# Basic characteristics of ultrathin InN layers prepared by sputtering on various AlN templates

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Among III-nitride semiconductors, InN has the smallest electron effective mass and the highest peak drift velocity and electron mobility. Therefore, InN is believed to be a promising material for high-speed or high-frequency devices. However, it is known that InN has a high density of electrons at the interfaces, which makes operation of InN-based field effect transistors difficult. It is also known that AlN has large spontaneous polarization and it should affect the electron concentrations at the interfaces of InN. In fact, theoretical investigation has predicted that the sheet charge density induced by spontaneous polarization at the interface between AlN and InN varies from negative to positive when the polarity changes from Al to N-polar. In this work, we have investigated the structural and electrical characteristics of sputtering InN ultra-thin films prepared on various AlN templates.

First, we prepared Al-polar AlN (template A) grown on sapphire by HVPE and Al-polar AlN (template B) grown on sapphire by MOCVD. N-polar bulk AlN and N-polar AlN templates prepared by sputtering were also used. Ultra-thin InN films were grown on AlN templates by sputtering. Characteristics of ultra-thin InN films were investigated by atomic force microscopy, X-ray diffraction, and Hall-effect measurements.

Figure 1 shows the surface of 1 nm-thick InN films on AlN template A and B. Judging from root mean square value of surface roughness, we can conclude that 1 nm-thick InN on AlN template B showed a flatter surface than that of AlN template B. Full width at half maximum of 10-10 X-ray rocking curves and calculated a-axis lattice constant of 1 nm-thick InN on both AlN templates are shown in Table 1. This result indicates 1 nm-thick InN was strongly compressed and possesses higher crystallinity.

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Table 1 The results of X-ray diffractions of 1 nm-thick InN

| | on AlN template A | on AlN template B |
|---|---|---|
| FWHM of 10-10 XRC | 0.438° | 0.293° |
| *a*-axis lattice constant | 3.428 Å | 3.442 Å |

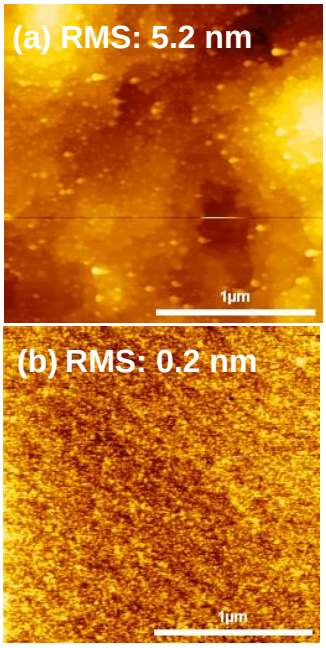


Fig. 1 AFM images of 1 nm-thick InN films on AlN templates (a) A and (b) B.