

Project Number : 2014B-E03  
Program Title (English) : Molecular beam epitaxy of GaAs on MnSb: in situ studies of spintronic nano-interface formation  
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Key words :

### 1. Summary

X-ray diffraction (XRD) data detailing GaAs growth on several different MnSb/GaAs virtual substrates was obtained successfully. A variety of scan types including  $hk$ ,  $\theta - 2\theta$  and crystal truncation rod (CTR) scans were made. Reflection high energy electron diffraction (RHEED) was also recorded during the experiment. A diagram showing a typical layer structure studied is shown in Figure 1. GaAs was grown on MnSb virtual substrates at BL11XU.

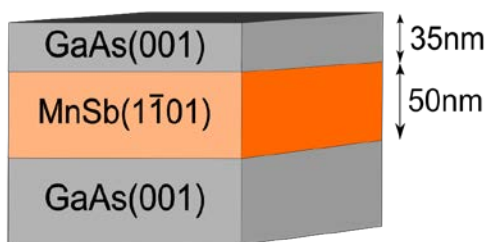


Figure 1 – Final layer structure of the GaAs(001) sample: the top GaAs layer was grown in situ

### 2. Experimental

The data collected for four separate virtual substrate samples is as follows :

- GaAs/MnSb/GaAs(111)A –  $\theta - 2\theta$  and CTR data from before and after GaAs growth,  $\theta - 2\theta$  scans during growth
- GaAs/MnSb/InGaAs(111)A –  $\theta - 2\theta$  ,  $hk$  and CTR data from before and after GaAs growth,  $\theta - 2\theta$  scans after GaAs growth
- GaAs/MnSb/GaAs(001) –  $\theta - 2\theta$  and  $hk$  data from after GaAs growth

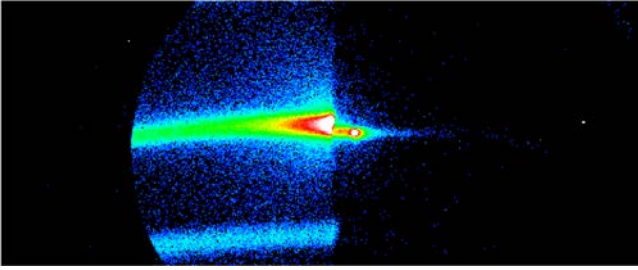
### 3. Results and Discussion

We found that GaAs(001) layers can be grown by molecular beam epitaxy onto MnSb( $1\bar{1}01$ ), despite the oblique geometry of the MnSb virtual substrate. This is a new and very useful result confirmed by in situ RHEED (Figure 2) and XRD. It is a crucial result for spintronic device development, allowing the common (001) III-V growth orientation to be exploited (e.g. through established growth protocols for high quality quantum well structures) along with the known in-plane magnetic anisotropy of MnSb ( $1\bar{1}01$ ).



Figure 2 – RHEED pattern showing the growth of crystalline GaAs(001) on MnSb(1-101)

XRD in-plane  $hk$  scans were collected from this GaAs(001) surface, and an example PILATUS image from one of these scans is shown in Figure 3. This in-plane data will provide valuable information about the structure of the GaAs(001)/MnSb( $1\bar{1}01$ ) interface. We also obtained data on GaAs(111) / MnSb epitaxial layers.



*Figure 3 - A PILATUS detector image collected towards the end of an in-plane  $hk$  scan of the GaAs(001) sample near the (440) Bragg peak.*

4. Others

N/A