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Heterojunction-Enhanced Photocatalytic Water Oxidation Activity of Hematite

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Since the global energy challenges in recent decades, many scientists and engineers have been involved in development of inexpensive and active materials for photocatalytic water splitting [1-3]. Hematite (α-Fe_2O_3) is one of promising candidates due to its low cost and favorable band gap (2.1~2.2 eV) to absorb photons in the visible light range [4]. However, the short life time of the photo-generated charge carriers (< 10 ps), short diffusion length of holes (2-4 nm) and poor mobility of charge carriers (< 0.2 cm^2 V^{-1} s^{-1}) are three major notorious weaknesses to hinder the photocatalytic efficiency of the α-Fe_2O_3 [4].

To overcome the technical barrier for development of hematite-based photocatalysts for water splitting, α-Fe_2O_3 has been incorporated with the reduced graphene oxide (rGO) to form a rGO/α-Fe_2O_3 composite by a thermal hydrolysis process. The α-Fe_2O_3 on the rGO nanosheets had a nanoparticle size about 50 nm. As compared with bulk α-Fe_2O_3, the nanostructured α-Fe_2O_3 facilitates the charge carrier transport to the interface of the hematite and electrolyte. Also, rGO acts as an effective channel for promoting the electron transfer from the α-Fe_2O_3 nanoparticles. The photocatalytic activity of water oxidation of the rGO/Fe_2O_3 nanocomposite (752 µM O_2 g^{-1} h^{-1}) was much higher than that of the monolithic Fe_2O_3 nanoparticles (387 µM O_2 g^{-1} h^{-1}). Photoelectrochemical measurement results show that coupling the rGO with the hematite nanoparticles greatly increase the photocurrent and reduce the charge recombination rate.

Reference

1 Meng, F. K.; Li, J. T.; Hong, Z. L.; Zhi, M. J.; Sakla, A.; Xiang, C. C.; Wu, N. Q.; *Catal. Today*, 2012, j. cattod. 2012.05.038.

2 Li, J. T.; Meng, F. K.; Suri, S.; Ding, W. Q.; Huang, F. Q.; Wu, N. Q.; *Chem. Commun.*, **2012**, *48*, 8213.

3 Cushing, S. K.; Li, J.; Meng, F.; Senty, T.; Suri, S.; Zhi, M.; Li, M.; Bristow, A.; Wu, N. Q.; *J. Am. Chem. Soc.*, **2012**, *134*, 15033.

4 Sivula, K.; Zboril, R.; Formal, F. L.; Robert, R.; Weidenkaff, A.; Tucek, J.; Frydrych, J.; Gratzel, M.; *J. Am. Chem. Soc.*, **2010**, *132*, 7436.