Indian Journal of Pure & Applied Physics (IJPAP)

The Influence of Isoleucine on Structural, Optical and Electrical Properties of Lithium Dihydrogen Phosphate Crystal

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DOI: https://doi.org/10.56042/ijpap.v62i7.7784

Keywords: LDP, Powder XRD, Optical parameters, Complex impedance, Modulus plots

Abstract

The present investigation systematically explores the impact of isoleucine doping on the structural, optical, and electrical properties of lithium dihydrogen phosphate (LDP) crystals. Pure and isoleucine-doped LDP crystals with various dopant concentrations (0.3, 0.6, and 0.9 wt%) have been synthesized using the slow solvent evaporation technique. Structural analysis utilizing X-ray diffraction revealed a reduction in crystallite size and a reduction in the compressive and tensile strains induced by isoleucine integration. Optical examinations showcased a gradual reduction in the bandgap energy alongside an increase in the Urbach energy with escalating dopant concentration, indicating increase in structural disorder. Moreover, the extinction coefficient, optical conductivity, and refractive index show an upward trajectory with doping, while optical density exhibits an inverse

correlation. Electrical characterization that include dielectric and impedance spectroscopic methods showed a decline in DC conductivity and a rise in grain resistance, attributable to diminished charge carrier mobility and density. The power law exponent indicated ideal long range path ways and diffusion limited hopping mechanism. The relaxation kinetics exhibited deviation from ideal Debye behavior, with the stretch exponent parameter signifying an improvement in relaxation dynamics at higher doping levels. The complex impedance and modulus plot analysis showed the dominancy of grain relaxation mechanism within the range of frequency studied. In summary, this exhaustive investigation shows the intricate interplay between isoleucine doping and the diverse properties of LDP crystals, offering valuable insights for potential applications.

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Published
2024-06-27

Issue
Vol. 62 No. 7 (2024): Indian Journal of Pure & Applied Physics (IJPAP)

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