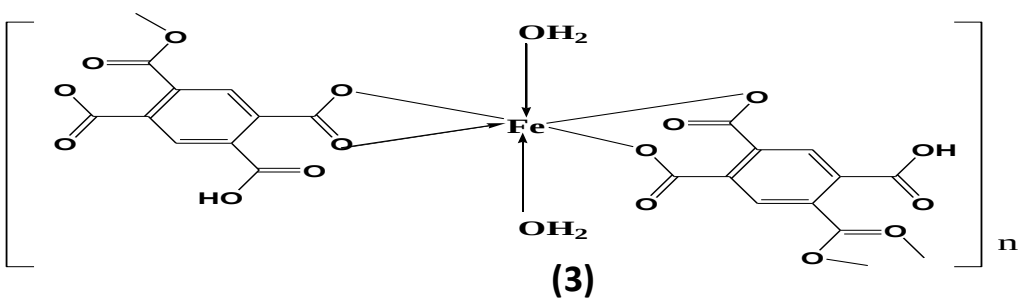
Results and discussions: (1) and (2) were obtained as single crystals, (3) was obtained in crystalline powder. They were characterized using elemental analysis, FT-IR, XRPD, TGA, UV-VIS and X-ray in order to know their structural composition. The structures of (1) and (2) were confirmed by single crystal X-ray analysis while that of (3) was proposed based on the other characterization techniques



(1)



(2)



(3)

PHOTOCATALYTIC ACTIVITY

Photocatalytic degradation of methylene blue dye was carried out under solar irradiation using benign H_2O_2 as the electron acceptor. Using the three compounds and PC50, (3) shows the highest photoactivity in the degradation of MB solution, with complete degradation achieved after 120 minutes.

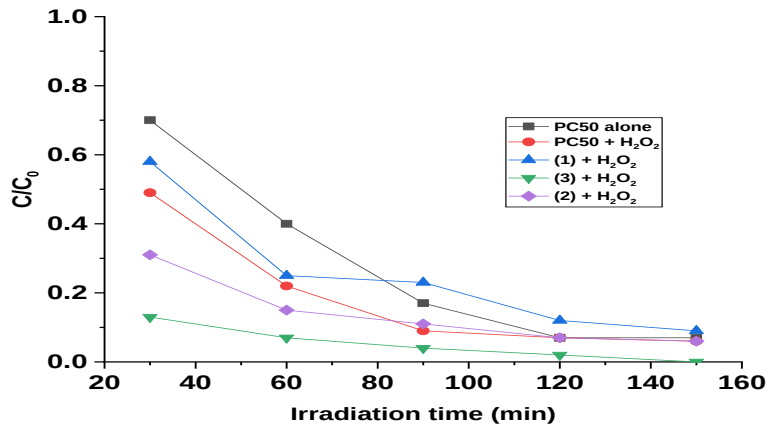


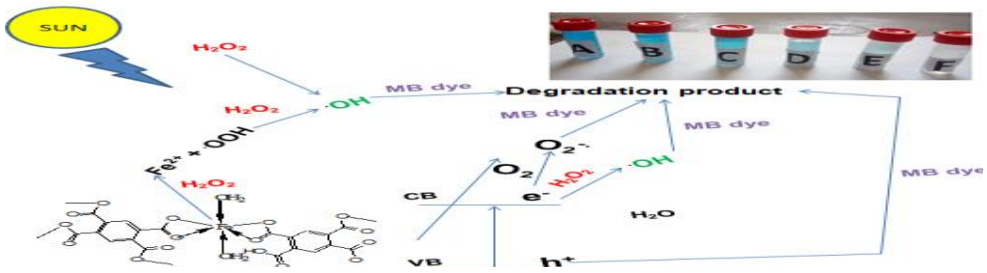
Fig: Degradation efficiency of the photocatalysts and PC50

DEGRADATION MECHANISM

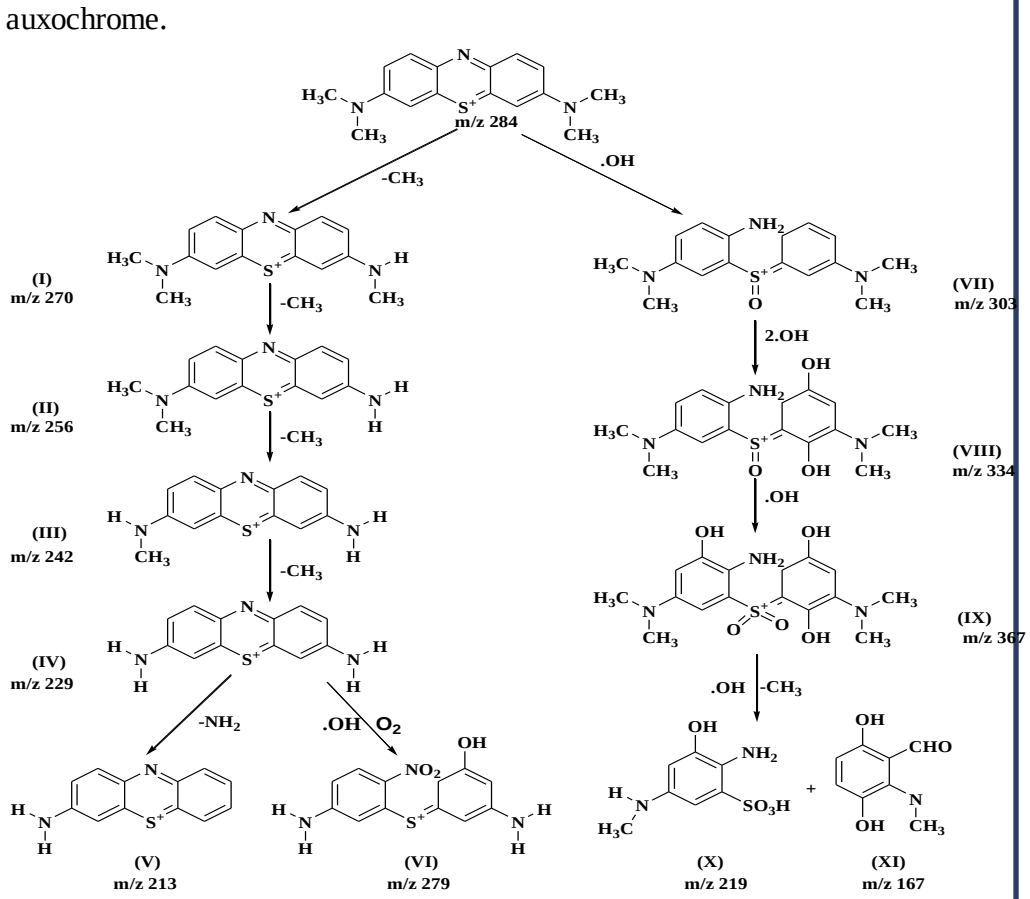
Active specie trapping experiment led to the deduction that holes, superoxide and hydroxyl radicals were involved in the reaction. The better degradation efficiency of (3) than (1) and (2) could be due to the generation of additional hydroxyl radical by H_2O_2 decomposition through the Fenton-like reaction.

$$Fe(III) + H_2O_2 \xrightarrow{\cdot} Fe(II) + HO\cdot_2 + H^+$$

$$Fe(II) + H_2O_2 \longrightarrow Fe(III) + \cdot OH + OH^-$$



Reaction Intermediates: LC-MS analysis of the degraded MB dye solution shows that the degradation of MB dye follows two different pathways – first, degradation of the chromophores, and secondly, the degradation of the auxochrome.



CONCLUSION: The synthesized CPs were effective for the photocatalytic degradation of MB dye.

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