Chapter 6

Concluding remarks

This dissertation is a summarization of research on thin film growth and the material properties of rare earth doped GaN. The author showed a very stable luminescence property against temperature variation, high emission efficiency, and carrier-mediate emission property of Eu doped GaN. Those results relate the potential of application to photonic devices. The author clarified the emission mechanisms by comparing energy transfer models, and coordination symmetries of Eu doped GaN and Tb:GaN. The author also introduced the magnetic properties of RE:GaN measured by magnetization measurements for DMS application .

In this dissertation, the author showed the potential of RE doped GaN for a material of novel optical application through the researches on,

- **Structural properties of Eu doped GaN,**
  - Single crystalline growth of 0.1 at.% Eu doped GaN
  - Mixing of Cubic phase and twin structure was observe in 2 at.% Eu doped GaN
  - Phase separation into GaN and EuN observed in 16 at.% Eu doped GaN
- **Optical properties of Eu doped GaN,**
  - Sharp and stable red luminescence from Eu3+ observed.
  - Carrier mediate luminescence (PLE).
  - Luminescence intensity proportional to Eu content up to 2 at.%. doped GaN.
  - Concentration quenching observed at 16 at.% Eu doped sample Defect related energy transfer suggested.
- **Comparative studies between RE doped GaN,**
  - luminescence from Tb^{3+} observed.
  - Remarkably weaker luminescence intensities compared to Eu doped GaN.
  - Low energy transfer efficiency caused by mismatching between the defect level and excited state of Tb doped GaN.
  - Lower coordination symmetry causes higher transition probability results in stronger emission intensity of Eu doped GaN.

Additionally, the author also introduced,

- **the magnetic properties of RE doped GaN for the application to DMS.**