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Visible light driven photocatalysis for water purification by highly crystalline multiferroic $BiFeO_3$ nanoparticles synthesized via wet chemical route

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ABSTRACT

$BiFeO_3$ (BFO) multiferroics were synthesized via a low-cost wet chemical method. The enigma involved the optimization of different reaction conditions. A comprehensive study was carried out to optimize the reaction conditions such as molar ratios of surfactant with total concentration of precursors, chemical source and solubility of precursors and annealing temperature. A pragmatic nucleation of precursors was achieved at molar proportions 1:1 between cetyltrimethylammonium bromide (CTAB) and total molar concentration of precursors. An endeavor approach was made to accomplish the appropriate flexibility of emulsion phase by adding small quantity of ethanol as a co-surfactant, nevertheless the solubility of $Bi(NO_3)_3$/$BiCl_3$ was unfavorably affected. Subsequently, the single phase product of BFO was observed with reaction conditions 1:1 molar concentration ratio between precursors and CTAB, with precursors $BiCl_3$ and $Fe(NO_3).9H_2O$ and annealing temperature of 900°C for a time of 7 h. The structural elucidation was made by comparing the extracted data with standard cards (ICDD - 01-086-1518) of XRD. The crystallite size was computed to be 18 nm. The DC conductivity was found to be 1.005×10^{-9} S cm^{-1}. The optical band gap was found in the range of ~2.6 eV. Keeping in view the optical band gap, BFO nanoparticles were investigated for photocatalytic degradation of Congo Red dye under visible light. The photocatalytic degraded sample was investigated through the high-performance liquid chromatography (HPLC) and chemical oxygen demand estimation (COD value) for treated sample was calculated to be 63.27% which is less than the untreated sample which disclosed a photodegradation of Congo Red dye into simple hydrocarbon products as perceived in HPLC–chromatogram. The post XRD data showed the stability of BFO which could be separated through a simple bar magnet from reaction container.

Keywords: Visible light; Photocatalysis; Nanoparticles; Micro-emulsion

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