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Preparation of Crack-Free $Al_xGa_{1-x}N$ Films with High Al Composition for Schottky-Type UV Detectors

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High-quality $Al_xGa_{1-x}N$ layers with an Al composition of x=~0.4 were prepared on a GaN/sapphire substrate by a combination of controlling the growth kinetics, resulting in a slow growth rate of 5 nm/min, and introducing a stress-compensating thin AlGaN interlayer between the $Al_xGa_{1-x}N$ and GaN layers. To control the growth kinetic activity, the reactor pressure, TMAl/TMGa flow rate, and H_2/NH_3 flow rate were all adjusted to obtain less-defective and homogeneous $Al_xGa_{1-x}N$ layers with high Al compositions, and optimized at a reactor pressure of 50 torr, TMAl/TMGa flow rate of 70/40 μmol/min, and H_2/NH_3 flow rate of 6/6 slpm. As a result, the sequential growth of an $Al_xGa_{1-x}N$ layer on a 10-nm-thick AlGaN interlayer grown at 700°C on a 2.0-μm-thick GaN layer finally produced a crack-free, less defective, homogeneous $Al_{0.33}Ga_{0.67}N$ film with 0.5 μm thickness. Thereafter, a typical Schottky diode of Pt/$Al_{0.33}Ga_{0.67}N$/LT-AlGaN interlayer/n^+-GaN exhibited a promising electro-optical sensitivity, including a reverse leakage current of 1 nA at –5 V, UV-visible extinction ratio of ~10^4, and responsivity of 150 mA/W at a radiation wavelength of 280 nm.

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