Effective Mass in Zinc Nitride Thin Films
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**INTRODUCTION:** Zn$_3$N$_2$ is an $n$-type nitride semiconductor. We reported electrical properties of Zn$_3$N$_2$ polycrystalline films which had high mobilities (~85 cm$^2$V$^{-1}$s$^{-1}$) [1]. To evaluate Zn$_3$N$_2$ as a semiconductor, research on effective mass ($m^*$) in Zn$_3$N$_2$ is still needed.

**EXPERIMENTS:** Zn$_3$N$_2$ films were grown on YSZ(100) heated at 100–250 °C by reactive sputtering technique. The Infrared transmittance ($T$) and reflectance ($R$) were measured using a FTIR spectrophotometer. We performed fitting analyses of $T$ and $R$ spectra using the Drude model (Drude fitting) in order to derive $m^*$. 

**RESULTS & DISCUSSION:** All the films in this study were confirmed to be a degenerate semiconductor possessing $n_e$ on the order of $10^{19}$ cm$^{-3}$. As seen in Fig. 1, $T$ and $R$ spectra of Zn$_3$N$_2$ epitaxial films clearly exhibited Drude-like behavior. The spectra could be reproduced well by using the Drude model (continuous lines in Fig. 1). In the Drude fitting procedure, plasma frequency ($\omega_p$) and scattering time were used as fitting parameters. We calculated $m^*$ values from $\omega_p$ and carrier concentration ($n_e$). As shown in Fig. 2, $m^*$ increased with an increase in $n_e$. Such behavior is usually interpreted in terms of non-parabolicity of the conduction band. We adopted a non-parabolic band model proposed by Pisarkiewicz et al. [4] to analyze $n_e$ dependence of $m^*$. The solid line in Fig. 2 presents the best fit of the non-parabolic model to the experimental data. From this result, the effective mass at the bottom of the conduction band ($m_0^*$) was deduced to be $m_0^* = 0.073 m_0$ ($m_0$ denotes free electron mass). The $m_0^*$ value is as small as those in GaAs and InN. These results suggest that Zn$_3$N$_2$ is a very promising as a high mobility semiconductor.

**REFERENCES**