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Damage development of gallium nitride under plasma exposure

DAISUKE OGAWA, YOSHITSUGU BANNO, YOSHITAKA NAKANO, KEIJI NAKAMURA, Chubu University — Plasma damage has been focused on since 1990s. In this era, this issue was mainly targeted onto silicon-based semiconductors. However, since the gallium nitride (GaN) was paid attention to after blue LEDs, they start to consider the damages given to GaN as well. We have so far utilized photoluminescence (PL) emission from the surface of GaN film to monitor the evolution of damage given by plasma exposure. This measurement gives us clues how plasma exposure changed intermediate electronic states in the film without taking the film out of the chamber. First of all, we analyzed the development of damage given by argon plasma, which is one of the most fundamental plasma to analyze. Argon plasma is responsible to give only physical damages over a GaN film. Our PL measurements showed a significant decrease within approximately 10 seconds after the plasma exposure started. This means that ions and radiations created from the plasma give significant damages to the GaN film even short period of time. Chlorine-related gas is normally utilized for chemical etching. Chlorine species realize continuous damage layer removals, but some reports already mentioned that the processed device has different electrical properties after the plasma exposure. In this presentation, we will show what happens to GaN film after the plasma exposure in terms of crystal structure and impurities of GaN, by connecting PL emission and ex-situ measurements.

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