Synthesis of iron doped TiO2 nanoparticles by ball-milling process: the influence of process parameters on the photocatalytic efficiency

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Abstract (Arial 10)

Titanium Dioxide (TiO_2) absorbs only a small fraction of incoming sunlight in the visible region limiting its photocatalytic efficiency and concomitant photocatalytic ability. TiO_2 is a wide band gap semiconductor (3.02eV for anatase crystalline structure), reducing the energy range by which it can be activated. The next generation of TiO_2 materials will be able to absorb both UV and visible light through the application of doping processes with metals. It has been reported that the addition (doping) of foreign ions (Fe^{+3}, Cr^{+3} or Pd^{+4}) can be a strategy to increase the visible light absorption of TiO2 materials. The inclusion of foreign chemical elements in the TiO2 lattice can tune its band gap resulting in an absorption edge red-shifted to lower energies enhancing photocatalytic performance in the visible region of the electromagnetic spectrum. The doping processes improve the photocatalytic activity by decreasing the energy band gap or preventing (e^-/h^+) pair recombination. The trapping effects enhance the probability of (e^-/h^+) pairs to reach the TiO_2 surface without suffering recombination and thus taking part in the photocatalytic reactions.

TiO_2 nanoparticles (Aeroxides® TiO_2 P25 from Evonik industries with a density of 3.8g/cm^3, used as bought) were doped with iron powder in a planetary ball milling system by using stainless steel balls. In the milling process [1,2], the effective doping was promoted by the local temperature increase experienced by the impact between the powders and the stainless steel balls. This research work studies the effect of the milling process parameters (time and rotation speed) in the obtained properties of the Fe doped TiO_2 nanoparticles. The nanoparticles were characterized via UV-Vis Spectroscopy, X-Ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR). Additionally, a TiO_2 colloidal dispersion was prepared in order to evaluate its zeta potential and photocatalytic properties.

References

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