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Nanocrystal TiO_2 engulfed SiO_2-Barium Hexaferrite for Enhanced Electrons Mobility and Solar Harvesting Potential

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Abstract. Barium hexaferrite embedded-silica-titania photocatalyst (TiO_2-SiO_2-$BaFe_{12}O_{19}$) was synthesized through sol-gel, liquid catalytic phase transformation and solid reaction routes. The magnetic photocatalyst was aimed to harvest the photoenergy from the sunlight, minimize the electron-holes recombination rate, improve the long lifetime charge-carriers transfer to maximize the photocatalytic activity and enhances the separation and reusability of it. The as-synthesized photocatalyst was characterized and the photocatalytic activity was evaluated for the reduction of 2, 4-dichlorophenol (2, 4-DCP) under direct sunlight. The presence of SiO_2 interlayer in TiO_2-SiO_2-$BaFe_{12}O_{19}$ prevents the phase transformation of magnetic core. TiO_2-SiO_2-$BaFe_{12}O_{19}$ benefits the magnetic separation with appreciable magnitude of coercivity (5035.6 Oe) and saturation magnetization ($18.8256E^{-3}$ emu/g), respectively. The ferrite ions from the magnetic core which dispersed into TiO_2 matrix exhibited an evident shift of the absorption in the visible region. This was again confirmed with the reduced band gap energy of 1.90 eV. Furthermore, TiO_2-SiO_2-$BaFe_{12}O_{19}$ destructed 100% of 2, 4-DCP compound within 150 min under very bright sunlight with an average irradiance of 820.8 W/m^2 (results not shown). The embedding of $BaFe_{12}O_{19}$ with a SiO_2 layer onto TiO_2 nanocrystals contributed for an excellent solar-light utilization and ease magnetic separation of the nano-sized photocatalyst.