**Abstract**

In the present study, TiO2 and Nd doped TiO2 [nanoparticle](https://www.sciencedirect.com/topics/materials-science/nanoparticles%22%20%5Co%20%22Learn%20more%20about%20Nanoparticles%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) was synthesized through [Sol-gel method](https://www.sciencedirect.com/topics/engineering/sol-gel-process) with different [molar ratio](https://www.sciencedirect.com/topics/engineering/molar-ratio) and different starting material. The synthesized nanoparticle was characterized by XRD, UV-Vis, PL, FE-SEM, HR-TEM, and EDS analysis. The [X-ray diffraction](https://www.sciencedirect.com/topics/materials-science/x-ray-diffraction) pattern confirms tetragonal anatase phase with average [crystallite size](https://www.sciencedirect.com/topics/engineering/crystallite-size) of 14–10 nm. The influence of phase transition was identified by the addition of [dopant](https://www.sciencedirect.com/topics/materials-science/doping-additives%22%20%5Co%20%22Learn%20more%20about%20Doping%20%28Additives%29%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) Nd. The calculated band gap is in the range of 3.48–3.44 eV. Near UV and blue emission in PL spectrum indicate the presence of crystal defects in TiO2 lattice. The structural morphology of the prepared sample was analyzed by FESEM. The average particle size of the sample was determined by TEM analysis. The [elemental compositions](https://www.sciencedirect.com/topics/engineering/elemental-composition) and incorporation of Nd ions into the TiO2 nanoparticles was detected by using energy dispersive spectra analysis. The antibacterial activity of pure TiO2 and Nd doped TiO2 nanoparticle was tested for different bacterial organisms like Escherichia coli (Gram-negative) and staphylococcus aureas (Gram-positive) bacteria. The [photo catalytic activity](https://www.sciencedirect.com/topics/engineering/photocatalyst) of the prepared samples on degradation of [Methylene](https://www.sciencedirect.com/topics/engineering/methylene%22%20%5Co%20%22Learn%20more%20about%20Methylene%20from%20ScienceDirect%27s%20AI-generated%20Topic%20Pages) Blue and Congo Red under ultraviolet irradiation were also studied.