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반응성 RF 마그네트론 스퍼터링으로 증착한 AlN 박막의 기판 온도 변화에 따른 특성 분석

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Aluminum nitride (AlN) has shown great potential for high-frequency surface acoustic wave devices and it is important to control the preferred orientation of the crystal structure with deposition parameters. Piezoelectric AlN thin films have been deposited on Au/Si (100) substrates by using reactive RF magnetron sputtering method in a gas mixture of Ar and N_2 with the variation of substrate temperature. In this paper, the effect of substrate temperature on the microstructural properties of AlN thin films have been investigated by using X-ray diffractormeter (XRD), Scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS) and Atomic force microscope (AFM). It was found that the crystal orientation and surface morphology have a strong dependence on substrate temperature. While the substrate temperature was varied in the range up to 400℃, highly c-axis (002) oriented film can be obtained at 300℃ with full width at half maximum (FWHM) 3.1°. Increase in surface roughness from 3.9 nm to 5.9 nm found to be associated with increase in grain size, with substrate temperature; however, the AlN film fabricated at 400℃ exhibited a granular type of structure with non-uniform grains. The Al $2p_{3/2}$ and N $1s$ peak in the XPS spectrum confirm the formation of Al-N bonds. The XPS spectrum also indicates the presence of oxynitrides and oxides, resulting from exposure to air and the presence of oxygen in the vacuum chamber. It is concluded that the AlN film deposited at substrate temperature of 300℃ exhibited the most desirable properties for the application of high-frequency surface acoustic devices.