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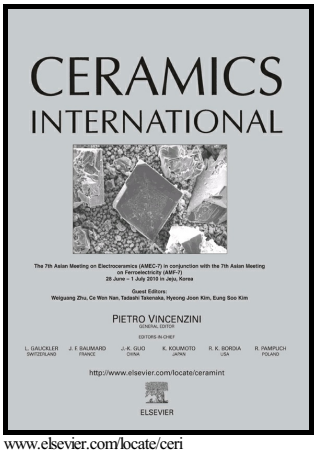

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Physical properties of La-doped NiO sprayed thin films for optoelectronic and sensor applications

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Abstract

Lanthanum-doped nickel oxide NiO:La thin films were deposited onto glass substrates at 450°C, by the spray pyrolysis technique using nickel and lanthanum chlorides as precursors. These films belonging to cubic structure, crystallize preferentially along (111) plane. First, Raman study shows the presence of bands corresponding to NiO structure. The same study confirms the presence of both $Ni(OH)_2$ and $LaNiO_3$ as secondary phases. Moreover, using SEM observations, all samples exhibit porous microstructures with rough surfaces and spherical nanoparticles of about 40 nm as size. Second, NiO:La films present a direct band gap energy value lying in the range of 3.63-3.84 eV. Also, the effect of the La incorporation in NiO matrix on the disorder is studied in terms of Urbach energy. Some optical constants (refractive index, extinction coefficient, dielectric constants, and dispersion parameters) are reached. On the other hand, the photoluminescence spectroscopy reveals the presence of peaks related to the electronic transition of the Ni^{2+} ions and others confirming the presence of some defects in NiO matrix in terms of La content. Finally, it has been found that La doping allows the improvement of the electrical conductivity as well as Haacke's figure of merit of NiO sprayed thin films by at least, three orders of magnitude.

Keywords: NiO, La doping, spray pyrolysis, structure, optical properties, PL measurements, electrical conductivity.

1. Introduction

Nickel oxide (NiO) is an important p-type semiconductor binary material with a wide band gap ranging from 3.6 to 4.0 eV [1]. Due to its excellent chemical stability, magnetic and