Supporting information

Sustainable synthesis of AFe_2O_4 (A= Mg, Zn, Mn) catalysts: comparing the photooxidative and electrochemical properties towards organic dyes detection and degradation

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Characterization. Phase configuration of the synthesized catalysts is identified using Bruker AXS D8 advance instrument X-ray diffractometer though CuKα radiation (λ = 1.5405Å) at 30 kV and 15 mA with 2θ ranging from 10°-80° at room temperature. Perkin Elmer spectrometer is employed to record Fourier transform infrared spectra in the range of 400-4000 cm^{-1} using KBr as the reference standard. Magnetic characterization through *M–H* curves are considered from VSM measurements of the samples using vibrating sample magnetometer (Lakeshore VSM 7407) with a magnetic field of 2.5 T. Diffused reflectance spectroscopic studies are supported by JASCO V-750 UV/VIS spectrometer operated in the range of 200–800 nm. The surface morphology and the elemental composition of the synthesized samples are reviewed utilizing field emission scanning electron microscopy (F E I Quanta FEG 200) and high resolution (HR) transmission electron microscopy (H-7600, Hitachi-Japan) operating at 200 kV. Barrett-Joyner-Halenda (BJH) and Brunauer-Emmet-Teller (BET) method using Quantachrome® ASiQwin™ instrument are employed to obtain the pore size distribution and surface area. CHI 1211C Electrocatalytic work station is functional to carry out the electrochemical measurements in three electrode cells, as well as differential pulse voltammetry. Here, the modified GCE (surface area = 0.072 cm^2), saturated Ag/AgCl and Pt wire are active as working, reference and counter electrodes, respectively.

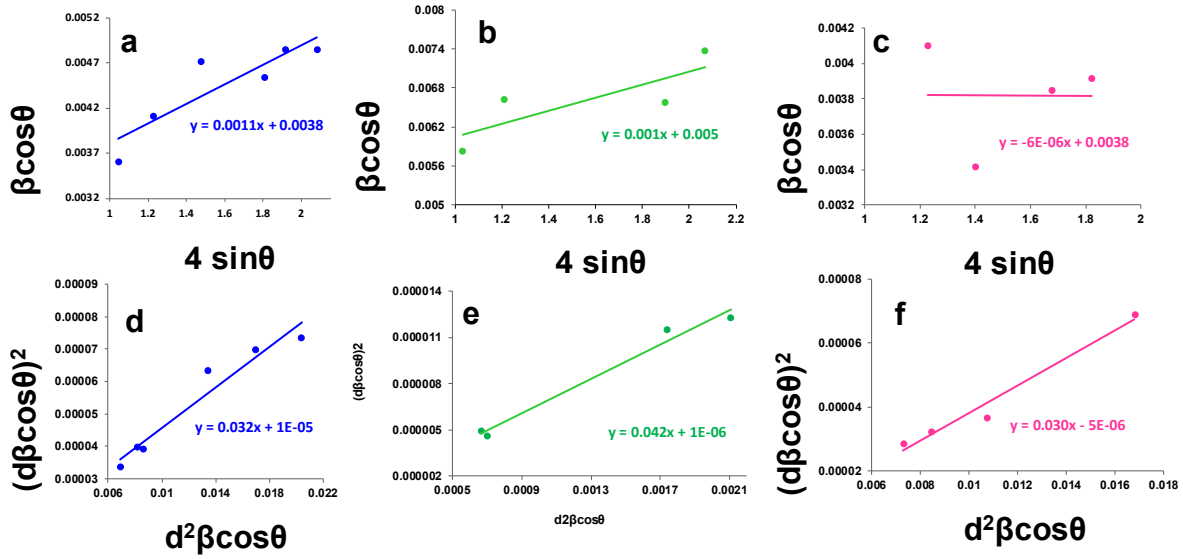


Figure S1. The plots of W-H method for (a) MFM, (b) ZnFM, (c) MnFM and SSP of (d) MFM, (e) ZnFM, (f) MnFM nanoparticles.

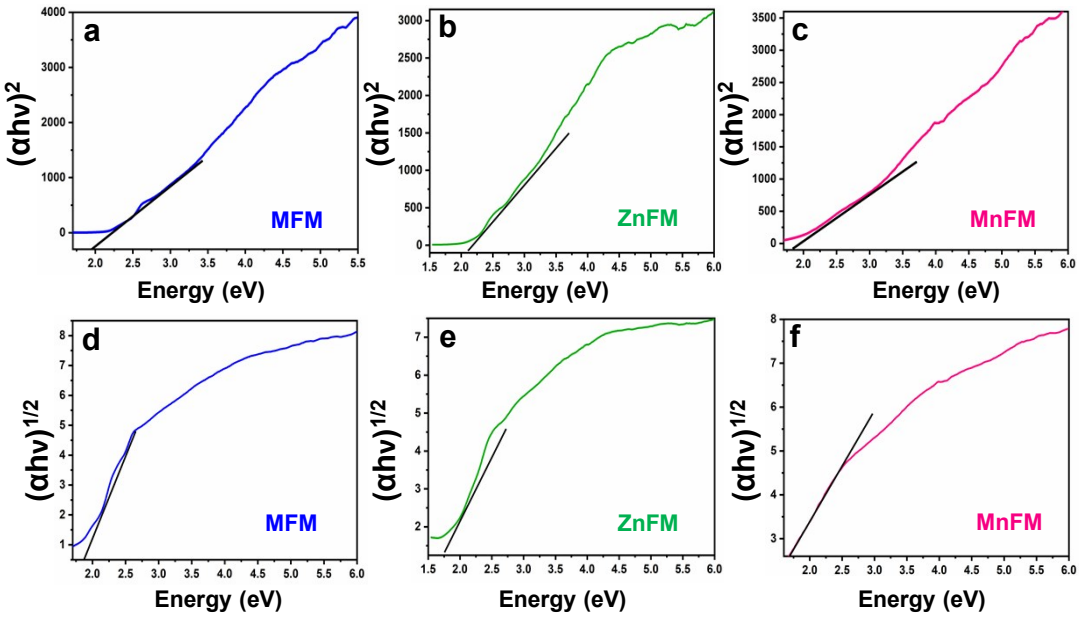


Figure S2. (a-f) Tauc plots containing direct transitions and indirect transitions of MFM, ZnFM and MnFM nanoparticles, respectively.

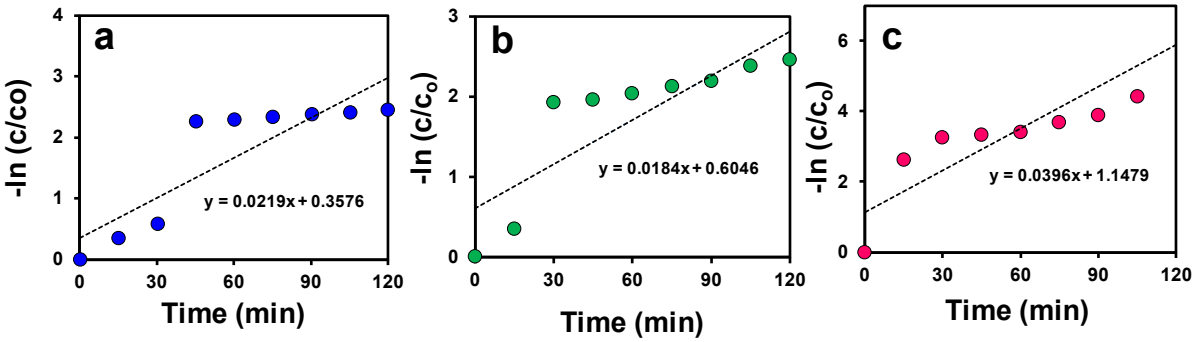
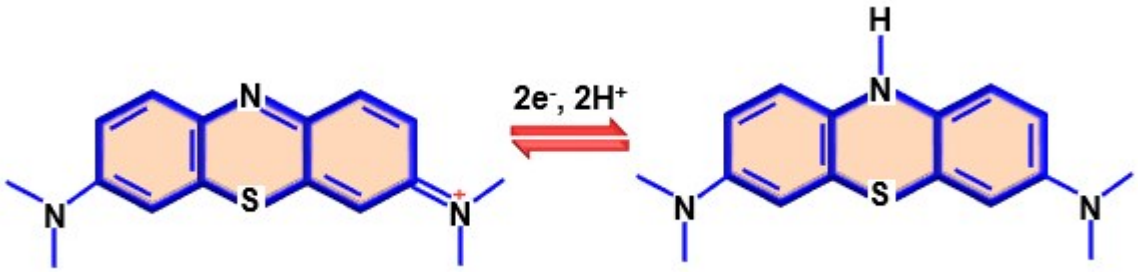


Figure S3. Photo-kinetics of (a) MFM, (b) ZnFM and (c) MnFM spinels.



Scheme S1. Electrochemical oxidation-reduction reaction mechanism of methylene blue

Table S1. Comparison of Analytical Values for the Determination of MB at MnFM Modified Electrode with Different Analytical Methods.

Methods	Working Range (μM)	LOD	Sensitivity ($\mu A\ \mu M^{-1}\ cm^2$)	Ref.
UV	0.31–28.5	-	-	S1
UV	0.63–21.9	0.19 μM	-	S2
DPV	0.01-1.1	3.9 nM	-	S3
CV	1-14	0.4 μM	-	S4
DPV	**0.1-9.6**	**9 nM**	**4.42**	**This work**

REFERENCES

S1. Bélaz-David, N., Decosterd, L.A., Appenzeller, M., Ruetsch, Y.A., Chioléro, R., Buclin, T. and Biollaz, J., 1997. Spectrophotometric determination of methylene blue in biological fluids after ion-pair extraction and evidence of its adsorption on plastic polymers. *European journal of pharmaceutical sciences,* 5(6), pp.335-345.

S2. Razmara, R.S., Daneshfar, A. and Sahrai, R., 2011. Determination of methylene blue and sunset yellow in wastewater and food samples using salting-out assisted liquid–liquid extraction. *Journal of Industrial and Engineering Chemistry,* 17(3), pp.533-536.

S3. Hassan, S.S., Nafady, A., Solangi, A.R., Kalhoro, M.S., Abro, M.I. and Sherazi, S.T.H., 2015. Ultra-trace level electrochemical sensor for methylene blue dye based on nafion stabilized ibuprofen derived gold nanoparticles. *Sensors and Actuators B: Chemical,* 208, pp.320-326.

S4. Tonlé, I.K., Ngameni, E., Tcheumi, H.L., Tchiéda, V., Carteret, C. and Walcarius, A., 2008. Sorption of methylene blue on an organoclay bearing thiol groups and application to electrochemical sensing of the dye. *Talanta,* 74(4), pp.489-497.