

Supplementary material for

Sonochemical Synthesis of Mesoporous ZrFe_2O_5 and Its Application for Degradation of Recalcitrant Pollutants

Sankar Chakma and Vijayanand S. Moholkar*

Department of Chemical Engineering

Indian Institute of Technology Guwahati

Guwahati – 781 039, Assam, India

* Corresponding author. Email: vmoholkar@iitg.ernet.in, Fax: +91 361 2582291

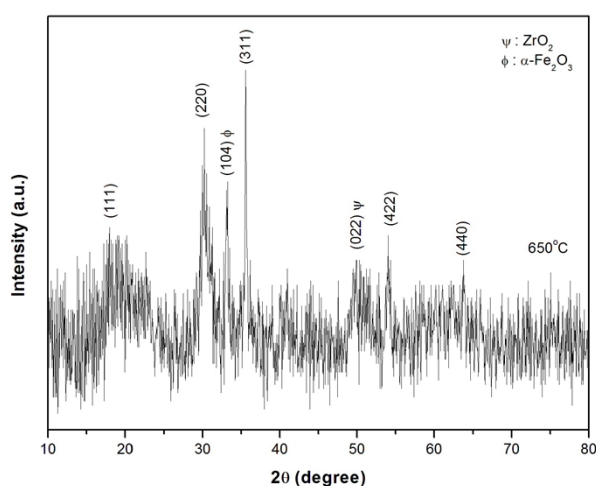
A. Assessment of relative contributions of photo-activity and Fenton activity of ZrFe_2O_5 catalyst

The dye degradation caused by ZrFe_2O_5 catalyst is by virtue of its photo-activity as well as Fenton activity due to presence of $\alpha\text{-Fe}_2\text{O}_3$ phase. The following experiments distinguish between these activities in terms of their relative contribution to dye degradation.

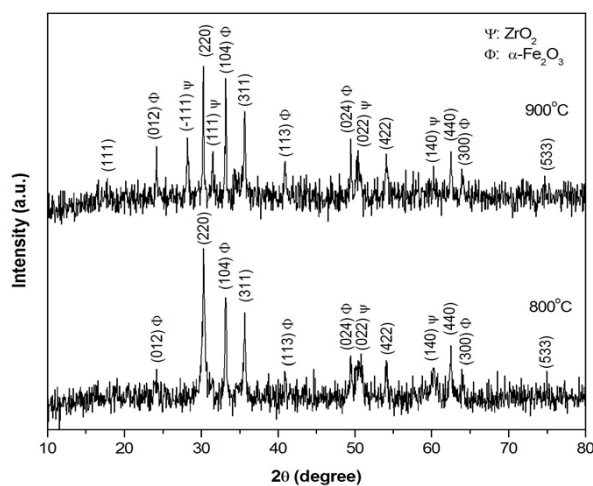
ZrFe_2O_5 was synthesized through sonochemical route and calcined at a lower temperature of 650°C , so that the formation of $\alpha\text{-Fe}_2\text{O}_3$ phase is minimized. The $\alpha\text{-Fe}_2\text{O}_3$ phase grows with temperature, and it was very difficult to completely eliminate the $\alpha\text{-Fe}_2\text{O}_3$ phase from the catalyst particles. But ZrFe_2O_5 catalyst calcined at lower temperature catalyst has significantly lower percentage of $\alpha\text{-Fe}_2\text{O}_3$ as compared to the catalyst used in experiments reported in the manuscript. For ZrFe_2O_5 calcined at 650°C , the XRD shows a feeble peak corresponding to $\alpha\text{-Fe}_2\text{O}_3$ indicating low concentration of this phase.

In the second stage, experiments were performed to compare the degradation efficiency of the two catalysts. In the first step, the photocatalytic activity of the two catalysts was compared in presence of UVA. The results of dye decolorization in photocatalysis with the two catalysts are shown in Fig. S1(B). The decolorization profiles for the two catalysts overlap closely. This clearly indicates that the two catalysts had almost similar photocatalytic activity. This essentially means that even traces of $\alpha\text{-Fe}_2\text{O}_3$ phase are sufficient to give the hole-electron recombination effect. In second step, the experiments were performed with two catalysts to compare for the Fenton activity in presence of H_2O_2 . The results of decolorization profiles are shown in Fig. S1(C). It could be seen that the catalyst calcined at lower temperature gives lesser and slower decolorization indicating reduction in the Fenton activity.

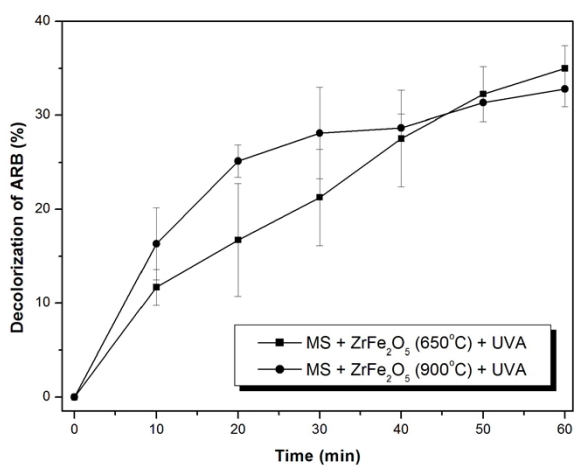
Thus, the above experiments clearly distinguish between the photocatalytic and Fenton activities of the ZrFe_2O_5 catalyst, and also show that reduction in the photocatalytic activity due to $\alpha\text{-Fe}_2\text{O}_3$ phase, providing recombination center for electron-hole pairs, is compensated by the Fenton activity. These results clearly support our conclusions as well.



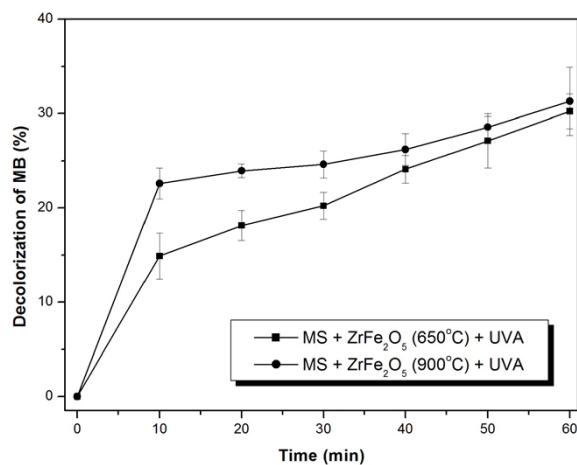
(A.1)



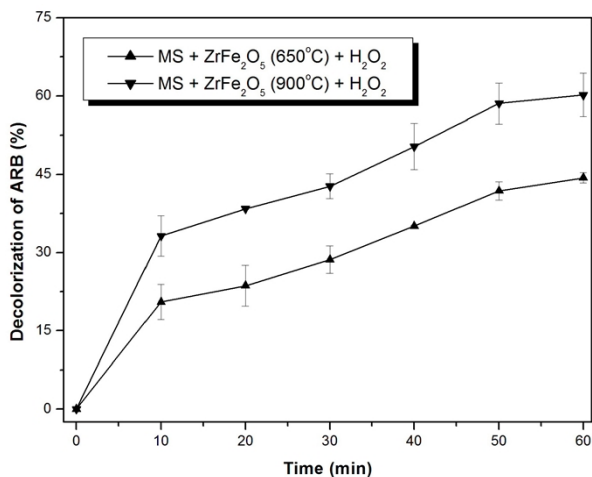
(A.2)



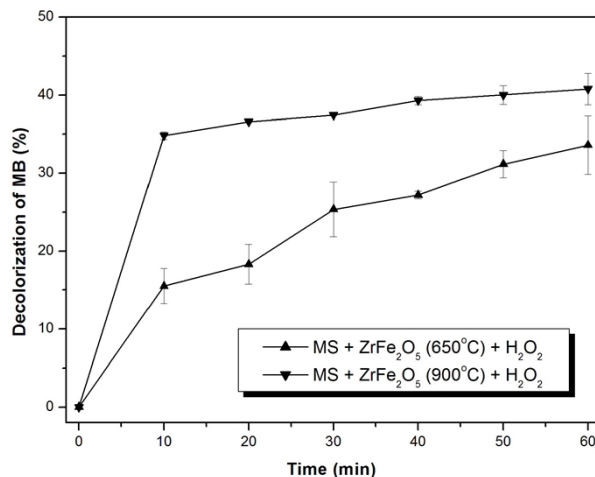
(B.1)



(B.2)



(C.1)



(C.2)

Figure S1: (A.1) XRD pattern of ZrFe₂O₅ calcined at 650°C, (A.2) XRD spectra of ZrFe₂O₅ calcined at 800°C and 900°C showing the increased of α -Fe₂O₃ phases with temperature, (B.1 & B.2) Decolorization profile of ARB and MB dyes under UVA irradiation, (C.1 and C.2) Time profile of decolorization of ARB and MB with high and low percentage of α -Fe₂O₃ phase