Supplementary Information

Effect of Speciation Transformation of Manganese on Aggregation and Deposition of Graphene Oxide

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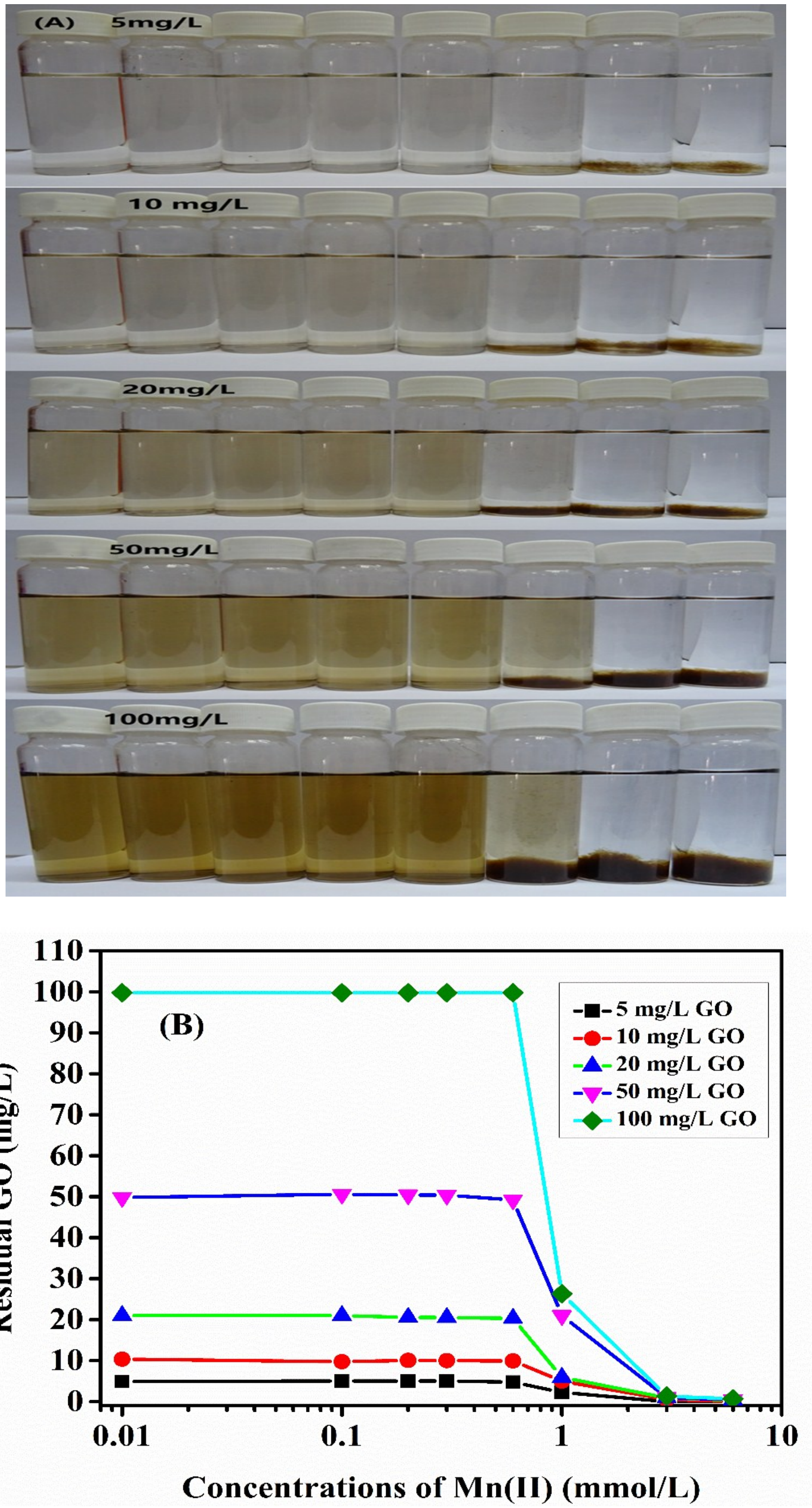
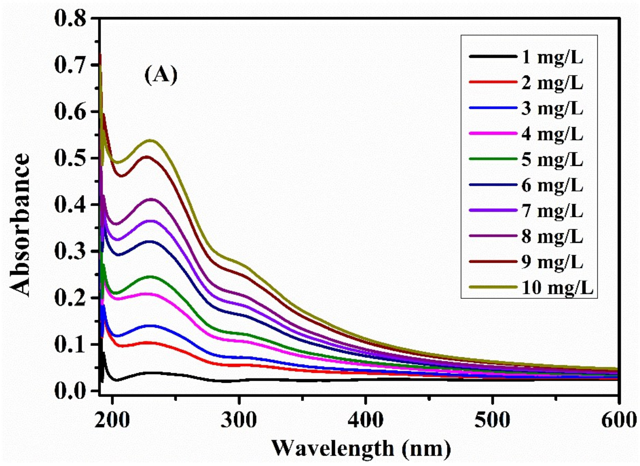


Fig. S1 (A) Optical images of GO aggregation tests with GO concentration from 5 to 100 mg/L in the presence of different Mn(II) concentration. (B) Concentrations of residual GO flakes in the supernatant as a function of Mn(II) concentration. pH of solution was fixed 7±0.1.

UV-vis Absorption Spectroscopy of GO at Different GO Concentrations

The absorbance of different concentrations of GO was determined by UV-vis spectrophotometry (Agilent 8453, USA). The UV-vis absorption spectroscopy results for GO as a function of GO concentrations are presented in Fig. S2. The optimum wavelength of GO was determined to be 230 nm (Fig. S2A). An $R^2 > 0.99$ for the calibration curve of GO at 230 nm suggested that the GO absorbance results can be directly correlated to their concentrations (Fig. S2B).



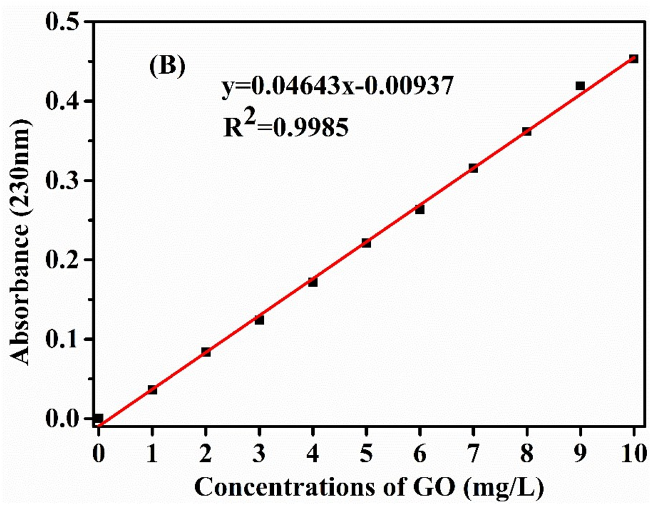


Fig. S2 UV-Vis absorption spectra of GO and standard curve at absorbance of 230 nm.

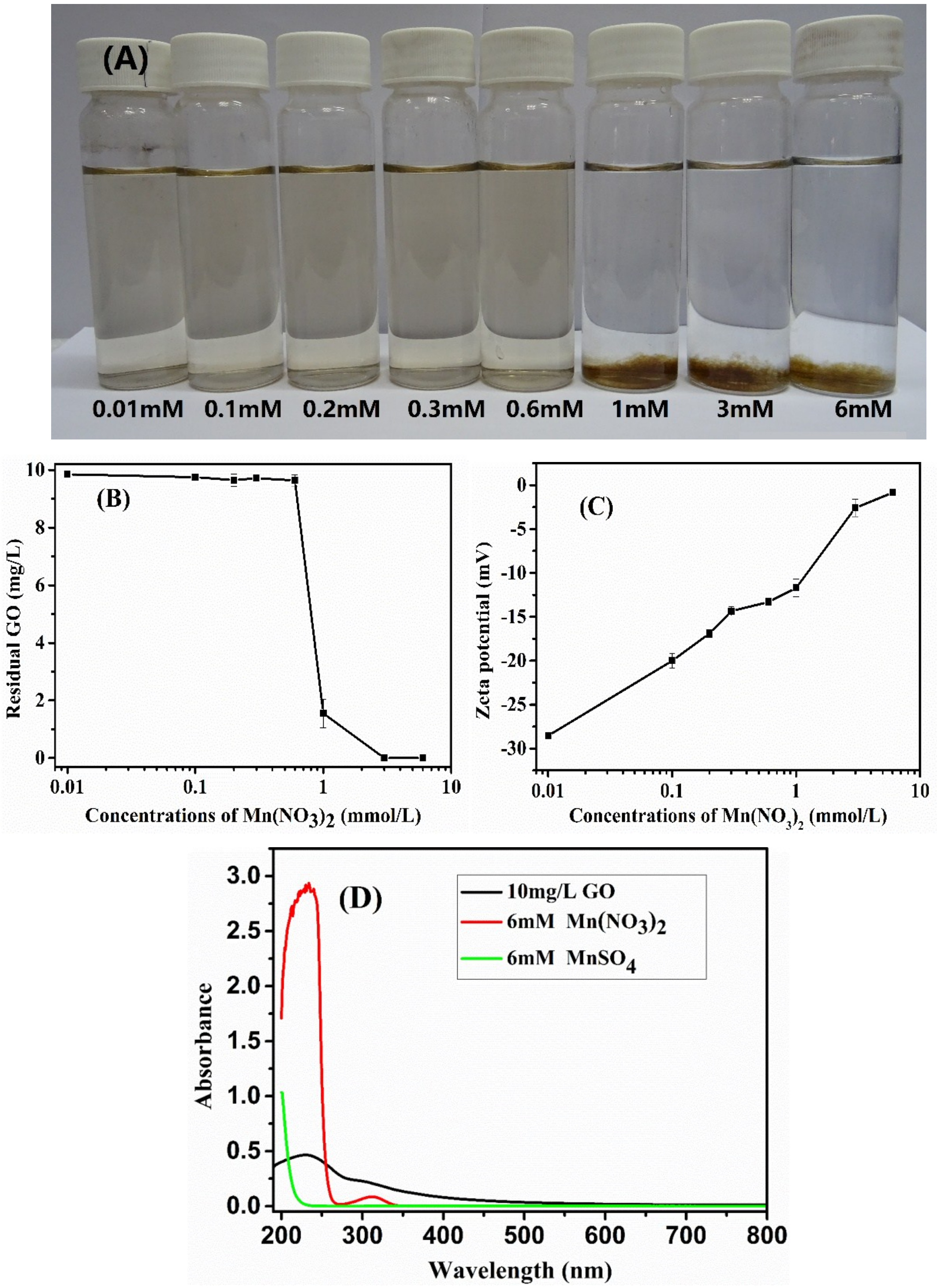


Fig. S3 (A) Optical images of GO in the presence of different $Mn(NO_3)_2$ concentration. (B) Concentrations of the residual of GO in the supernatant as a function of $Mn(NO_3)_2$ concentration. (C) Zeta potentials of GO as a function of $Mn(NO_3)_2$ concentration. (D) Wavelength scanning spectra of GO, $Mn(NO_3)_2$ and $MnSO_4$, pH=7.0±0.1, $C_{(GO)initial}$=10 mg/L.

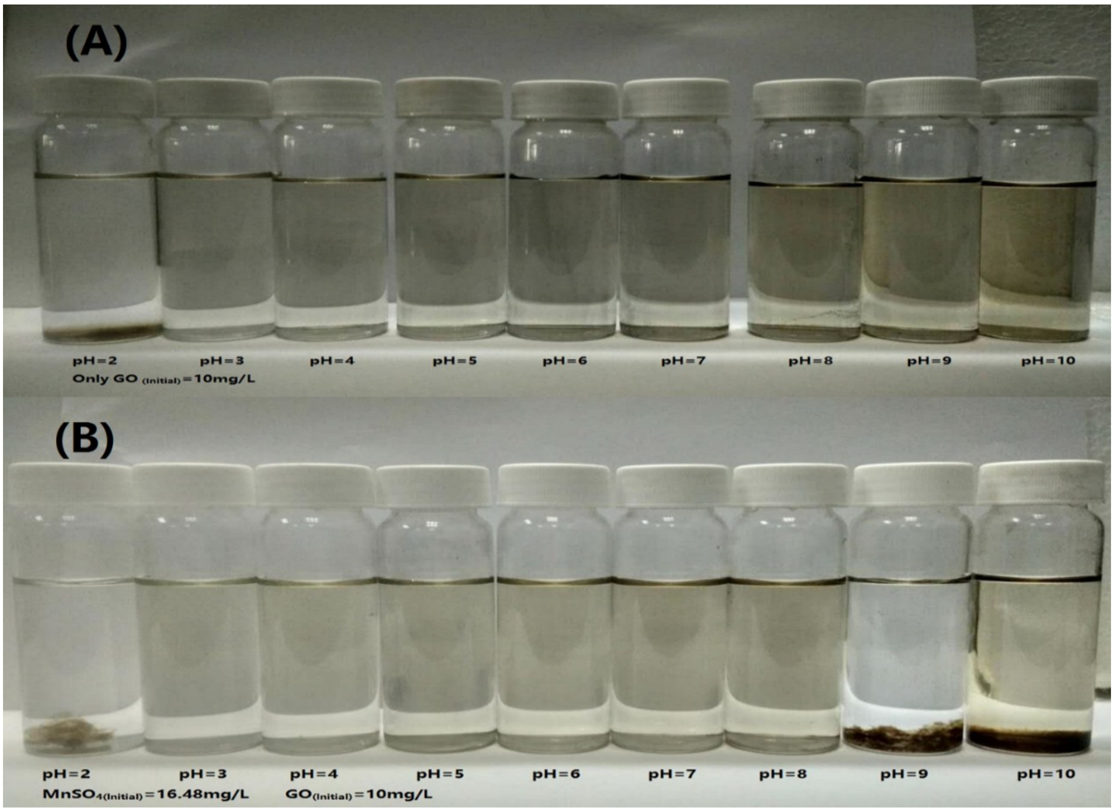


Fig. S4 (A) Optical images of only GO at different pH conditions. (B) Optical images of GO with addition 0.3 mM Mn(II) at different pH conditions, I=0.005 mol/L NaCl (NaCl was served as an electrolyte in order to adjusting pH of solution)

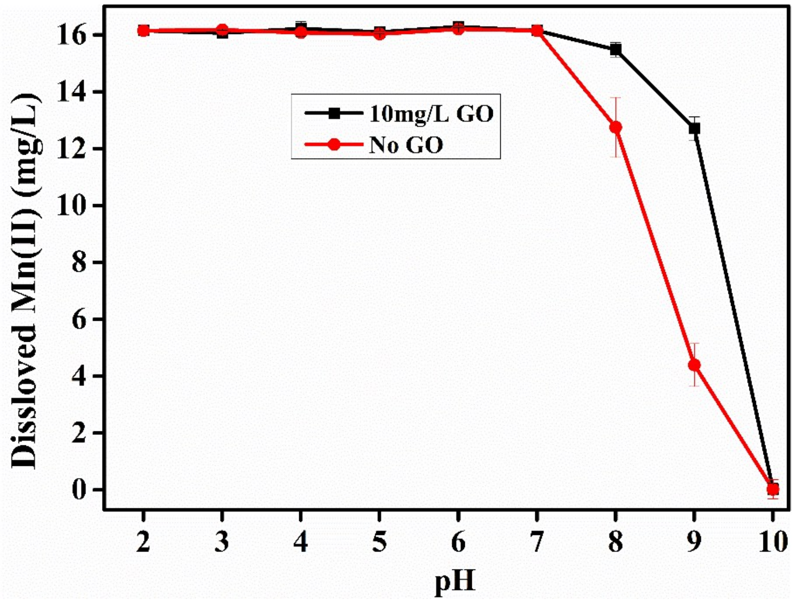


Fig. S5 Dissolved manganese in the presence and absence of GO in the supernatant. $C_{(GO)initial}$=10 mg/L, $C_{(Mn)initial}$=0.3 mmol/L, DO= 8.0 ± 0.3 mg/L.

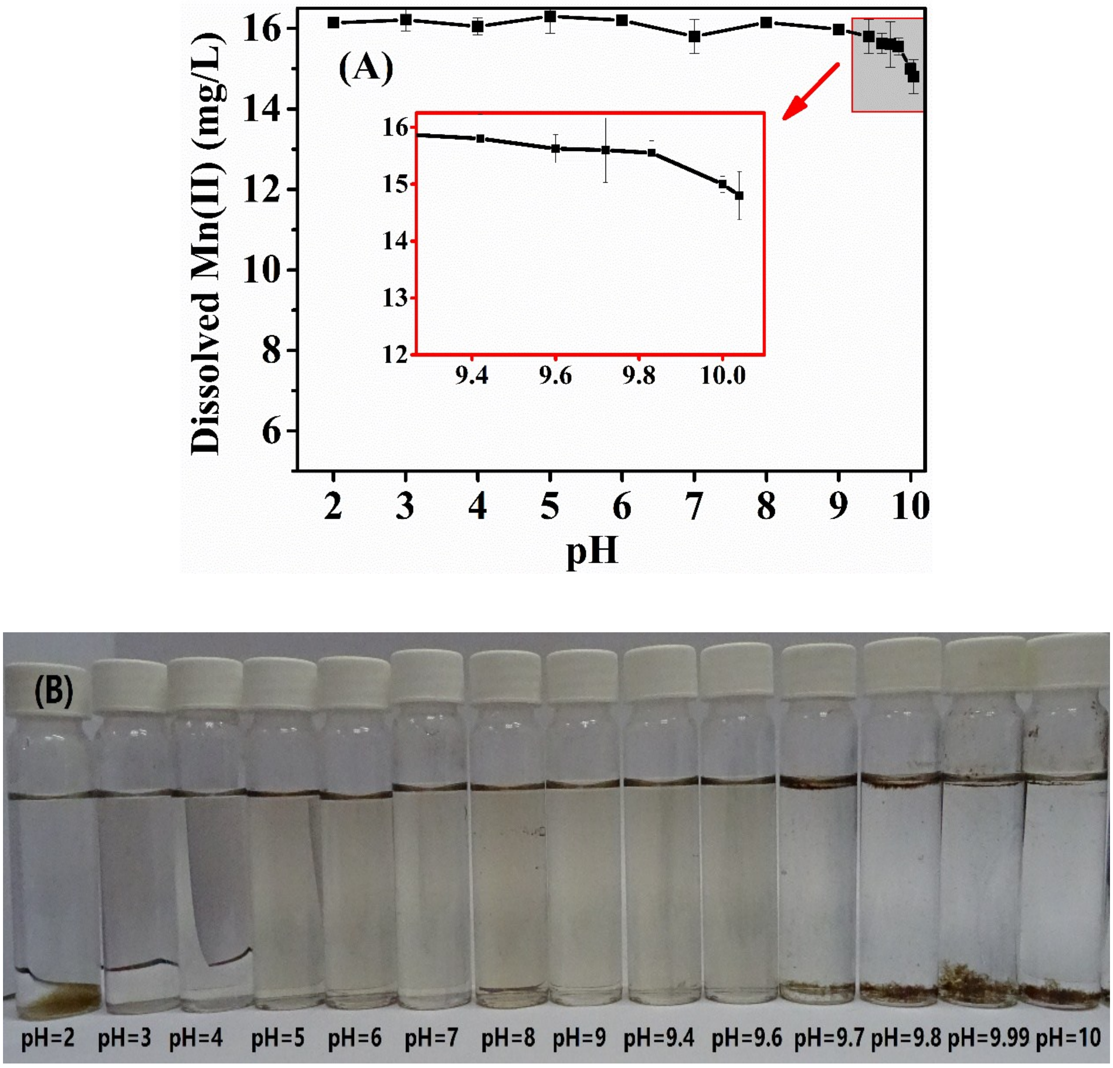


Fig. S6 (A) Dissolved manganese at different pH conditions. (B) Optical images of residual GO at different pH conditions in anoxic conditions. $C_{(GO)initial}$=10 mg/L, $C_{(Mn)initial}$=0.3 mM. Reactions were carried out under anoxic conditions (DO= 0.12 ± 0.03mg/L).

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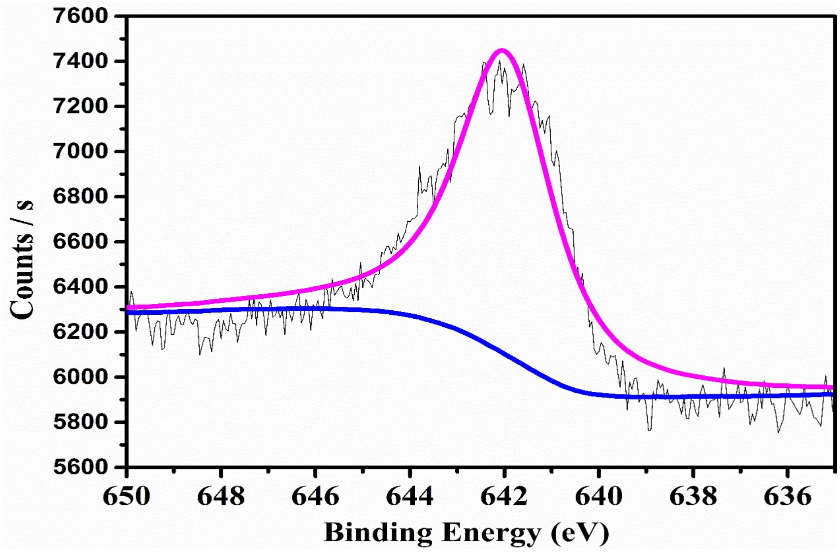

Fig. S7 XPS pattern of GO /manganese aggregates at pH

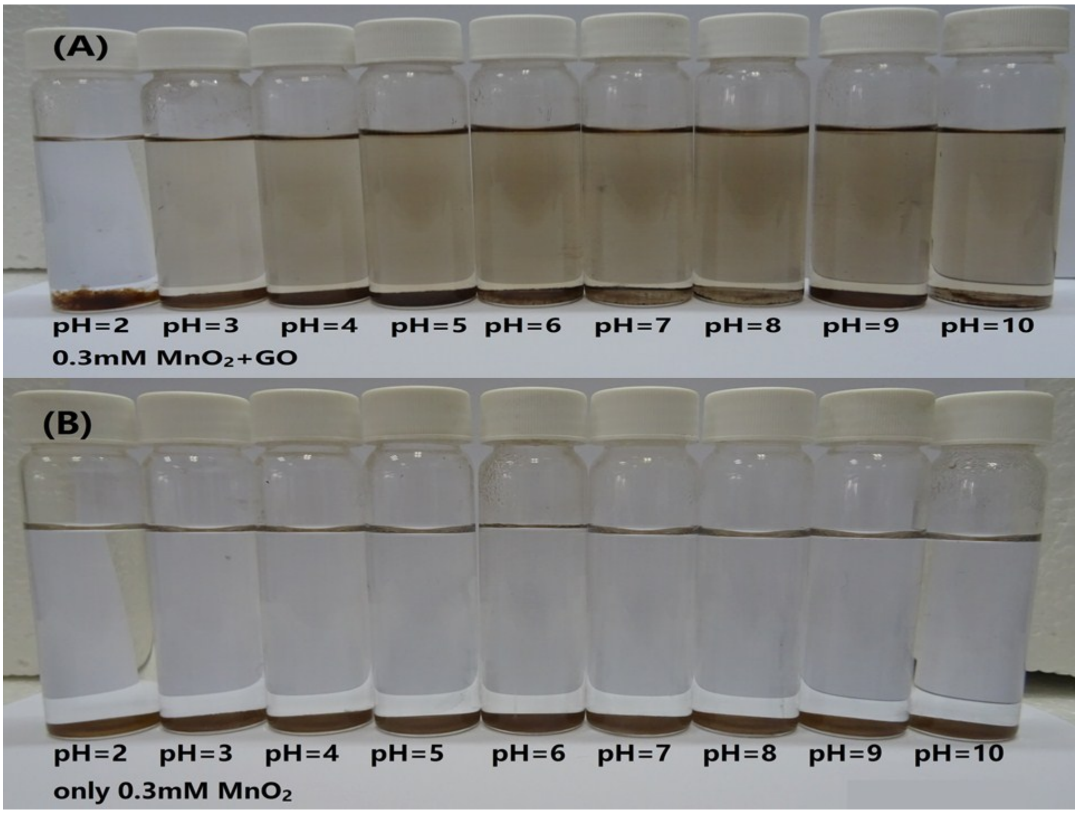

Fig. S8 (A) Optical images of GO with 0.3 mM MnO_2 in various pH conditions. (B) Only 0.3 mM MnO_2 at different pH values $C_{(GO)initial}$=10 mg/L, $C_{(MnO2)initial}$=0.3 mM I=0.005 mol/L NaCl. (NaCl was served as an electrolyte in order to adjusting pH of the solutions.)