Production, Characterization and Application of Fe/Au Bi-metallic Nanoparticles

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Abstract: In this study the gold coated iron particles were prepared by the foam method. The bimetallic particles were then characterized using the SEM and XRD studies. The particles were used to degrade 100 mg/L of trichloroethylene.

1 Introduction

Gold coated iron particles are of interest in wide variety of applications which includes cell separation, MRI, DNA separation, drug delivery and degradation of chlorinated compounds. Unprotected Fe particles are very reactive thus mainly for biomedical studies they are coated with gold particles (Zhang et al. 2006). Gold has been recognized as the best candidate for coating due to its biocompatibility, functionality with various enzymes and chemical inertness (Sun et. al., 2006). A unique reverse micelle method has been developed to prepare 10 nm range Fe/Au nanoparticles (Zhou et al. 2001). Another method of preparation of 7 nm range Fe/Au nanoparticles involves the sodium citrate reduction of $HAuCl_4$ and $FeCl_3$ in 1:7 molar ratio (Brown et al. 2006). Fe/Au particles have the potential for use in biological applications that require magnetic nanoparticles. Zn/Au has been used in the degradation of Carbon tetrachloride (Boronina et al. 1998)

2 Objective

The objective was to prepare Fe/Au nanoparticles by the foam method, characterize it using various techniques and use it in the degradation of trichloroethylene.

3 Materials and method

Fe/Au bimetallic was synthesized by blending the suspension of $FeSO_4.7H_2O$ and $HAuCl_4$ vigorously at room temperature. After $NaBH_4$ was added the mixture was blended for another 15 min or until visible hydrogen gas had ceased. The particles were then washed with acetone to break the foam. The particles thus formed were characterized using XRD and SEM methods. These particles were used to degrade TCE solubilized in water.

4 Results and discussion

The x-ray diffraction pattern of the particles synthesized by the foam method showed Fe and Au peaks, but no diffraction associated with oxide. The SEM analysis of the particles prepared by the foam method showed needle shaped particles thus giving the particles more surface area. The particle size was in the range of 200 nm. The time taken to degrade 50 % of 60 mg/L TCE using 20g/L of Fe particle (solution method) was 75 min whereas 90% of 100 mg/L of TCE was degraded using 20 g/L of Fe/Au particles in 65 min.

5 Conclusion

The Fe/Au particles were prepared successfully using the foam method and their characterization was done using SEM and XRD methods. Fe/Au particles produced by the foam method were more effective in degrading TCE compared to the Fe particles produced by the solution method.

6 Acknowledgement

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7 References

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2. Brown K., Wijaya A., Alper J.D., Hamad-Schifferli K., "Synthesis of Water Soluble, Magnetic Fe/Au Nanoparticles" Mater.Res.Soc.Symp.,Proc.Vol.900E, 2006

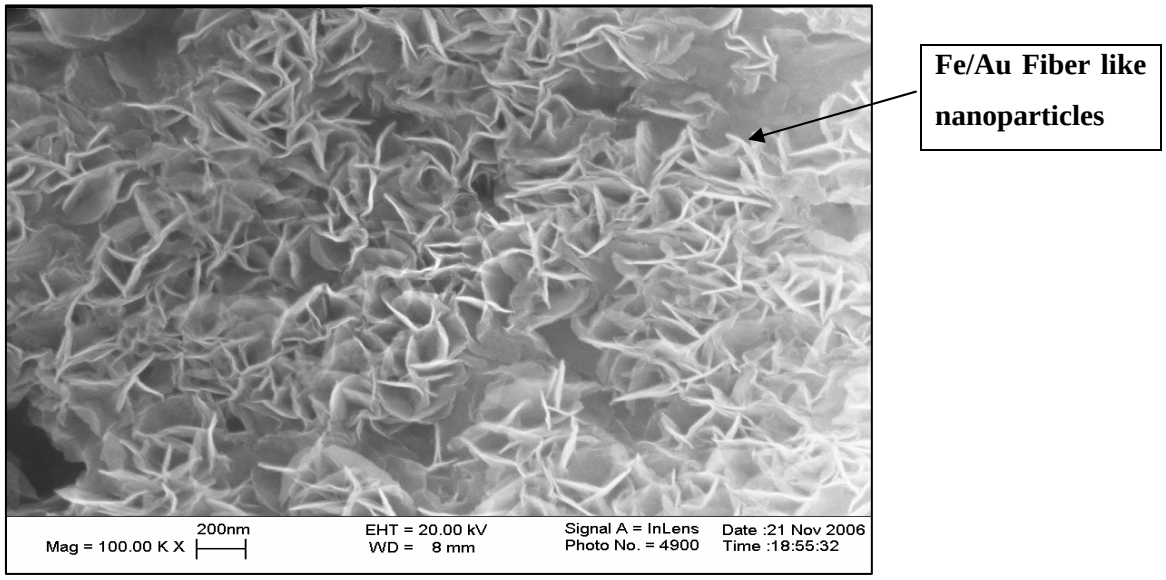

Figure.1. SEM analysis of Fe/Au nanoparticles prepared by the foam method

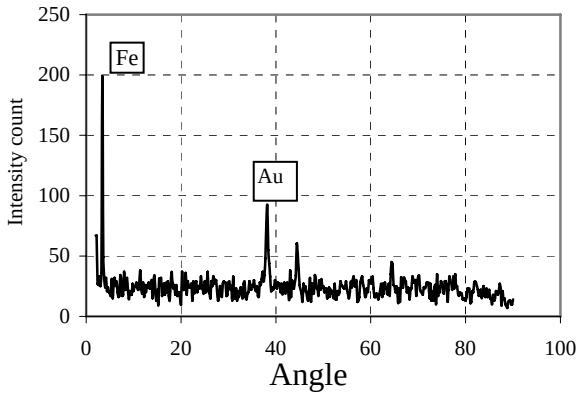

Figure.2. x-ray diffraction patterns of Fe/Au nanoparticles prepared by the foam method

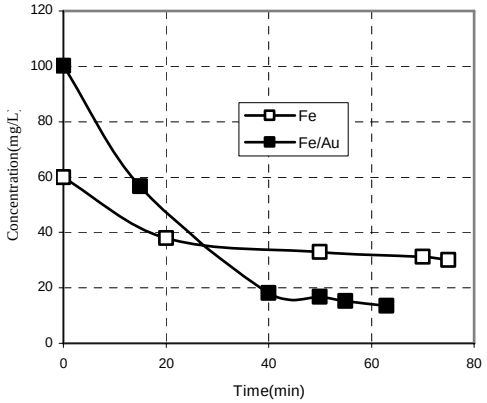

Figure.3. Degradation of 100 mg/L of TCE using Fe/Au nanoparticles and 60 mg/L of TCE using Fe particles