13-Defects, Microstructures and Textures

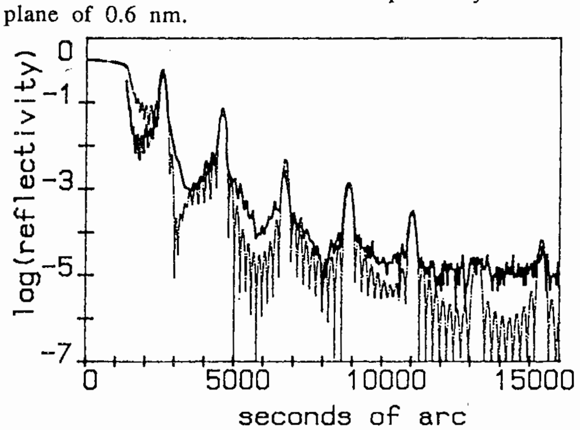
PS-13.02.26 A HIGH RESOLUTION X-RAY DIFFRACTION STUDY OF BIAXIAL STRESS INDUCED BY COSPUTTERED $MoSi_2$ FILMS IN SILICON SUBSTRATES.
By Krishan Lal and Reshmi Mitra*, National Physical Laboratory, New Delhi - 110 012, and G. Srinivas and V.D. Vankar, Physics Department, Indian Institute of Technology, New Delhi - 110 016, India.

(100) silicon wafers with 1000 Å thick cosputtered molybdenum - silicon films have been investigated before deposition, just after deposition and after rapid thermal annealing. Biaxial stress, σ, was determined from curvature measurements (LAL, GOSWAMI, WURFL AND HARTNAGEL, 1990, *J. Appl. Phys.*, **67**, 4105-4113) by employing a double crystal X-ray diffractometer designed and developed at NPL. Diffractometry and topography was used to monitor crystalline perfection of substrate crystals (symmetrical Laue geometry; (+,-) configuration). We chose blank wafers with a range of radii of curvatures (33m to 250 m). For determining the value of biaxial stress in wafers with deposits, curvature of blank wafers was taken into account. A typical value of σ is 9.0×10^9 dyn/cm^2 (compressive) for as - deposited films. The wafers with higher initial bending showed higher values of stress. Deposition led to degradation of perfection. Distribution of stress was investigated by recording stationary topographs at different orientations on the diffraction curve.

Rapid thermal annealing at 1000 °C for 4 min formed $MoSi_2$ phase. It led to notable relaxation of stress. A typical value of σ is 2.63×10^9 dyn/cm^2 (tensile). Annealing improved the degree of crystalline perfection. The final value of stress is lower for blank wafer with small bending.

PS-13.02.27 LOW ANGLE X-RAY DIFFRACTION STUDY OF Mo-Si MULTILAYERED STRUCTURES.
By #C. Bocchi*, #C. Ferrari, #L. Lazzarini,°G. Leonardi and °L. Tullii; #MASPEC Institute, via Chiavari 18/A-43100 Parma-Italy; °Ce.Te.V. (Vacuum Technology Centre)-67061 Carsoli(AQ)-Italy.

Multilayer structures containing alternating layers of high and low atomic number elements, have recently became very interesting due to their applications in soft X-ray optics such as spectroscopy, X-ray lithography, astronomy and synchrotron research. A quantitative structural characterization of the multilayers can be achieved by Low Angle X-Ray Diffraction (LAXRD). This powerful technique provides nondestructively detailed informations about the multilayer periodicity, the thickness of the individual layers and the interface roughness. The above informations can be derived by comparing the experimental diffraction profile and that calculated on the basis of an optical theory in which the scattering from the whole structure is calculated recursively, adding sequentially the reflectivity of each interface (J.H. Underwood and T.W. Barbee,Jr., Appl. Optics, 1981, 20, 3027-3034). This communication deals with a LAXRD and transmission electron microscopy (TEM) investigation of Mo-Si multilayers prepared by Ion Beam Sputtering (IBS). The IBS technique permits an extremely controlled deposition to be achieved in which the mass of deposited material is proportional to a previous calibrated deposition time; however, quartz crystals are also used to monitor in situ the amount of deposited material. Fig.1 shows an example of low angle x-ray diffraction profile of a Mo-Si 10 periods multilayer. The better simulation (dashed-dotted line) of the experimental profile (full line) has been obtained by assuming asymmetric graded interfaces and a root-mean-square deviation of the interface atoms from the perfectly smooth plane of 0.6 nm.



PS-13.02.28 STRAIN MEASUREMENTS IN MISMATCHED SEMICONDUCTOR CRYSTAL HETEROSTRUCTURES.
By C. Bocchi, C. Ferrari* and P. Franzosi; MASPEC Institute, via Chiavari 18/A-43100 Parma-Italy.

Strained semiconductor heterostructures are of considerable interest in device application because of the possibility of modifying the electronic or the optical properties of the semiconducting material, as in the case of InGaAs/GaAs based heterostructures. The measurement of the difference Δθ of the Bragg angles of the structure by means of high resolution diffraction techniques is a well established method for determining the parallel ε and the perpendicular ε strain components of the layers with respect to the interface.

This work is aimed at showing the best experimental conditions for allowing accurate measurements of both strain components. For CuKα X-ray wavelength the 117 and 335 reflections are much more sensitive to the perpendicular and the parallel strain components on 001 oriented substrates than the usual 004 and 115 reflections. The lattice plane tilting due to the tetragonal deformation are seen to introduce a systematic deviation if the Bragg angle difference

