Article

Concentration Dependence of Optical Properties in Arsenic-Doped ZnO Nanocrystalline Films Grown on Silicon (100) Substrates by Pulsed Laser Deposition

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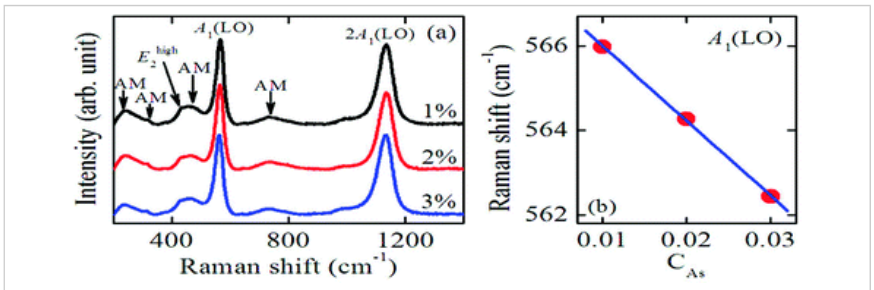
Section: Optical, Electron, and Mass Spectroscopy and Other Related Properties

Abstract



Arsenic (As)-doped (1% to 3%) ZnO nanocrystalline films with the grain size of 20 nm have been grown on silicon substrates by pulsed laser deposition. X-ray diffraction analysis shows that the films are polycrystalline and exhibit the hexagonal wurtzite phase. The As dopant effects on lattice vibrations and electronic transitions of the ZnO films have been investigated by Raman scattering and photoluminescence spectra at room temperature. With increasing As concentration, A_1(LO) phonon frequency is shifted toward lower energy side of 4 cm^{-1}. Ultraviolet and near-infrared optical transitions can be observed and remained as a constant. Moreover, orange and green luminescence are strongly dependent on the As concentration owing to different oxygen vacancy, zinc vacancy, oxygen interstitial, and morphology. Dielectric functions of the films have been determined in the photon energy from 2.5 to 6.0 eV by near-normal incident spectral reflectance. By fitting the experimental data with the Adachi's model, [Adachi, S. *Phys. Rev. B* **1987**, *35*, 7454] the optical constants and film thickness have been uniquely extracted. It is found that the dielectric function values of the

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films are less than that of undoped ZnO material, which could be attributed to the As doping and the porosity of films.

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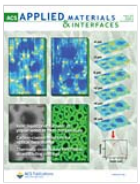

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