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Optical and Structural Characterization of ZnO Films Deposited by Chemical Bath and Activated by means of Microwaves

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Abstract. Zinc oxide (ZnO) is a direct, wide band gap semiconductor material having many promising properties for UV/blue optoelectronics, transparent electronics, spintronic devices and sensor applications. The ZnO is synthesized by the technique of Chemical Bath Deposition by microwaves heating (MW-CBD). The urea concentration in the solution is varied, maintaining constant the zinc nitrate in ratio 1:1 ... 1:10. The physical properties of ZnO thin films were examined by X-ray diffraction (XRD), SEM-EDS, and Raman scattering, which are convenient tools that can provide us with plenty of information about crystal structure and elementary excitons. By X-rays one obtains that it has hexagonal polycrystalline wurtzite type structure. The IR absorption line at 3577 cm^{-1} detected at 300 K in bath chemical ZnO is assigned an O–H bond primarily aligned with the c-axis of the crystal and bonding between Zn-O (473cm^{-1}, 532 cm^{-1}). The Raman spectra show the first order experimental Raman spectra of ZnO excited by 514.5 nm laser line. The first order Raman modes A_{1T}, E_{1T}, $E_2(H)$, A_{1L} and E_{1L} are identified as the peaks sited at 385, 426, 437, 572 and 584 cm^{-1}

Introduction

Zinc oxide (ZnO) is a semiconductor of direct band, with a wide band gap (E_G) of 3.37 eV [1] whose exciton binding energy is around 60 meV at room temperature, greater than ZnS (20 meV) and GaN (21 meV), which is of interest for its application in the manufacture of optical devices [2], solar cells [3], gas sensors [4,5]. Its photoluminescent behavior in the green band is of interest for exhibitors in flat panels, but is also used as substrate[6] or buffer layer [7] to grow GaN, or as an light emitting material by its own right [8, 9]. Also, it has a lot of industrial and technological importance, particularly in its polycrystalline presentation that is used to vulcanize rubber, and produce varistors for its marked non ohmic current-voltage characteristics [10].

Diverse techniques exist for obtaining the ZnO and a wide variety of oxides: sputtering [11], spray pyrolysis [12], sol-gel, pulsed laser deposition (PLD) [13], molecular beam epitaxy (MBE) [14], metal organic chemical vapor deposition (MOCVD) [15] and chemical bath deposition (CBD). This last technique presents the advantage of using precursor reagents in aqueous solution with easily controlled parameters. It is a cheap technique that has allowed to synthesize other types of good quality materials [16] and could represent an alternative technique to solve the problem of obtaining controlled and repetitive p-type conductivity of ZnO, due to easiness of being able to explore doping *in situ*.

We use the CBD technique but activated with microwaves, reason for which its initials change to MW-CBD. The ZnO films are grown on glass substrates, while powders are precipitated materials