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SYNTHESIS AND CHARACTERIZATION OF BARE, Ag-DOPED, AND Gd-DOPED TiO_2 NANOPARTICLES FOR THE PHOTO-DEGRADATION OF METHYLENE BLUE DYE

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Abstract

TiO_2 nanoparticles (NPs) doped with different Ag and Gd contents were prepared by a modified sol-gel method using, titanium tetraisopropoxide (TTIP), silver nitrate ($AgNO_3$) and gadolinium oxide (Gd_2O_3) as precursors and 2-propanol as the solvent. In this study, bare, 1% and 2% Ag-doped and Gd-doped TiO_2 NPs were synthesized and the effects of Ag and Gd doping on the crystallization, Ti-O-Ti metal bonding, particle size and photocatalytic activity were analyzed using PXRD, FT-IR spectroscopy, particle size analyzer and UV-Visible spectroscopy respectively. The XRD investigations of all these TiO_2 NPs confirmed the tetragonal form of anatase phase of TiO_2. FT-IR spectra showed the TiO_2 peaks in the characteristic region of Ti-O-Ti metal bond at the wavenumber between 450 and 900 cm^{-1}. Average particle size of synthesized TiO_2 NPs was varied according to the type and the amount of dopant added. Average particle size of bare TiO_2, 1% and 2% Ag-doped TiO_2 and 1% and 2% Gd-doped TiO_2 were 68.1 nm, 189.5 nm, and 314 nm respectively. Gd-doped TiO_2 NPs have shown the highest particle size compared to bare and Ag-doped TiO_2. Photocatalytic activity was measured using the cationic dye, methylene blue (MB) which commonly used as a dye and as a medication and, injection of MB cause different side effects including dizziness, nausea, headache etc. Here, 2% Gd-doped TiO_2 has shown the highest colour degradation efficiency under 2-hour UV irradiation at the wavelength of 365 nm. According to the photo degradation efficiency of methylene blue dye, bare TiO_2 NPs only showed 78.3 % while 2% Ag-doped and 2% Gd-doped TiO_2 NPs have shown 90.3 % and 95.1 % photo degradation efficiency respectively. Therefore, it can be concluded that doping with, noble metal ions and lanthanide metal ions can enhance the photo degradation efficiency of methylene blue and when increasing the doping concentration, dye degradation rate too increased.

Keywords: *Metal ion doping, Ag-doped TiO_2 NPs, Gd-doped TiO_2 NPs, Methylene blue dye, Photocatalytic activity*