EUROPEAN **S**YNCHROTRON **R**ADIATION **F**ACILITY

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ESRF

ESRF	**Experiment title:** Short range ordering in InGaAsSbN dilute quantum wells probed by Sb-edges XAFS	**Experiment number**: **HS-2956**
Beamline: ID26	**Date of experiment**: from: 02 November 2005 to: 08 November 2005	**Date of report**: 21/02/06
Shifts: 18	**Local contact(s)**: Dr. Pieter GLATZEL	*Received at ESRF:*

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Report:

We investigated the local structure of Sb in diluted GaAsSbN epilayers and InGaAsSbN quantum wells via XAFS performed in fluorescence detection. We recorded with success XANES for a number of epilayers and quantum wells at the L3 edge of Sb, while it was difficult to extend the K-range to the EXAFS region.

The experiment presented a lot of technical challenges not only related to the dilution and small thickness of the nanostructured samples, but also to the presence of several In L-fluorescence lines which were very close to the Sb ones (≈ 100 eV between Sb Lα1 and In Lβ1, ≈ 30 eV between Sb Lα1 and In Lβ3). The separation of the Sb Lα1 fluorescence line, which was used for the experiment, was possible by using the WDX spectrometer equipped with a PET crystal and ionization chambers available at the ESRF detector pool and installed at the ID26 beamline. Fig. 1 shows the "forest" of fluorescence emission peaks resolved by the spectrometer for an incidence energy set above all the In and Sb L-absorption threshold.

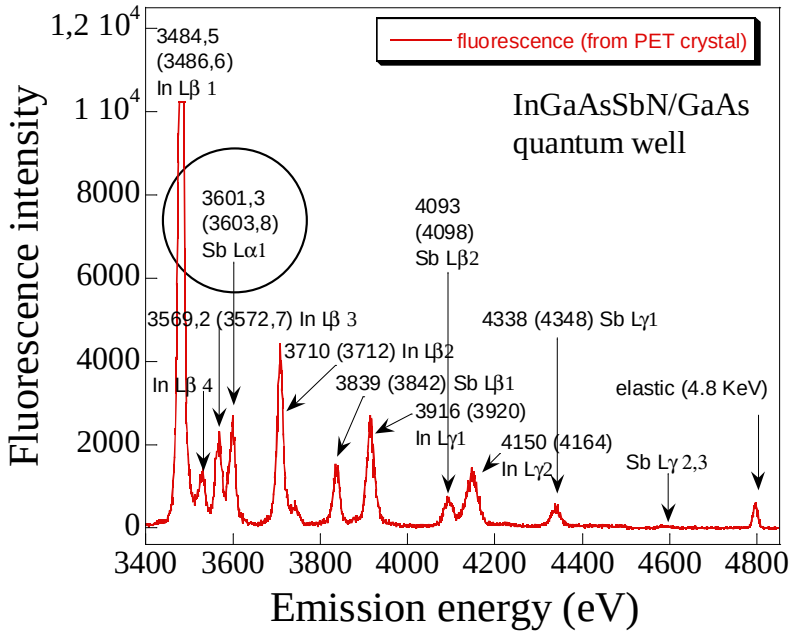

Fig. 1: emission spectrum from InGaAsSbN QW recorded by using the WDX spectrometer

Resolution of such close fluorescence lines would have been impossible with the use of semiconductors detectors (such as hyperpure Ge) usually employed in fluorescence mode XAFS, which have a typical FWHM resolution still > 150 μ even when the largest peaking time is employed.

Fig. 2 reports the XANES spectra recorded with this setup for three selected samples: a reference N-free GaAsSb, a GaAsSbN/GaAs 80 nm epilayer (Sb = 7%) and a 8 nm InGaAsSbN/GaAs (Sb = 1.5%, N = 1 %) quantum well. Note that the high-brilliance of the Id26 beamline allowed us to measure also the most dilute sample with good signal to noise; the same data quality have been achieved for all the 12 annealed samples investigated.

Fig. 2 show that spectra for epilayers and quantum wells change due to the different local coordination of Sb; simulations of the absorption cross section in the full multiple scattering approach (FMS) are in progress in order to understand if the experimental XANES line shape is in agreement with a random distribution of atoms or if, on the contrary, some form of short range ordering occurs in the alloys. SRO could explain some of the atypical optical properties of these materials, which are exploited in the manufactory of infrared emitters.

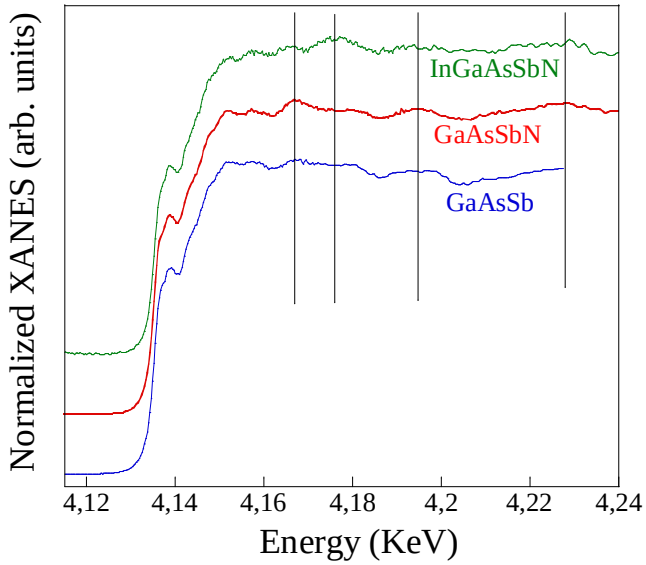

Fig. 2: Sb L3 edge XANES for three selected samples.

Even if for some sample it was possible to extend the spectra until k = 8, this was not the case for all alloys. In fact, some distortion takes place in the XAFS region possibly due to effects related to the perfect crystalline structure of the samples, which causes the Bragg's law to be satisfied at certain energies, and related modulations of the fluorescence intensity due to the excitation of a stationary wave field. A possible solution to reduce such distortions in the future, by averaging the Bragg's condition, could be the installation of the rotating sample holder of the BM29 fluorescence station, designed by the proposer, in front of the WDX spectrometer.