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## Reactive magnetron sputtering of epitaxial grown aluminum nitride on sapphire

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The piezoelectricity of aluminum nitride (AlN) is widely used in industry for MEMS sensors and actuators [1]. Besides, AlN can be utilized for energy harvesting from mechanical vibrations where it even succeeds the performance of lead zirconate titanate (PZT) due to its low permittivity [2, 3]. In recent years, AlN has gain much attention in the field of ultraviolet (UV) photonic devices due to its high band-gap (6,2 eV), large thermal conductivity and low thermo-optic coefficient [4].

In this study, AlN was deposited on a c-plane (0001) sapphire substrate by using reactive magnetron sputtering with a scia Magna 200 at an elevated substrate temperature of 450 °C. Detailed information about the sputtering system, process parameter settings and process monitoring are presented. It is shown, that optical emission spectroscopy is a powerful method to characterize the process at high N<sub>2</sub>/Ar ratio and elevated substrate temperature.

The crystal structure was investigated by using x-ray diffraction (XRD). The existence of the (0002) peak shows the epitaxial growth of the AlN on the (0001) sapphire. Further study of the crystalline lattice was done by rocking curve measurements. Atomic-field microscopy was used to extract the surface roughness. Further, optical properties were investigated by ellipsometry. As a result, the deposited 300 nm thick AlN layer is c-axis textured which is confirmed by a FWHM of 1,5° (rocking curve measurement) The surface roughness measurement yield 1.7 nm RMS. This investigation proves the excellent crystalline quality of the sputtered AlN which makes it suitable for UV photonic devices and MEMS.

[1] A. Igbal et al., DOI: 10.3390/s18061797

[2] A. Bertacchini et al., DOI: 10.1109/ESSDERC.2011.6044220

[3] C. Fei et al., DOI: 10.1016/j.nanoen.2018.06.062

[4] C. Xiong et al., DOI: 10.1142/S0129156414500013

### Keywords

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