The Characterization of Sputtered Nickel Oxide Thin Films by DC Reactive Sputtering for Application of an Electrochromic device

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Nickel oxide (NiO) electrochromic thin films were prepared by dc reactive magnetron sputtering. The as-deposited optical property and electrochromic behavior strongly depended on the target operation mode and the substrate temperature. The films were deposited with substrate temperature from room temperature to 300 ℃. NiO films were investigated using X-ray diffraction, FE-SEM images and Hall effect measurements. The dependences of electrochromic properties on crystalline structure deposited from heated substrate temperature during dc reactive sputtering of NiO films were studied. The preferred orientation of NiO film change from (111) to (200) when the substrate temperature increased.

1. INTRODUCTION

Electrochromic materials enable dynamic control of the throughput of radiant energy and play a significant role in energy efficient "smart windows" by reducing the cooling and lighting cost of buildings [1]. Recently, nickel oxide (NiO) is of special interest because of high color contrast ratio, cyclic reversibility, durability and low cost [2].

The NiO film can be prepared by several methods such as sol-gel processing, chemical vapor deposition, thermal evaporation and sputter deposition [3]. Among these methods, dc reactive sputtering is used to deposit NiO film in this study.

2. EXPERIMENTAL DETAILS

NiO thin films were grown on the glass using dc reactive magnetron sputtering system from Ni target (4 inch in diameter, 99.9% purity) in a mixture of oxygen and argon gases. The distance between the target and the substrate was approximately 5 cm. The chamber was evacuated to a pressure below 5×10^{-6} Torr before deposition and working pressure was 1×10^{-2} Torr. The substrate was varied from room temperature to 300 ℃ in 50 ℃ step during deposition of the NiO films. To measure the electorhcormic properties of NiO films, in these case, NiO films were deposited on the indium tin oxide glass.

3. RESULTS AND DISCUSSION

The figure presents the XRD diffraction patterns of the samples prepared at different substrate temperature with dc power of 100 W. The diffraction peaks are observed at 2θ = 37.2° and 43.3° corresponding to (111) and (200) crystal planes of the cubic NiO phase, respectively.

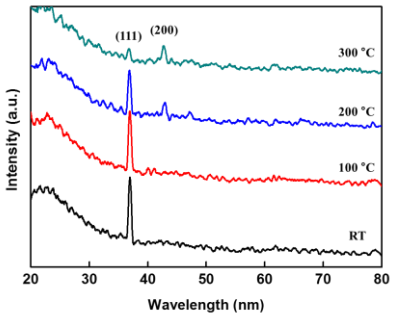

Fig. 1 XRD spectrum from the as-deposited NiO films prepared with different substrate temperature at dc power 100 W.

The electrical properties of NiO films are measured by the Hall effect measurement. The values of resistivity, mobility, Hall coefficient and carrier concentration are influenced by substrate temperature.

Also, the electrochromic properties of NiO films are measured such as cyclic voltammograms, response time and transmittance modulation between colored state and bleached state.

4. REFERENCES

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