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Improved Visible Light Activities for Degrading Pollutants on ZnO-TiO2 Nanocomposites Decorated with C and Fe Nanoparticles

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Abstract : In recent years, semiconductor photocatalytic degradation processes have attracted a lot of attention and are used widely for the destruction of organic pollutants present in waste water. Among various semiconductors, titanium dioxide (TiO2) is the most popular photocatalyst due to its excellent chemical stability, non-toxicity, relatively low cost and high photo-oxidation power. It has been known that zinc oxide (ZnO) with band gap energy 3.2 eV is a suitable alternative to TiO2 due to its high quantum efficiency, however it corrodes in acidic medium. Unfortunately TiO2 and ZnO both are active only in UV light due to their wide band gaps. Sunlight consist about 5-7% UV light, 46% visible light and 47% infrared radiation. In order to utilize major portion of sunlight (visible spectrum), it is necessary to modify the band gap of TiO2 as well as ZnO. This can be done by several ways such as semiconductor coupling, doping the material with metals/non metals. Doping of TiO2 using transition metals like Fe, Co and non-metals such as N, C or S extends its absorption wavelengths from UV to visible region. In the present work, we have synthesized ZnO-TiO2 nanocomposite using reverse microemulsion method. Visible light photocatalytic activity of synthesized nanocomposite was investigated for degradation of aqueous solution of malachite green (MG). To increase the photocatalytic activity of ZnO-TiO2 nanocomposite, it is decorated with C and Fe. Pure, carbon (C) doped and carbon, iron(C, Fe) co-doped nanosized ZnO-TiO2 nanocomposites were synthesized using reverse microemulsion method. These composites were characterized using, X-ray diffraction (XRD), Energy dispersive X-ray spectroscopy (EDX), Scanning electron microscopy (SEM), UV visible spectrophotometery and X-ray photoelectron spectroscopy (XPS). Visible light photocatalytic activities of synthesized nanocomposites were investigated for degradation of aqueous malachite green (MG) solution. C, Fe co-doped ZnO-TiO2 nanocomposite exhibit better photocatalytic activity and showed threefold increase in photocatalytic activity. Effect of amount of catalyst, pH and concentration of MG solution on the photodegradation rate is studied. Stability and reusability of photocatalyst is also studied. C, Fe decorated ZnO-TiO2 nanocomposite shows threefold increase in photocatalytic activity.

Keywords : malachite green, nanocomposite, photocatalysis, titanium dioxide, zinc oxide
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