Chapter 5 Conclusion

In this thesis, we had studied the V shaped defects on GaN film from AFM images and profiles. We also employed the μ-Raman scattering to characterize the optical properties of V-defects. Raman spectra of V-defects in different doping concentration and different sizes had been measured and discussed. Besides, quantitative analyses on the V-defects by LO phonon plasmon coupling model and effective electron density were also carried out.

From the optical and AFM images, morphologies of V-defects were observed. The six side lines separate into twelve and form additional six facets in V-defects larger than 4.8μm. The vertex angles of V-defects are obtained by subtracting the angles between plain and facets. The vertex angles in different size V-defects are in the range of 76^{o}~82^{o}.

Raman spectra of V-defects and the plain region in different doping concentration samples had been studied. The spectra of the plain region in these samples indicate that the two LO related peaks are A_1(LO) of *u*-GaN layer and LOPC of *n*-GaN layer. The spectra of 3.3μm V-defects show distinct blue shift as large as 3.4cm^{-1} and broadening about 4.9cm^{-1} comparing with those of the plain region.

For V-defects of different sizes, forbidden Raman modes A_1(TO) and E_1(TO) appeared gradually and LO related peaks blue shifted by 6cm^{-1} in 6.0μm V-defect. We believed that the forbidden modes are caused by the right angle scattering because of the change of morphology. The blue shifts of LO related

modes manifest the interaction between phonon and plasmon, as induced by higher dislocation density under V-defects. Line scan Raman spectra of 6.0μm V-defect provide a further support of the assumption. Gradual displacements of LO related modes and occurrence of forbidden modes from the plain region to the center of the V-defect also favor this suggestion.

In order to examine the influence of dislocation density on free carrier concentration, LO phonon plasmon coupling model and effective electron density were applied. The simulations reflect that dislocation density inside V-defects is on the order of $10^{10}cm^{-2}$, and 10^{8}~$10^{9}cm^{-2}$ in the plain region. All the results show that the dislocation density inside V-defects plays an important role of carrier supply.