

Title: Effect of Nb doping on structural, morphological and optical properties of solid-state sintered Na_{0.5}Y_{0.5}Cu₃Ti₄O₁₂ ceramics

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Abstract: The numerous characteristics of sodium yttrium copper titanate (NYCTO) ceramics are strongly connected to its structure, surface morphology, and synthesis technique. This work presents the successful fabrication of Na_{0.5}Y_{0.5}Cu₃Ti₄O₁₂ and Na_{0.5}Y_{0.5}Cu₃Ti_{3.99}Nb_{0.01}O_{12.005} ceramics using solid-state sintering route and provides the effect of Nb doping on microstructure, surface morphology, and optical properties. The X-ray diffraction analysis reveals that both samples exhibit a high degree of crystallinity and consist of a body-centered cubic perovskite crystal structure. There were impurity phases of CuO identified in undoped NYCTO sample. The lattice parameter was determined using the Rietveld method. The addition of Nb results in a rise in the lattice parameter from 7.381 to 7.384. The size of crystallites has been found to decrease as a consequence of Nb doping. Positive slope value of the W-H plot indicated the presence of tensile strain in the samples. Relative density has decreased from 96.42% to 93.94% with Nb doping. The Field Emission Scanning Electron Microscope FESEM images shows clearly defined grains in the material, exhibiting a random range of grain sizes. The smaller grains are positioned among the larger grains. These images demonstrate how Nb doping substantially influences the surface morphology of NYCTO. The incorporation of Nb facilitated a decrease in the average grain size. The UV-visible investigation revealed that doping with Nb resulted in an increased optical absorption and a reduced band gap.

Keywords: Grain size , Optical diffraction , Photonic band gap , Optical device fabrication , Surface morphology , Morphology , Lattices

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