Step Flow Growth Mode of N-polar Ga(In)N Structures under N-rich conditions in Plasma-Assisted MBE

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Growth of GaN layers on bulk GaN $(000\bar{1})$ substrates by plasma-assisted molecular beam epitaxy (PAMBE) was studied. Influence of growth parameters: III/V ratio and substrate offcut on the morphology of GaN and InGaN layers grown at 650-750°C was investigated.

We found that for the growth under nitrogen excess the growth mode was changed from 3D growth (Fig. 1(a)) to layer-by-layer growth (Fig. 1(b)) on $(000\bar{1})$ orientation by using increased nitrogen flux and offcut angle of the substrates. The same conditions for growth of GaN on (0001) GaN surface orientation resulted always in 3D morphology. This difference can be attributed to higher gallium adatoms mobility on $(000\bar{1})$ than on (0001) nitrogen terminated surfaces [1].

We investigated also the PAMBE nitrogen – rich growth of $(000\bar{1})$ InGaN/GaN quantum wells. The role of the growth temperature on the PL emission intensity was studied. High growth temperature promotes increase of the PL intensity which can be explained by lower unintentional oxygen incorporation [2].

Optimal growth conditions for GaN and InGaN layers will be presented. Experimentally observed crystal morphologies will be compared with Monte Carlo simulations.
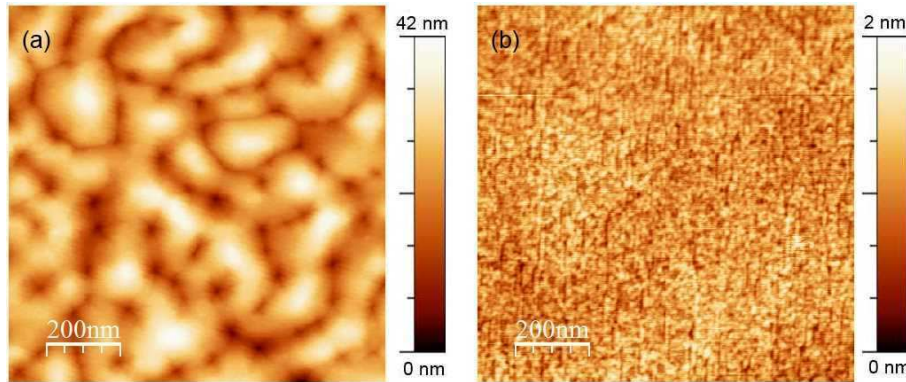

Fig. 1.

Morphology of GaN layer grown on bulk $(000\bar{1})$ GaN substrates using (a) nitrogen flux of $3.6 \cdot 10^{14} \frac{atoms}{cm^2}$, offcut angle of 1 deg, and (b) nitrogen flux $1.1 \cdot 10^{15} \frac{atoms}{cm^2}$, offcut angle 4 deg.

[1] T. Zywietz et al., Appl. Phys. Lett., **73** (1998) 487,
[2] T. Zywietz et al., Appl. Phys. Lett., **74**, (1999) 22.