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Properties of AlN layers grown on c-sapphire substrate using ammonia assisted MBE

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Abstract

AlN epilayer properties (120 nm thick) grown by ammonia assisted molecular beam epitaxy on c-sapphire substrates with different low temperature AlN buffer layers (LT-BL) have been studied. The role of the LT-BL on the AlN structural and optical properties was investigated as a function of the LT-BL thickness and growth temperature. Optimum growth conditions were identified with LT-BL thickness of 3 nm and growth temperature between 480°C and 520°C. It was shown that by optimizing these conditions, a reduction of both mixed and edge threading dislocation densities up to 75 % is achieved. The impact of the growth temperature of the AlN epilayer was also studied showing an additional improvement of the AlN crystal and morphological properties while growing at higher temperature. A correlation between the epilayer strain and the PL emission was also investigated. Finally, an Al_{0.7}Ga_{0.3}N:Si doped layer was grown on the top of the optimized AlN template showing a smooth surface with monoatomic steps and a roughness ~ 0.2 nm, confirming the potential of such templates for the fabrication of AlGaN based heterostructures.

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