Self-Assembled Indium Nitride Nanocolumns Grown by Molecular Beam Epitaxy

Hock M. Ng
Bell Laboratories, Lucent Technologies
600 Mountain Ave, Murray Hill, NJ 07974, USA

Rong Liu and Fernando Ponce
Department of Physics and Astronomy,
Arizona State University, Tempe, AZ, 85281, USA.

Indium nitride (InN) has recently drawn the attention of the semiconductor research community as a result of the experimental observations that indicate a much smaller direct bandgap [1] (0.7-0.8 eV) than what was previously measured (1.9 eV). This finding has consequences that will impact optoelectronic devices based on InN. As such, it is important to study and understand the epitaxial growth of InN. In this work, I will discuss the growth behavior and structural characterization of self-assembled InN nanocolumns on c-plane sapphire by plasma-assisted molecular beam epitaxy (MBE).

The morphology of InN was studied using scanning electron microscopy (SEM). As shown in Figs. 1 to 3, self-assembled nanocolumns with heights up to 0.5 μm were observed. The InN nanocolumns have the wurtzite structure and were found to have the (0001) orientation along the growth direction as measured by x-ray diffraction. The ω rocking curve full-width at half maximum (FWHM) was between 0.23 and 2.3° for a range of different samples. It is still unclear at this time whether these nanocolumns have In- or N-polarity. The average diameter of the nanocolumns from different samples was between 50 and 200 nm. By increasing the In/N ratio, the nanocolumns gradually increased in diameter and grew as continuous films at higher In/N ratio. When the In flux was further increased, In droplets started to form on the surface of the film.

Preliminary transmission electron microscopy (TEM) and selected area diffraction results also support the fact that the nanocolumns are single crystals with wurtzite structure.

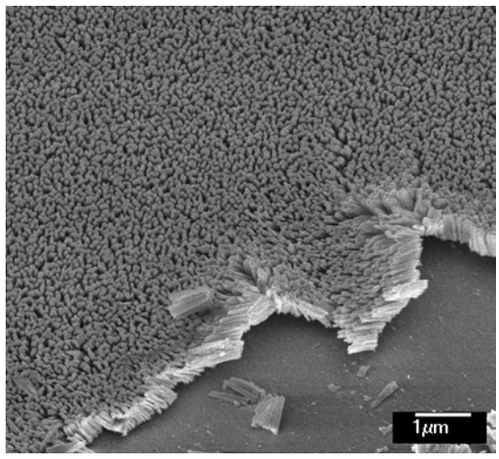

Fig. 1. SEM image of the InN nanocolumns grown on (0001) sapphire.

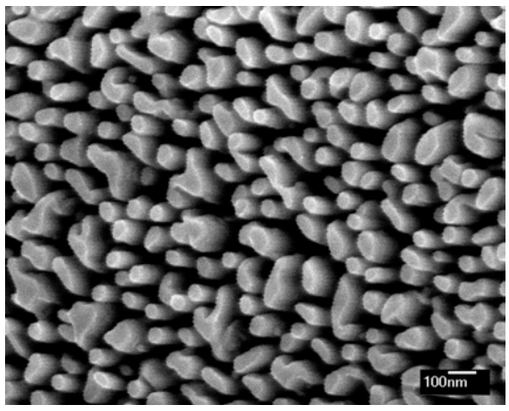

Fig. 2. High magnification top view of the InN nanocolumns.

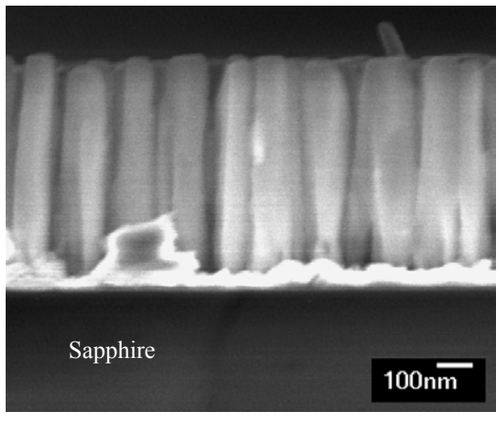

Fig. 3. Cross-sectional SEM image of the InN nanocolumns.

REFERENCES

1. V.Y. Davydov *et al.*, Phys. Stat. Sol. (b) **229**, R1 (2002); J. Wu *et al.*, Appl. Phys. Lett. **80**, 3967 (2002); T. Matsuoka *et al.*, Appl. Phys. Lett. **81**, 1246 (2002).