Structure, morphology and optical behavior of Ni1-xCoxO thin films prepared by a modified sol-gel method

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Abstract

Nanocrystalline Ni1-xCoxO thin films (0 <= x <= 0.4) have been prepared on glass substrates using sol-gel/spin-coating technique. The effect of the concentration of cobalt ions on the structure, morphology and optical behavior of the doped NiO thin films are investigated by the X-ray diffractometer, scanning electron microscopy, Raman spectroscopy and spectrophotometer. All films showed a single phase face centered cubic structure, implying the complete solubility of the Co ions into the NiO cubic crystal up to 40 at.%, for the first time. The texture coefficient revealed that the Co ions tend to force the NiO grains to grow along (200) direction. The Raman spectroscopy showed one longitudinal optical phonon mode (LO) at 518 cm(-1) and two longitudinal optical phonons mode (2LO) at 1070 cm(-1). The decrease of the intensity and the shift of the peak position of the two modes, indicating the scattering contribution of the LO-mode outside the center of Brillouin zone and the creation of oxygen vacancies due to the incorporated Co ions into the NiO cubic crystals. The Ni1-xCoxO thin films have shown high optical transparency around 80%. A decrease of the band gap energy of the NiO films from 3.69 eV to 3.41 eV was observed when the concentration of Co ions increased to 10 at.%, followed by an increase to 3.58 eV as the Co ions concentration increased to 40 at.%. The high optical conductivity and low dissipation factor of the developed Ni1-xCoxO thin films will open a new avenue for future applications in the optoelectronic devices such as reflectance mirror and display light shutter. (C) 2016 Elsevier Ltd. All rights reserved.

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