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Structural investigations of bulk undoped and Ni doped ZnO samples: Role of NiO Secondary phase

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ABSTRACT

In the present paper we have performed the structural analysis of the undoped and Ni doped ZnO bulk samples. The X-ray diffraction measurements reveal the formation of the polycrystalline wurtzite phase of ZnO. From the detailed investigation it is observed that incorporation of Ni in ZnO matrix leads to the increase in the lattice parameter c which is reflected as a shift in the XRD peak of NiZnO towards lower Bragg angle. EDAX results confirm the presence of Ni with effective atomic percentage of 3.84$\pm$0.8%. Incorporation of Ni leads to the structural distortion in the host matrix.

Keywords: X-ray diffraction, Lattice parameter, Disorder, Braggs Law, EDAX

I.INTRODUCTION

Zinc oxide (ZnO) has established itself as the promising candidate material for making blue light laser sources [1, 2]. The versatility of the material lies in the fact that apart from having large band gap and large exciton binding energy, this material is also chemically stable and is environment friendly [3]. Band gap engineering in ZnO is possible by suitably doping with Cadmium (Cd) or Magnesium (Mg) [4-6]. Room temperature ferromagnetism is also reported in ZnO when doped with Co, Ni, and Mn [7, 8] and makes it an important candidate in the field of diluted magnetic semiconductors (DMSs) which have potential applicability in emerging spintronics devices [9]. It has been reported that doping ZnO with Ni not only gives room temperature ferromagnetism, but it also causes lowering of the band gap. Combining these two properties can lead to the formation of heterostructures which will give rise to spin specific potential barrier heights to the carriers. NiO is also an important semiconductor exhibiting a typical p-type conductivity, which is attributed to the plentiful intrinsic acceptor defects [10-14] and has band-gap of 3.7 eV. Some groups have also observed a spin-glass or a paramagnetic behavior in their Ni doped samples [15].

Apart from all the investigations and observations, the successful growth of single phase TM ion doped ZnO is still a challenging task. Various important properties and characteristics of ZnO derived systems like room temperature ferromagnetism, high conductivity, and optical transparency are believed to be mainly influenced by the TM ion doping and the modifications in intrinsic defect levels. Due to low solubility limit of TM ions in ZnO, it is somehow difficult to avoid the secondary phase formation. In this scenario it becomes imperative to investigate and characterize the TM ion oxide phases in ZnO matrix. In the present work, we report the