Synthesis and Investigation of Cr doped ZnO Thin Films

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ABSTRACT

Sol-gel dip coating technique is utilized to deposit thin films of Cr doped ZnO. Percentage of Cr was varied 1-2 at. Wt%. XRD confirms wurtzite hexagonal structure of ZnO. Upon increase in Cr doping percentage, crystallite size increases while the band gap decreases. Thin films are ferromagnetic and magnetic properties deteriorate with an increase in Cr doping percentage. Cr doped ZnO thin films can be an important part of spintronics and optoelectronics devices.

1. INTRODUCTION

ZnO is of special interest due to its unique electronic, magnetic and optical properties (Wang 2009). Doping with transition metals modify its properties to tailor the band gap to use in optoelectronic devices (Sun 2007). Cr\textsuperscript{3+} is of nuisance value because its ionic radius (0.063 nm) is close to Zn\textsuperscript{2+} (0.074 nm), so Cr\textsuperscript{3+} replace Zn into ZnO lattice (Aydin 2016). It has also optical, semiconducting and magnetic properties. Cr doped ZnO thin films has acquired less consideration of researchers, so in this project Cr doped ZnO thin films were dip coated to explore their properties and to be used in spintronics.Cr doping percentage was varied 1-2 at wt. %.

2. RESULTS

2.1 Structural Properties

Structural study of thin films of Cr doped ZnO with Cr doping 1-2 at. Wt. % was conducted by X-ray diffracto-meter Bruker XRD model D8 Discover (Germany).
XRD spectra of Figure 1 shows no impurity peak with all other diffraction peaks indexed to ZnO. Figure 1 shows that with increase in Cr doping percentage intensity of (101) plane is decreasing while intensity of all other peaks are decreasing.

![XRD pattern of Cr doped ZnO thin films.](image)

**2.2 Optical Properties**

The transmission curves obtained from Hitachi U 2800 are used to explored band gap of thin films. Direct band gaps are recorded by plotting $(\alpha \nu^2)$ Vs $\nu$ as displayed in Figure 2. Optical band gaps are 3.75 and 3.93 eV for thin film with 1 and 2 at wt. % Cr doping percentage. It means band gaps are increasing with increase in Cr doping percentage. Increase in the band gap with Cr doping percentage is also reported by Ajimshah 2011, Kaur 2014.
2.2.1 MAGNETIC PROPERTIES

Fig. 3 shows hysteresis recorded by Lake Shore Vibrating sample magnetometer (VSM) for Cr doped ZnO thin films. It shows ferromagnetic behaviour of thin films. It is inferred from these hysteresis that with the increase in Cr doping percentage coercivity of thin films increases while saturation magnetization decreases. Ferromagnetism of Cr doped ZnO thin films is also confirmed by Fu 2013 and Liu 2013.
3. CONCLUSIONS

Cr doped ZnO thin films were dip coated on glass substrate. Films are polycrystalline having ZnO structure with no impurity peak. Thin films are direct band gap which increases with Cr doping percentage. Magnetic properties of thin films are deteriorated with decrease in saturation magnetization and increase in coercivity.

REFERENCES


