Crystallite size-dependent optical properties of nanostructured NiO films

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Abstract:

A simple spraying technique was employed to deposit nickel hydroxide films on glass substrates. Nickel oxide films with different crystallite size were obtained by post annealing of Ni(OH)2 films in air at 523–673 K. The structure, chemical composition, surface morphology and thickness of the as-deposited and annealed films were investigated using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). The crystallite size was found to increase with increasing the annealing temperature. SEM revealed rather homogeneous films with an average thickness of about 10 μm. Optical absorption study in 200 - 900 nm wavelength range reveals high absorption for wavelengths (λ) less than 400 nm in the ultraviolet (UV) and visible range. The UV absorption edge of NiO nanostructured films show shorter wavelength-shift that increases with increasing the crystallite size. NiO films exhibit optical transition by both direct and indirect allowed transitions. Direct and indirect optical energy gaps were calculated and found to decrease from 3.25 to 2.87 eV and 3.84 to 3.62 eV respectively; while the width of the localized states increases from 0.306 to 0.586 eV with decreasing the crystallite size from 23.4 to 5.7 nm. Dispersion spectra, real and imaginary parts of the dielectric constant spectra are examined at high frequencies.

Keywords:

Nickel oxide; Nanostructured films; Optical properties.

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