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Semi-insulation Behavior of GaN Layer Grown on AlN Nucleation Layer

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The sheet resistance (Rs) of undoped GaN films on AlN/c-plane sapphire substrate was investigated in which the AlN films were grown by R. F. magetron sputtering method. The Rs was strongly dependent on the AlN layer thickness and semi-insulating behavior was observed. To clarify the effect of crystalline property on Rs, the crystal structure of the GaN films has been studied using x-ray scattering and transmission electron microscopy. A compressive strain was introduced by the presence of AlN nucleation layer (NL) and was gradually relaxed as increasing AlN NL thickness. This relaxation produced more threading dislocations (TD) of edge-type. Moreover, the surface morphology of the GaN film was changed at thicker AlN layer condition, which was originated by the crossover from planar to island grains of AlN. Thus, rough surface might produce more dislocations. The edge and mixed dislocations propagating from the interface between the GaN film and the AlN buffer layer affected the electric resistance of GaN film.

Keywords: GaN, semi-insulating, AlN nucleation, dislocation