Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Electronic Supplementary Information

Fe_3O_4 Embedded ZnO Nanocomposites for Removal of Toxic Metal Ions, Organic Dyes and Bacterial Pathogen

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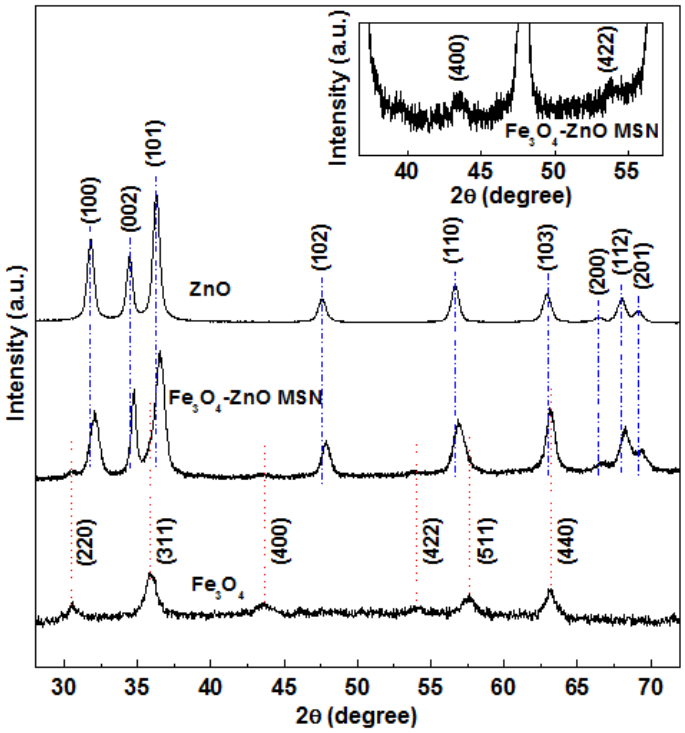

Fig. S1. XRD patterns of the Fe_3O_4, ZnO, and Fe_3O_4-ZnO MSN. Inset shows the expanded XRD pattern of Fe_3O_4-ZnO MSN revealing (400) and (422) planes of Fe_3O_4.

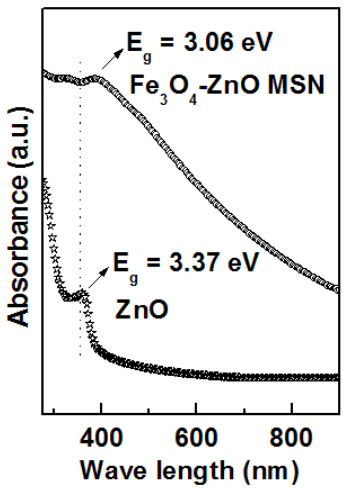

Fig. S2. UV-visible absorption spectra of ZnO and Fe_3O_4-ZnO MSN.

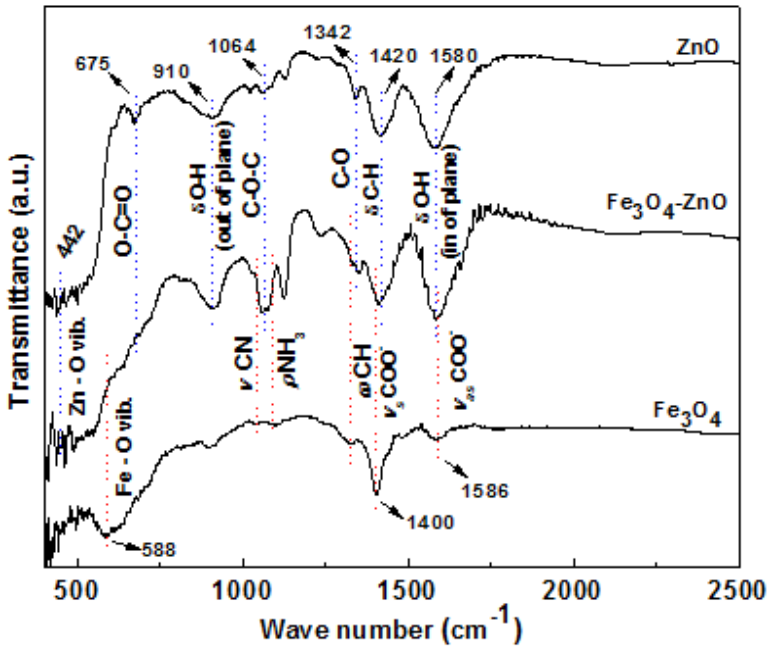

Fig. S3. FTIR spectra of ZnO, Fe_3O_4 and Fe_3O_4-ZnO MSN with their corresponding peak assignments. The bands appeared at 1580 and 910 cm^{-1} in FTIR spectra of ZnO are due to in and out of plane of O-H stretching vibration, respectively. The absorption bands appeared at 675, 1064 and 1420 cm^{-1} in ZnO can be ascribed to O-C=O vibration, C-O-C vibration and C-H bending modes, respectively. The peak appeared at 422 cm^{-1} and 588 cm^{-1} corresponds to vibrational modes of Zn-O and Fe-O, respectively. The band observed at 1400 and 1586 cm^{-1} in FTIR spectra of Fe_3O_4 corresponds to symmetric and asymmetric stretching modes of COO^- group. It has been observed that the important characteristic vibrational bands of Fe_3O_4 and ZnO are appeared in the FTIR spectra of Fe_3O_4-ZnO MSN with a slight shifting and/ or broadening band).

The results clearly suggest the presence of Fe_3O_4 and ZnO in Fe_3O_4-ZnO MSN.

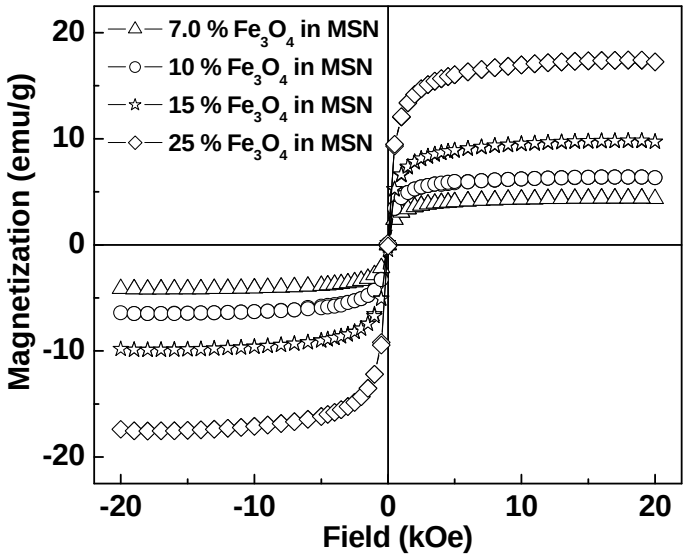

Fig. S4. Room temperature field dependence of magnetization (M *vs*. H) plot of Fe_3O_4-ZnO MSN containing different wt. % of Fe_3O_4 nanoparticles.

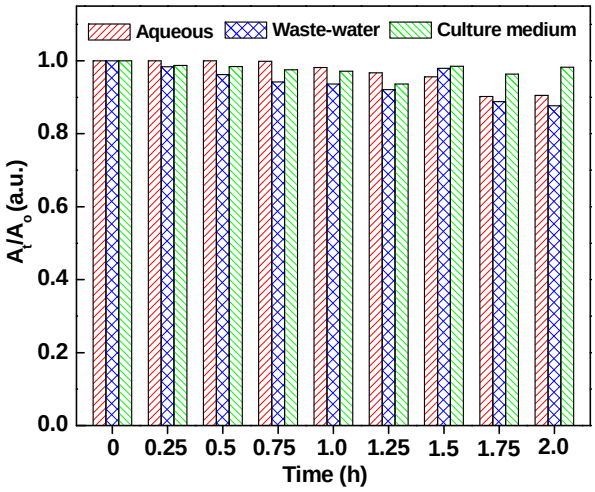

Fig. S5. Normalized UV absorbance (A_t/A_o) vs. time plot of Fe_3O_4 - ZnO MSN (1.0 mg/ml) at wavelength of 370 nm in aqueous, waste-water and culture media (A_t = absorbance at time 't' and A_0 = absorbance at t_o). The insignificant change in absorbance of nanocomposite suspensions in aqueous, waste-water and bacterial culture media (1.0 mg/ml) indicates their good colloidal stability. Furthermore, the light scattering intensity and polydispersity index of MSN suspensions hardly varies with time (as observed from DLS measurements) revealing their excellent colloidal stability.

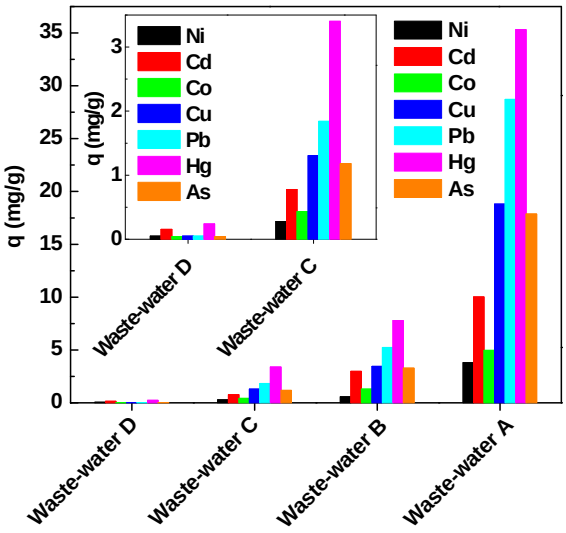

Fig. S6. The equilibrium adsorbed concentration, q (mg/g) of metal ions obtained after treating different waste-water with 50 mg of Fe_3O_4-ZnO MSN. Inset shows the results for waste-water C and D in expanded scale.

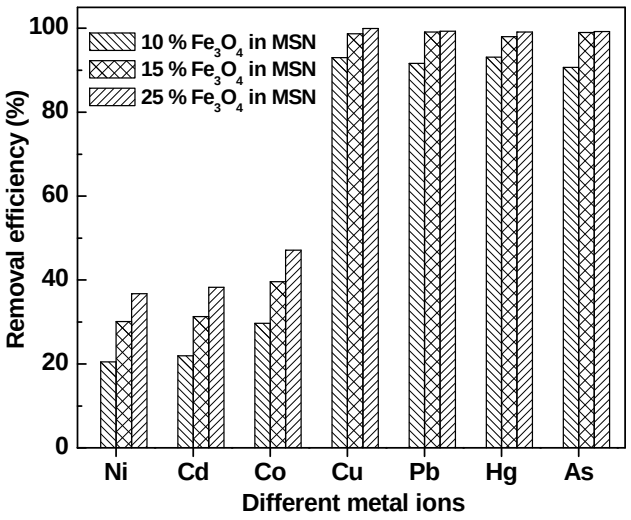

Fig. S7. Removal efficiency of metal ions by 50 mg of Fe_3O_4-ZnO MSN having 10, 15 and 25 wt. % of Fe_3O_4 (Fe_3O_4 nanoparticles prepared with different amounts of Fe_3O_4 nanoparticles).

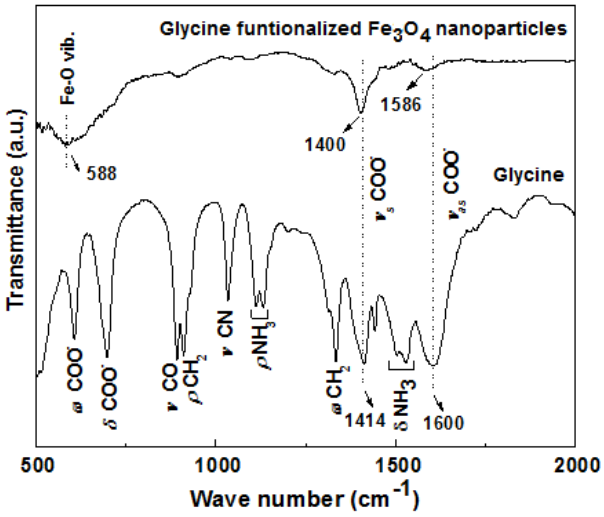

Fig. S8. FTIR spectra of glycine and glycine functionalized Fe_3O_4 nanoparticles with their corresponding peak assignments (Most of the vibrational modes corresponding to pure glycine are observed in FTIR spectrum of glycine functionalized Fe_3O_4 nanoparticles. The shifting of symmetric (ν_s) and asymmetric (ν_{as}) stretching modes of COO^- group from 1414 to 1400 cm^{-1} and 1600 to 1586 cm^{-1}, respectively upon functionalization of Fe_3O_4 clearly suggest the chemisorptions of glycine onto the Fe_3O_4 through carboxylate group, leaving freely exposed amine groups).

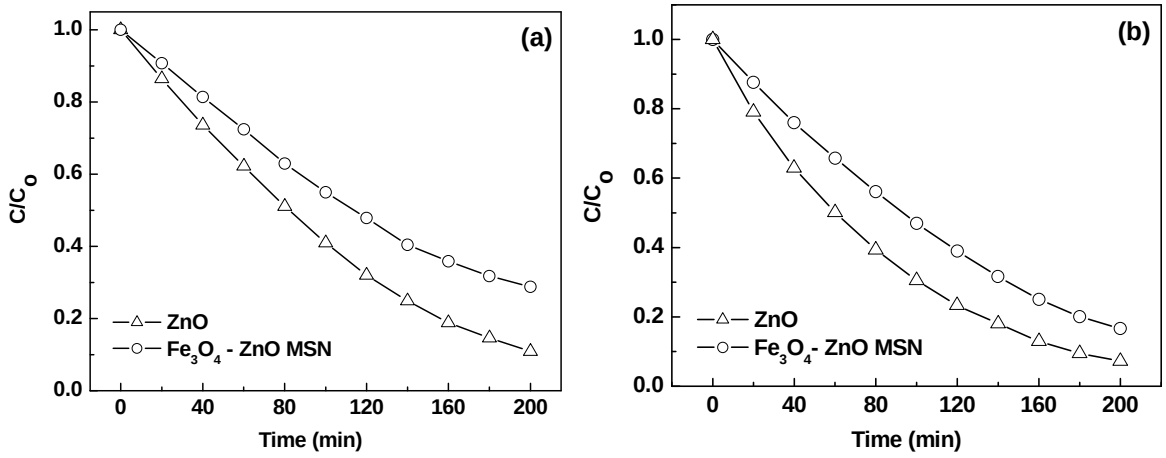

Fig. S9. Photodegradation of (a) MO and (b) RhB in the presence of Fe_3O_4-ZnO MSN under UV irradiation.

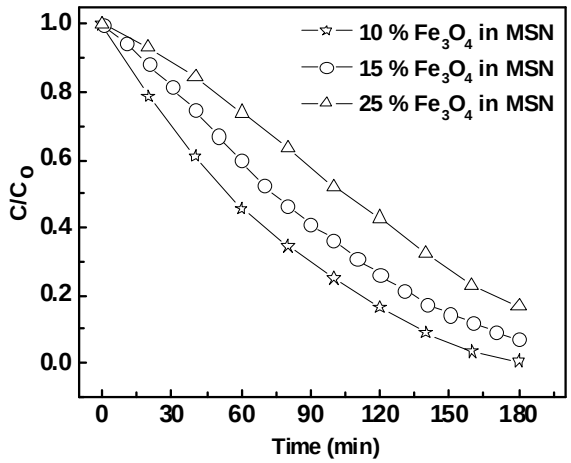

Fig. S10. Photodegradation of MB under UV irradiation in presence of Fe_3O_4-ZnO MSN having 10, 15 and 25 wt. % of Fe_3O_4 (MSN prepared with different amount of Fe_3O_4 nanoparticles).

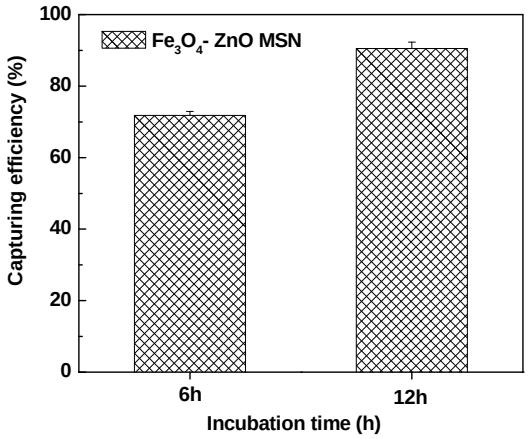

Fig. S11. Capture efficiency of *S. aureus* by 0.4 mg/ml of Fe_3O_4-ZnO MSN at different incubation time.