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Structural and Optical properties of Si-doped AlN SASHIKANTH MAJETY, BED PANTHA, ASHOK SEDHAIN, JING LI, HONGXING JIANG, JINGYU LIN, Texas Tech University — A lot of research has focused on controlling the conductivity in AlN by Silicon doping. AlN has the widest bandgap (∼6.1 eV) among III-Nitride semiconductors and exhibits excellent properties such as high temperature stability, high thermal conductivity, and deep ultraviolet transparency. In the AlN material system, doping causes crystal imperfections which can affect the structural and optical properties of the AlN epilayers. In this work, we investigated the impact of Si incorporation on the structural and optical properties of AlN epilayers. The formation of edge dislocations in Si-doped AlN is explained by the built-up tensile stress in the epilayers as revealed by X-ray diffraction measurement. Photoluminescence (PL) studies revealed that the full width at half maximum of both band-edge emission and impurity related transitions are correlated with the density of screw dislocations, N_{screw}, which is found to increase with increasing doping concentration of Si (N_{Si}). In addition, it was formulated that the band-edge (impurity) PL emission linewidth increases linearly with increasing N_{screw} at a rate of ∼3.3±0.7 meV/10^8 cm^{-2} (26.5±4 meV/10^8 cm^{-2}), thereby establishing PL measurement as a simple and effective method to estimate screw dislocation density in AlN epilayers.

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