

### Supplementary Information



Fig. S1: Precursor solution of GFO nanocrystal



Fig. S2: Final product of GFO nanocrystal after autoclaving at 250°C for 5 h (before centrifugation)



Fig. S3: n-Si substrate surface after coating by THBP GFO nanocrystal

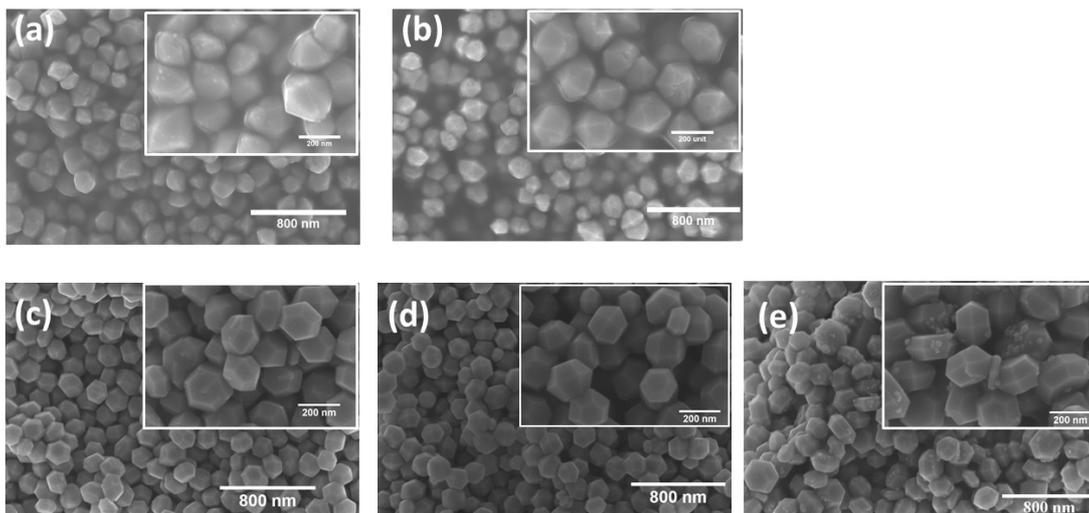


Fig. S4: FESEM images of  $\text{GaFeO}_3$  nano-crystals synthesized by hydrothermal method at  $250^\circ\text{C}$  with variable synthesis time: (a) 30 min, (b) 45 min, (c) 1 h, (d) 5 h and (e) 8 h.

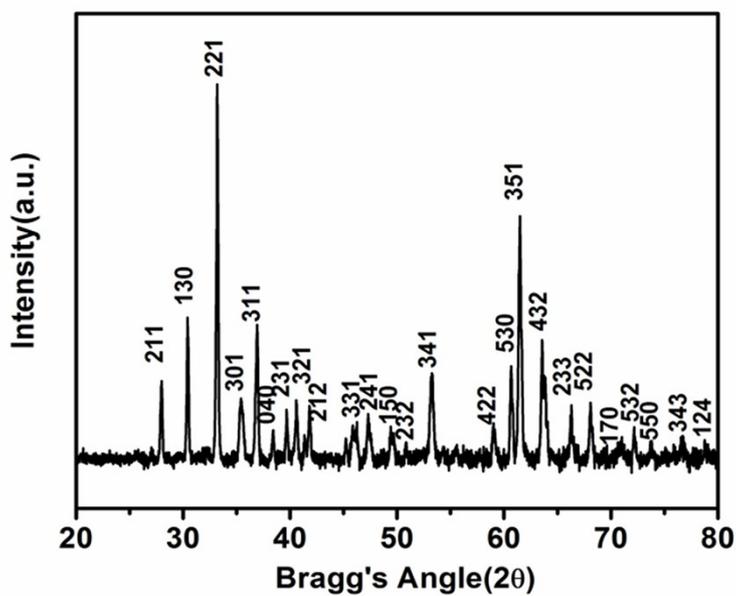


Fig. S5 XRD of THBP GFO nanocrystals heat treated at  $1100^\circ\text{C}$  for 1 h

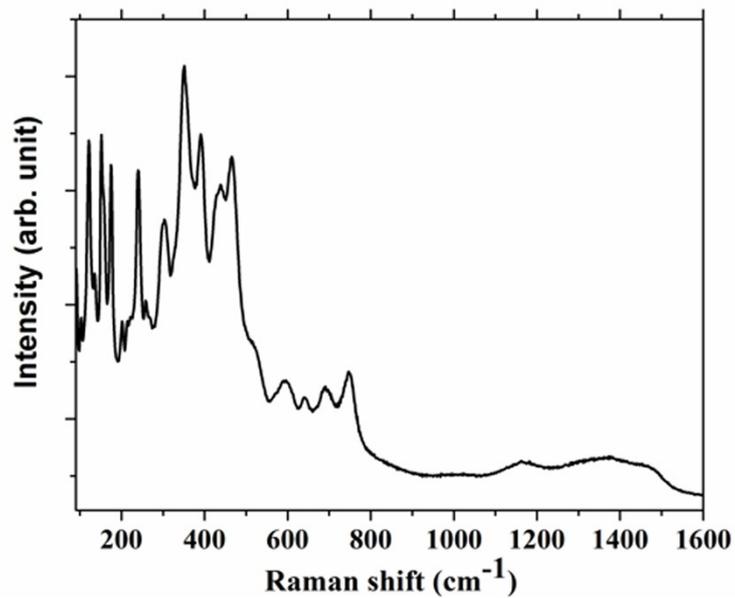


Fig. S6 Raman spectrum of GFO nanocrystals heat treated at  $1100^\circ\text{C}$  for 1 h

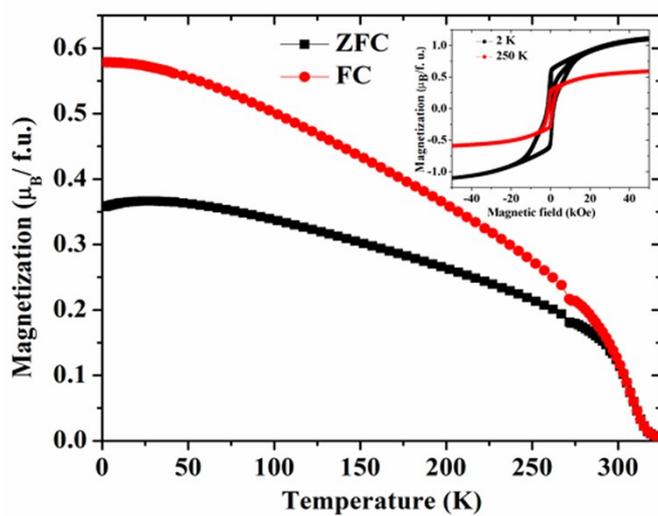


Fig. S7 Temperature dependent FC and ZFC magnetization of THBP GFO heat treated at  $1100^\circ\text{C}$  for 1 h. Inset shows the M-H plot measured at 2K and 250 K.

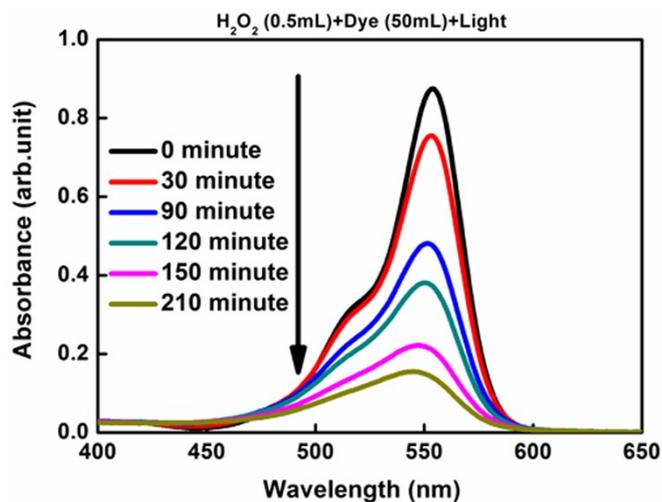


Fig. S8: Time dependence of the optical absorption spectrum of RhB dye solution after light irradiation in presence of H<sub>2</sub>O<sub>2</sub> only.

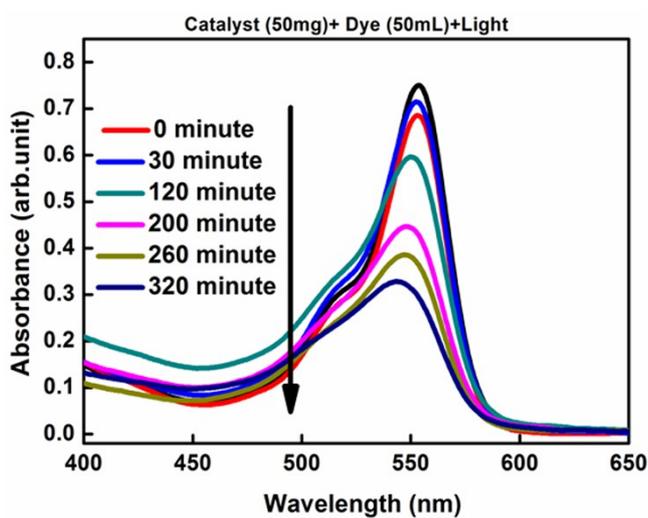


Fig. S9: Time dependence of the optical absorption spectrum of RhB dye solution after light irradiation in presence of THBP GFO nanocrystal only.

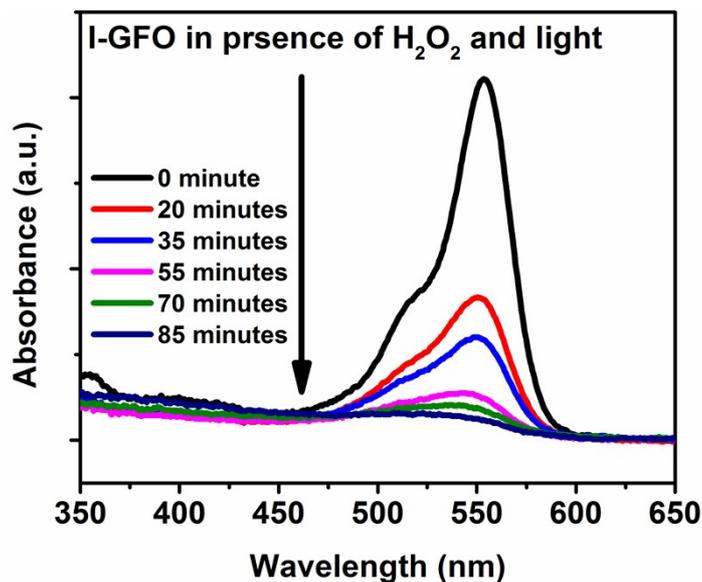


Fig. S10: Time dependence of the optical absorption spectrum of RhB dye solution after light irradiation in presence of I-GFO and  $H_2O_2$ .

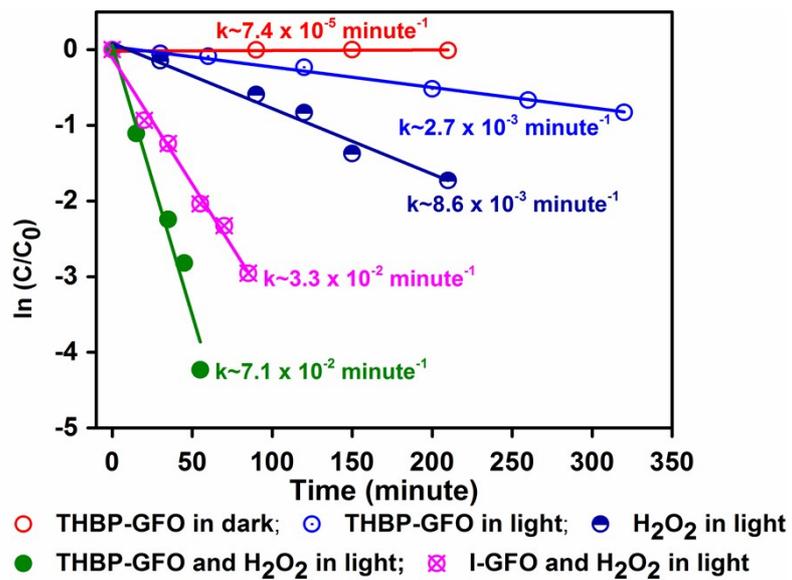


Fig. S11: Comparison of rate constant of photocatalytic reactions at various conditions