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Optical transitions in $Al_xGa_{1-x}N$ films grown by metal-organic chemical vapor deposition

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$Al_xGa_{1-x}N$ films with x ranging from 0 to 0.4 have been grown on c-plane Al_2O_3 substrate by using metal-organic chemical vapor deposition (MOCVD). The Al content x of $Al_xGa_{1-x}N$ films was controlled by the TMAl and the TMGa flow rates, and it was determined by X-ray diffraction (XRD), and photoluminescence (PL) measurements.

The optical properties of the $Al_xGa_{1-x}N$ film were investigated by PL measurement. The intensity of the PL peak decreased with increasing Al content. It is indicates that significant nonradiative carrier loss occurs before carriers thermally relax and become localized. The temperature dependence of PL peak position was fitted by Varshni's equation near room temperature and deviates from the expected temperature dependence at low temperature by an amount that increases with the Al content of the sample. The position of the transition temperature (T_m) for the different temperature dependence of the PL peak position went to higher with increasing Al content, which could be understood in terms of the localized exciton transition in the tail states due to alloy fluctuations.