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Improvement mechanism of sputtered AlN films by high-temperature annealing

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Abstract: The improvement mechanism of sputtered AlN films by high temperature annealing in nitrogen ambient has been investigated. Sputtered AlN films were annealed at 1100–1700 °C and their microstructures were observed by scanning transmission electron microscopy. A two-layer structure consisting of columnar domains with different sizes was observed in the as-grown sputtered AlN films. The first layer with 10 nm thickness located at the AlN/sapphire interface, comprised columnar domains with diameters of nm order and was compressively strained owing to the lattice mismatch between AlN and sapphire. The diameter of columnar domains in the other layer was approximately 25 nm. The columnar domains split into irregularly shaped and coalesced at an elevated annealing temperature, resulting in improved crystal quality. When the annealing temperature was 1700 °C, the domain boundaries in AlN films were almost annihilated and the full width at half maximum of the (0002)- and (10-12)-plane X-ray rocking curves were improved to as low as 49 and 310 arcsec, respectively. The polarity switched from N-polar to Al-polar after about 4–10 AlN layers in the growth direction.