The effect of the environment temperature of the wafer on InGaN grown by metalorganic vapor phase epitaxy

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Nowadays, nitride-based semiconductor allows people to obtain light emission from ultraviolet to green. But for longer-wavelength device with high indium content, such as yellow or red, the efficiency is still very low because of poor quality of InGaN active layer. One of the main reason is low growth temperature which leads to a low actual V/III ratio [1]. Thermodynamic calculations predict that ammonia (NH_3) decomposition plays a significate role on InGaN growth [2]. However, there were few reports on the effect of environment temperature on InGaN growth. In this work, we demonstrated a new method to change the environment temperature in order to change vapor phase reaction with the same wafer surface temperature as in a horizontal metalorganic vapor phase epitaxy (MOVPE) reactor. The dependence of the InGaN quality on environment temperature in the reactor was investigated.

A schematic configuration of the MOVPE reactor is shown in Fig. 1. Four kinds of wafer trays with different gaps between the wafer tray surface and wafer bottom are prepared. The wafer tray gaps were 150, 500, 1000 and 1500 μm. Wafer surface temperature decreases with the increasing tray gap. Thus, when we keep surface temperature constant, the environment temperature relatively increases. Five periods InGaN/GaN multi quantum well structures were grown on 2 μm-thick undoped GaN/sapphire templates at different temperature for each wafer trays. The thickness of InGaN well layer and GaN barrier layer is 1.5 nm and 3 nm. Triethylgallium (TEG), trimethylindium (TMI) and NH_3 were used as the gallium, indium and nitrogen sources, respectively.

Figure 2 shows the dependence of the peak photoluminescence (PL) intensity on the wafer tray gap. PL intensity increases with the increasing wafer tray gap. We assume that this phenomenon is explained by vapor phase reaction at higher environment temperature. A detailed discussion will take place at the meeting.

Acknowledgements: This work was partially supported by JSPS KAKENHI (16K06260) and JST SICORP V4-Japan research projects.

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[2] A. Koukitu *et al.*, Journal of Crystal Growth 170 (1997) 306.

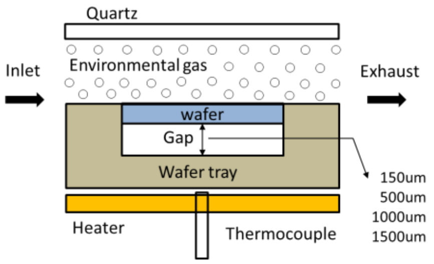

Fig.1 Schematic configuration of the MOVPE reactor.

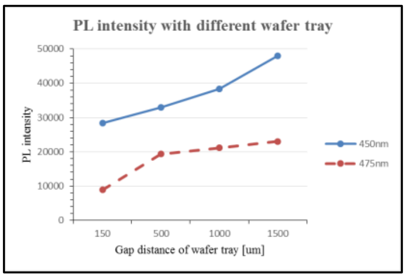

Fig.2 PL intensity dependence on wafer tray gap.