Electrical and Optical Properties of AZO/Ag/AZO Multilayer Thin Films Prepared by DC Magnetron Sputtering

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ABSTRACT

Silver nanoparticles were deposited on aluminium doped zinc oxide (AZO) thin films and coated with AZO to fabricate AZO/Ag/AZO multilayer thin films by DC magnetron sputtering. The electrical and optical properties of the multilayer thin films were studies by using Hall measurement and UV-visible spectroscopy and compared with AZO thin films. It was found that the sheet resistance and transmittance decreases with increasing of silver layer sputtering time. The figure of merit, which is used to determine a quality of thin films for transparent conducting oxide (TCO) applications, is found to be order of 10^{-4} Ω^{-1} for AZO/Ag(10 sec)/AZO compared to order of 10^{-7} Ω^{-1} for AZO. These multilayer thin films could be explored for TCO applications.

Key words: Ag nanoparticle, Sputtering, Thin film, Al-doped ZnO, Zinc oxide

INTRODUCTION

Transparent conducting oxide (TCO) thin films such as conducting tin oxide (CTO), indium tin oxide (ITO) and fluorine-doped tin oxide (FTO) have found extensive applications in optoelectronic devices such as flat panel displays (Betz et al., 2006), dye-sensitized solar cell (DSSC) (Katusic et al., 2006). For applications, the TCO thin film properties should exhibit low resistivity and high transparency. The most widely TCO thin films are indium tin oxide (ITO) thin film because of its good electrical and optical properties (Xu et al., 2007; Kim et al., 2006). However, the ITO thin films are high cost, toxicity and indium oxide is a scarcity material. Al-doped ZnO thin films (AZO) have attracted attention as TCO thin films because ZnO is a well-known wide band gap semiconductor material, ease in doping, low resistivity, a high transparency, abundance in nature, non toxicity and low cost (Pearton et al., 2005; Banerjee et al., 2006; Jeong et al., 2006).

Many techniques such as pulsed laser deposition (Shukla et al., 2006), sol-gel route (Kuo et al., 2006), spray pyrolysis (Romero et al., 2006), filter cathodic vacuum arc (Lee et al., 2004) and magnetron sputtering (Kim et al., 2005;