Enhancement of photocurrent in thin film dilute nitride cells separated by epitaxial lift-off technique

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Recently, the epitaxial lift-off (ELO) technique[1,2], which enables to separate the epitaxial layer from its substrate and to reuse the separated substrates, attracts much interest for a large potential of the cost reduction in III-V solar cells. In the thin film solar cells, not only for the application to novel functional devices with flexibility and light weight properties, but also several approaches of the optical management to enhance the light absorption by increasing the optical path length were studied[3,4]. In this work, we adopted the ELO technique to the dilute nitride GaInNAsSb solar cells, and demonstrated the enhancement of the photocurrent due to the light confinement effect in the released ELO thin film cell.

GaInNAsSb samples were grown by molecular beam epitaxy. The *n-i-p* GaInNAsSb solar cell structure was grown inverted on an AlAs release layer/GaAs substrate. We adopted weight assisted ELO method[2] with ~10% HF at ~25°C, and the device film was successfully separated without any cracks. No anti-reflection coating was deposited in this study.

Shown in Fig.1 are light current-voltage and external quantum efficiency (EQE) curves for the ELO thin film GaInNAsSb cell, and those for the GaInNAsSb cell on GaAs substrate are also plotted as the references. In the ELO thin film cell, clear enhancement in short circuit current density and EQE are observed. This indicates that additional chance to absorb transmitting photons in the GaInNAsSb layer contributed to the increase in the current density and EQE by removing the thick substrate.

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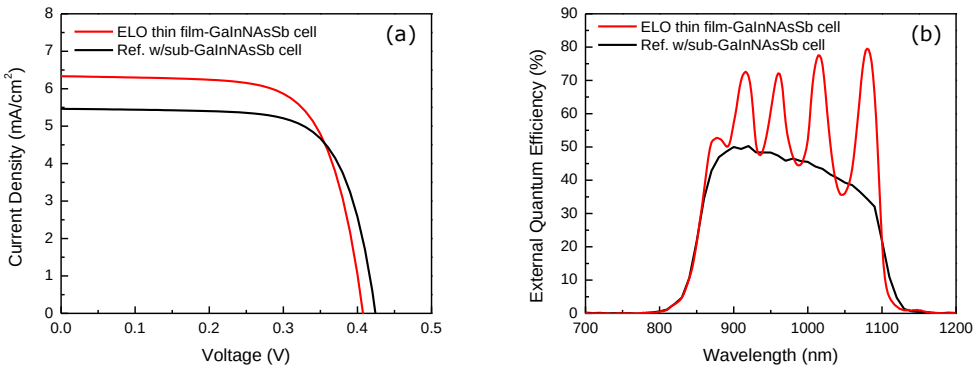

Figure 1 (a) Light I-V curves and (b) EQE spectra of the ELO thin film cell and reference cell measured under a long pass filter whose cut-off wavelength is nearly same as the GaAs absorption edge.