In-situ Monitoring of GaN Film in Process Plasma

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1. Introduction

Gallium nitride (GaN) is now looking forward to high power devices next to blue LEDs. The advantage of such a semiconductor is that the devices can be integrated with the combination of printing and plasma technology. However, the use of plasma is sometimes problematic. As seen in other semiconductor devices, plasma can induce damages on fabricating devices so that we should have good understandings of the mechanisms to create the damages through processing plasmas.

We have analyzed the damage developments with in-situ monitoring of GaN film that is exposed in argon plasma by photoluminescence (PL) method.[1] Our previous works showed that the ratio of blue luminescence (BL) band over the near-band edge (NBE) indicates the degree of damage, which enables in-situ damage monitoring.[1]

In this presentation, we will show the recent progresses from in-situ monitoring of GaN exposed in plasma. This time, chlorine-containing plasma will be utilized due to the fact that the gas is common to etch GaN films.

2. Experimental

The apparatus utilized in this experiment is omitted here because it has been shown elsewhere.[2] Here, we made a bit of change in the feeding gas to create the plasma. The mixture gas of argon (1.6 Pa) and chlorine (0.7 Pa) was utilized in order to make a stable plasma with inductive mode.

Fig. 1 is one of our preliminary results, which shows the change in the PL spectrum from GaN after plasma exposure for 30 min. As seen in the figure, the plasma exposure made only a slight change in the PL spectrum. The indication of plasma damage should have been observed in BL band (400 – 480 nm) if the damage would have been created and followed with former results from argon plasma. The possible reason for this result is because we had low plasma-density and the ions were not reactive enough. Our step-profiling measurement also showed no evidence for etching so that this result supported the in-situ measurement.

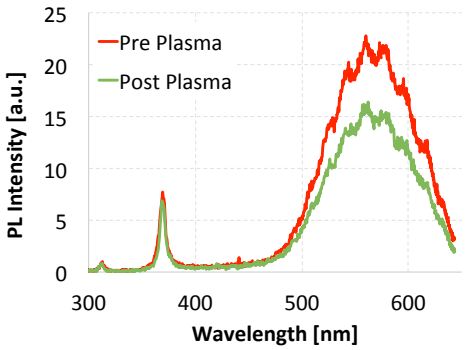

Fig. 1: PL Spectrum from GaN before and after the argon-chlorine plasma exposure.

References

1. Chen et. al., *Appl. Phys. Lett.*, **101** (2012) 071105.
2. Ogawa et. al., 61th JSAP Spring Meeting 18p-PA6-4.