ESRF	**Experiment title:** **Study of the In incorporation inside AlGaN:In** **Étude de l'incorporation de l'In dans AlGaN:In**	**Experiment number**: 30.02.614
Beamline: BM30B	**Date of experiment**: from: 09/07/2003 to: 12/09/2003	**Date of report**: 14/10/2003 *Received at ESRF:*
Shifts: 9	**Local contact(s)**: Xavier BIQUARD	

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Report:

Overview

The allocated beamtime was just sufficient to realize most of the study described in our proposal and we have recorded room-temperature fluorescence EXAFS and XANES spectra at the In K-edge (27.94keV) using the 30-element energy-resolved detector.

It was the first time that FAME was used to reach such a high energy edge. The beamline mirrors M1 and M2 were thus escaped, and the monochromator directly received the full incoming X-ray beam. Therefore, the front slits had to be closed to 1.5x40 mm2 to make the monochromator's LN_2 cooled first crystal temperature stable around -141°C.

Studied samples are made of AlGaN epilayers doped with different amount of In and deposited onto a thick GaN substrate. Therefore, the fluorescence detector was completely saturated with Ga K emission lines, and two 6µ filters of Cu and Co were used to desaturate the detector. Also, the Compton diffusion was very intense, so that for In content around 2%, it was difficult to record correct XAS datas. Finally, we had a lot of Bragg diffraction peaks superimposed on absorption spectra. Therefore, prior to data acquisition, we have extensively used quick-EXAFS scans to adjust X-ray incident angle on sample to minimize the number of (annoying) Bragg peaks.

Studied samples

As reference, we used a metallic In foil, In(9%):GaN (E338) and In(8%):AlN (S1447). We were able to record good quality XAS spectra for 4 samples: In(2%)Al(41%)Ga(57%)N (S1352), In(7%)Al(24%)Ga(69%)N (S1264), In(11%)Al(36%)Ga(53%)N (S1251) and In(14%)Al(22%)Ga(64%)N (S1249).

Results

Figure A and B shows the comparison of all recorded EXAFS data: EXAFS oscillations and pseudo-radial distribution. Clearly, there is a major change in second nearest neighbors nature with the amount of incorporated Indium.

1. As awaited, In:GaN (E338) and In:AlN (S1447) are completely different since 12 second neighbors of Ga are remplaced by 12 Al: less intense EXAFS oscillations and droping more rapidely.
2. The S1352 (2% In) look neither like In:GaN (E338) or In:AlN (S1447)
3. The S1264 (7% In) and E338 are very similar: 7% of In inside AlGaN look like In:GaN
4. The S1251 (11% In) and S1249 (14% In) are very different from E338. Back-scattering by the second nearest neighbors shell is much less intense: part of the 12 Ga may have been substituted by Aluminum or some In have specifically incorporated inside Al shell.

As detailed analysis is still under way, no clear conclusion are yet available. Nevertheless, we may reject the hypothesis of an In incorporating preferentially with a Ga surroundings shell independently of the Al presence, since the S1352 (2% In) doesn't look like the E338, but the S1264 (7% In) does. Clearly, In incorporation site depends on both Ga and Al.

Figure A: Comparison of recorded EXAFS oscillations

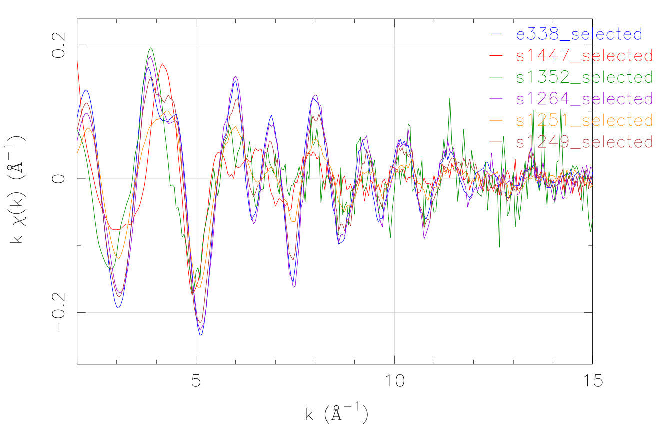

Figure B: Comparison of all pseudo-radial distributions