Acta Cryst. (2002). A**58** (Supplement), C40

X-RAY SCATTERING FROM LATERALLY SELF-MODULATED SEMICONDUCTOR SUPERLATTICES

V. Holy[1] J. Stangl[2] T. Roch[2] G. Bauer[2] J. H. Li[3] S. C. Moss[3]
[1]Institute of Condensed Matter Physics, Masaryk University, Kotlarska 2, 611 37 Brno, Czech Republic [2]Institute of Semiconductor Physics, Kepler University, Altenbergerstr. 69, A-4040 Linz, Austria [3]Department of Physics, University of Houston, 4800 Calhoun Rd., Houston, Texas 77204, USA

Processes of lateral self-modulation during the growth of semiconductor superlattices represent a promising route for a fabrication of semiconductor nanostructures (quantum wires and dots). Optical and electronic performance of these structures substantially depends on their structure properties. Surface-sensitive x-ray scattering methods (grazing-incidence small angle scattering - GISAXS, and grazing incidence diffraction - GID) can determine the shape of the nanostructures buried in the superlattice, their positions and their chemical composition.
Grazing incidence small angle scattering and diffraction were used for the investigation of self-organized SiGe quantum wires in SiGe/Si superlattices. It is generally believed that these structures are created during the epitaxial growth by bunching the monolayer steps at the growing surface. However, from the shape of the wires determined by GISAXS it follows that the wires were not produced only by this mechanism and another kinetically limited surface process affects the wire shape. Combining with the GID method, we have determined the mean chemical composition of the wires. Another type of self-organization has been observed in InAs/AlAs short period superlattices, where a lateral nearly periodic modulation the layer widths have been observed by GID. An analysis of the measured data revealed the shape of the modulations, and a possible mechanism of the organization was deduced.

Keywords: QUANTUM DOTS QUANTUM WIRES SURFACE SCATTERING

Acta Cryst. (2002). A**58** (Supplement), C40

STRAIN EFFECTS IN THIN-FILM QUANTUM WIRE STRUCTURES

Q. Shen
Cornell University Chess Wilson Laboratory ITHACA NEW YORK 14853 USA

We show in this presentation that high-resolution x-ray diffraction analyses on coherent thin-film microstructures on crystal surfaces can reveal variety of information on interfacial strain fields. Diffraction features that can be observed include diffuse interference fringes, asymmetric grating diffraction patterns, and asymmetric crystal-truncation-rod profiles due to the strain-varying regions in a microstructure. From these diffraction features, both longitudinal and transverse strain gradients can be determined near an interface, in addition to the average elastic strain-tensor components.

Keywords: INTERFACE STRAIN GRADIENT QUANTUM WIRE

Acta Cryst. (2002). A**58** (Supplement), C40

2-D X-RAY DIFFRACTION LINE SHAPE ANALYSIS OF OXIDE EPITAXIAL LAYERS

A. Boulle O. Masson R. Guinebretiere A. Dauger
SPCTS UMR CNRS 663

X-ray diffraction (XRD) and reciprocal space mapping are widely used tools for the microstructural characterization of epitaxial layers, especially semiconductor and metallic thin films. Comparatively with semiconductor materials, thin film oxides are much less well behaved in that they can only rarely be grown with a high crystalline quality level. In this presentation we will focus on two specific examples. At the higher defect density limit, XRD profile modeling is made very difficult. Nevertheless, information concerning the microstructure of the sample can still be obtained either by Fourier analysis of the XRD line profiles or by integral breadth - based methods. By these means, we measured the stacking fault density in the ferroelectric compound $SrBi_2Nb_2O_9$ epitaxied onto $SrTiO_3$ substrates. At the lower defect density limit, a vast amount of microstructural information can be accessed by the simulation of the reciprocal lattice points (RLPs), or by the simulation of selected sections across the RLPs. However, for this purpose the scattering model has to take into account the specificities of oxide materials. This approach has been used for the study of $Zr(Y)O_2$ epitaxial layers deposited on (110) sapphire substrates by sol-gel dip-coating. In the out-of-plane direction, the layer thickness, the thickness distribution function as well as the strain profile have been measured using XRD profile modeling. In the in-plane direction, the analysis of the diffuse scattering yields the orientation distribution function of the mosaic blocks, whereas the analysis of the coherent scattering evidences the existence of self-organized periodic microstructure.

Keywords: X-RAY DIFFRACTION OXIDE THIN FILMS MICROSTRUCTURE

Acta Cryst. (2002). A**58** (Supplement), C40

X-RAY STANDING WAVES IN MULTILAYERS

S. Zheludeva M.V. Kovalchuk N.N. Novikova
Institute of Crystallography Russian Academy of Sciences Leninsky Pr.59, Moscow 117333, Russia Moscow 117333 RUSSIA

X-ray standing wave (XRSW) technique that combines the advantages of high-resolution structure sensitive x-ray methods with spectroscopic selectivity of data obtained is shown to be extremely promising for characterization of organic and inorganic nanolayers and multilayers comprised of them. For the case when periodic multilayer (PM) is used as XRSW generator experimental results demonstrate the possibility to obtain thickness, density and roughness of ultra thin films imbedded in a multilayer, to detect alien interfacial layers, to get information about interdiffusion at the interfaces, to study x-ray mirror degradation under external treatment. Moreover, analytical expressions obtained for x-ray scattering and secondary radiation yield modulated by XRSW in a PM under kinematical Bragg diffraction conditions allow to reveal a direct way for characterization of XRSW generator as it is - to obtain the exact values of the parameters of nanolayers that form multilayer period. Fluorescence yield angular dependences exited by complicated evanescent wave/XRSW pattern at total reflection above solid substrate (including x-ray waveguide structures) are used to detect structure position of different ions in molecular organic Langmuir-Blodgett (L-B) systems, to study ion permeation through L-B nanostructures - models of biomembranes. The latest results connected with investigation by the above mention technique of organic monolayers on air/liquid interface are presented.

Keywords: X-RAY DIFFRACTION FLUORESCENCE MULTILAYERS