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Highly c-axis oriented AlN film grown by unbalanced magnetron reactive sputtering and its electrical properties

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Abstract

Highly c-axis oriented aluminum nitride films have been successfully grown by DC magnetron reactive sputtering with unbalanced magnetic fields at room temperature. It is shown that the application of unbalanced magnetic fields can improve the extent of preferential growth along the c-axis, and form AlN films with denser, larger grains and smaller surface roughness, compared to that grown with balanced magnetic fields. The AlN films prepared under optimized growth conditions have a dielectric constant of approximately 10.5 and a dielectric loss of 0.02 in the frequency range of 10^3 - 10^6 Hz, and a leakage current of $<1 \times 10^{-7}$ A/cm² at 5 V bias voltage, all the dielectric and insulating properties being superior to the films synthesized with balanced magnetic fields. In this work, the unbalanced magnetic fields are induced by adding an electromagnetic coil on the magnetron cathode.

Keywords: Aluminum nitride; Thin films; Magnetron reactive sputtering; Unbalanced magnetic field; Additional magnetic field; Electric properties

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