	Experiment title:	Experiment number:
SpLine	Atomic structure of SrTiO3/LaAlO3 multilayer systems	25-02-614
Beamline: BM25B	**Date(s) of experiment:** From : 08-02-07 To : 12-02-07	**Date of report:** 20-02-07
Shifts: 15	**Local contact(s):** Dr Juan Rubio-Zuazo	

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Report:

The main research topic of the Condensed Matter Physics & Devices Group at Twente University is the study of electric and magnetic properties of (devices of) thin layers, mostly consisting of rather simple oxidic materials. One of the methods used to deposit these compounds is Pulsed Laser Deposition (PLD). With the PLD method, it is possible to deposit oxidic materials layer by layer in a controlled way. One of the interesting developments of the method is the possibility of producing multilayers. As an example: on an atomically flat single crystal substrate ($SrTiO_3$ (001), cubic) alternating layers of n unit cells of $LaAlO_3$ and m unit cells of $SrTiO_3$ can be deposited. This ensemble is repeated l times, producing a 'superlattice single crystal' with a tetragonal unit cell of approximately $n*a_{LaAlO3} + m*a_{SrTiO3}$ in the direction perpendicular to the surface. The cell constants in the plane are equal to those of the $SrTiO_3$ substrate. Reciprocal lattice scans prove that there is no twinning and that the layer is perfectly epitaxial.

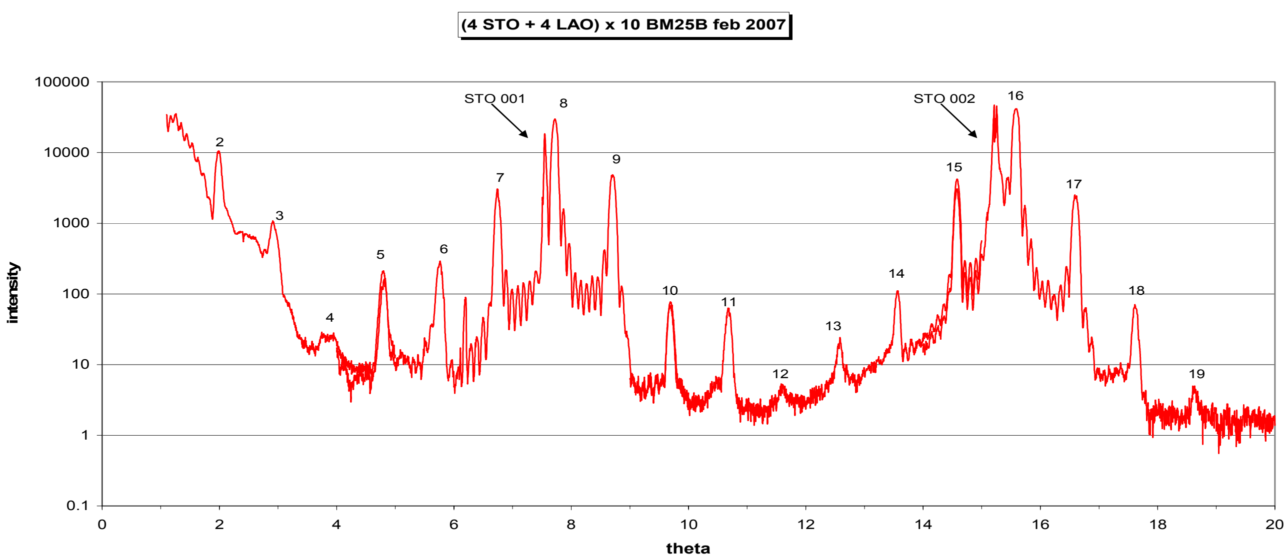

fig 1 Reflectivity scan of a sample with n = m = 4 and l = 10 The total number of unit cells (STO + LAO) is thus 80. All superstructure reflections are clearly visible. The peaks marked STO are from the substrate.

During the experimentwe studied four samples with different values for n,m and l. The out of plane lattice constant for all samples could be determined from reflectivity scans. Much more information is available, than could ever be determined by laboratory X-ray machines. As an example the reflectivity scan of the most perfect (n = m = 4, l = 10) sample is shown (fig 1)

Fig 2 shows an enlargement of the scan near the *008* superstructure reflections. In this figure clearly thickness fringes can be seen, proving that the total layer thickness is 10 times the size of the unit cell.

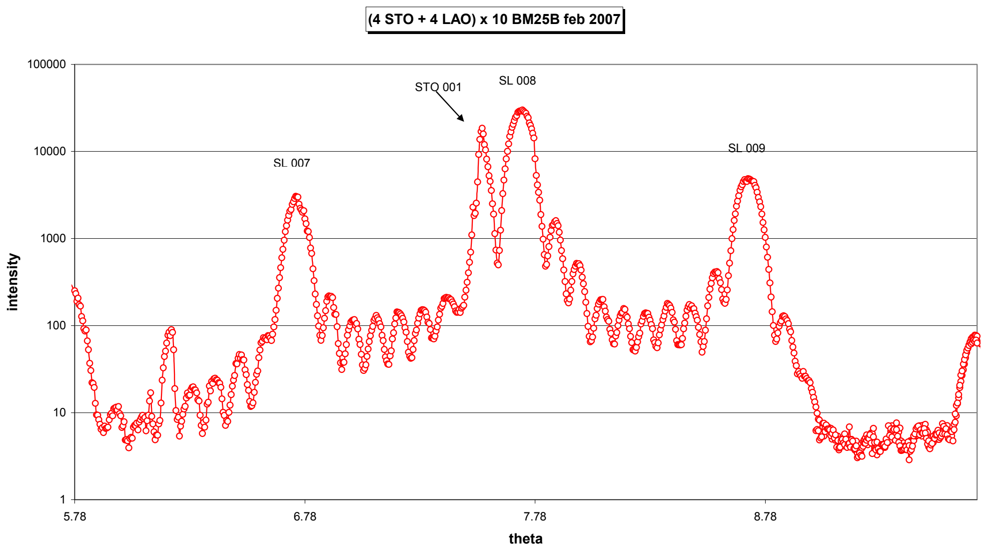

fig 2
Part of the reflectivity scan of the sample of fig 1. This picture clearly shows thickness fringes, indicating a smootrh layer consisting of 10 superlattice cells

For this sample the intensities of a large number of superstructure reflections have been measured. The results are presently being evaluated to determine the detailed atomic structure in the layer.
For the other three samples reflectivity scans were made to determine accurately the cell constants of the superlattice. Cell constants of the different compounds will be analyzed to determine the 'fractional cell constants' of the LAO and STO parts.