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Fe/Cu-CO-DOPED TIO_2 FOR EFFICIENT PHOTOCATALYTIC DYE DEGRADATION UNDER VISIBLE LIGHT

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TiO_2 photocatalysts have been widely used for the removal of pollutants from the environment. However, TiO_2 is active only in the UV range due to its wide band gap limiting its ability to harvest the full solar spectrum. Therefore, it is beneficial to extend its absorption to the visible region. TiO_2 has been doped with metals and non-metals to improve the visible light sensitivity. In this study, TiO_2 has been co-doped with Fe and Cu to enhance the use of the full solar spectrum via both reduction in the band gap and surface plasmon resonance effect. Nanoparticles of Fe doped TiO_2, Cu doped TiO_2 and 0.05 mol% Fe/Cu co-doped TiO_2 were synthesized via sol gel synthesis. These catalysts were tested for their photocatalytic activity for the degradation of methylene blue under visible light. Nanoparticles were characterized by powder X-ray diffraction (PXRD), transmission electron microscopy (TEM), Raman spectroscopy, scanning electron microscopy (SEM) and diffuse reflectance UV-Visible spectroscopy. PXRD patterns and Raman spectra show that the as-prepared TiO_2 photocatalysts have anatase and rutile crystalline phases. TEM and SEM images show agglomerated nanoparticles. Selected area diffraction patterns also show the presence of both anatase and rutile crystal phases. All the doped TiO_2 photocatalysts were red shifted and extended absorption in the visible region. Based on the diffuse reflectance spectra, the band gaps are calculated to be 2.85 eV (TiO_2), 2.80 eV (Fe-TiO_2), 2.74 eV (Cu-TiO_2) and 2.74 eV (Fe/Cu-TiO_2). These results indicate that doped nanoparticles are catalytically more active than undoped TiO_2. Further, Cu-TiO_2 show the highest rate of photocatalytic activity (0.1 min^{-1}) due to its comparatively narrow band gap and enhanced surface plasmon effect. Rate of reaction is very similar in Fe-TiO_2 and Fe/Cu-TiO_2 (0.009 min^{-1}). However, Fe/Cu co-doped TiO_2 shows less photocatalytic activity due to the electron hole pair recombination effect. Therefore, it could be concluded that Cu doped TiO_2 triggers the reaction via band gap reduction and surface plasmon effect, and that co-doping has reduced the band gap with enhancing the electron hole pair recombination.

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