CO_2 reduction to methanol under visible light irradiation over nanostructured $CuFe_2O_4/TiO_2$ photocatalyst

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Photocatalytic reduction of CO_2 to methanol has the beneficial to overcome fossil fuel depletion and global warming problem at the same time. TiO_2 is widely studied photocatalyst, but active only under UV-light irradiation. To develop efficient visible light active photocatalyst some conditions need to be satisfied, like i) increase the visible light absorption by decreasing the band gap, ii) efficient charge separation, iii) shift the conduction band (CB) to more negative region than the standard potentials for CO_2 reduction reactions [1-3]. Copper ferrite ($CuFe_2O_4$) is a visible light responsive material possessing very low band gap. The incorporation of $CuFe_2O_4$ onto TiO_2 might alter the band edges of the composite and might increase the CO_2 reduction ability. In the present work, $CuFe_2O_4$ and $CuFe_2O_4/TiO_2$ was synthesized to explore the photocatalytic reduction of CO_2 under visible light irradiation. The phases and crystallite size of the photocatalysts were characterized by XRD and it indicates $CuFe_2O_4$ as tetragonal phase incorporation with anatase TiO_2 in $CuFe_2O_4/TiO_2$ hetero-structure. UV-Vis absorption spectrum suggested the formation of the hetero-junction with relatively lower band gap than that of TiO_2. Photoluminescence (PL) technique was used to study the electron–hole (e^-/h^+) recombination process. The photocatalytic performance of $CuFe_2O_4/TiO_2$ was evaluated based on the methanol yield with varying amount of TiO_2 over $CuFe_2O_4$. Methanol yield over $CuFe_2O_4/TiO_2$ was found to be about three times higher (651 μmol/gcat L) than that of $CuFe_2O_4$ photocatalyst. This occurs because the energy of the band excited electrons lies above the redox potentials of the reaction products CO_2/CH_3OH.

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