Arsenic-diluted gallium nitride alloys with high As concentration grown by MOVPE

Nowadays GaNAs is the only well investigated III-N wurzite nitride alloy containing As. Experimental data describing growth and properties of this material come from samples grown via MBE. Incorporation of As into GaN crystal requires relatively low growth temperatures which leads to poorer crystal quality in comparison to state of the art GaN. Elaboration of the growth of high quality GaNAs with significant amount of As (between 1% and 10%) is desirable as this material presents interesting bandgap behavior, promising among others, better p-doping and light extraction for optoelectronic devices.

In ”Arsenic-diluted gallium nitride alloys with high As concentration grown by MOVPE” project we intend to develop ways of growing GaNAs that would allow new investigation of this interesting material. Closer investigation of As influence on the material band structure will be performed. We also plan to check arsenic influence on p-doping of gallium nitride. Well established methods of growing GaNAs, if realized, should also serve as good base for further development of III-V group alloys growth involving AlGaNAs, various heretostructures or use of hexagonal boron nitride.

So far with standard TMGa and NH_3 and unusually TMAs as precursors for Ga, N and As respectively first samples containing GaNAs were grown. HR-XRD shown that As contents of up to 5% were realized and in temperature range between 665 °C and 740 °C As incorporation increases as temperature decreases. XPS analysis of the samples confirms previous findings about shift of valence band maximum caused by As addition to GaN structure (Fig. 1). Values of this VBM shift for samples with 0.6%, 1.7% and 5% of As are 0.7 eV, 1 eV and 1.9 eV correspondingly.

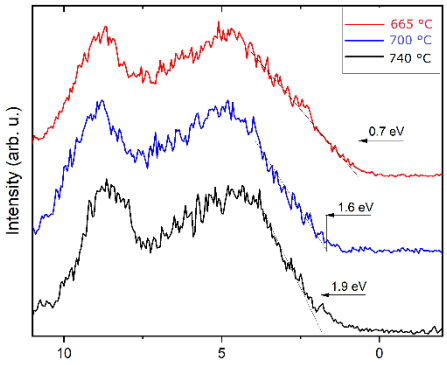

Figure 1 Valence band spectra for 3 of GaNAs samples. The VBM distance from Fermi level shift from value for undoped GaN equal to 2.6 eV is plainly visible and correlated with As content.

AFM scans of samples morphology shown atomically flat surfaces with RMS roughness of ~1 nm for samples grown in higher temperatures. Roughness decreases with reduced temperature but it is not clear if that is directly caused by lower growth temperature or indirectly through higher As concentration in grown layers. Altogether those results prove GaNAs MOVPE growths to be promising research direction to be explored in the project.