07.8-1 X-RAY DIFFRACTION FROM THIN EPITAXIAL SEMICONDUCTOR LAYERS AND MULTIPLE QUANTUM WELL STRUCTURES. By Paul F. Fewster, Philips Research Laboratories, U.K.

The control in the growth of epitaxial layers by Molecular Beam Epitaxy (MBE) is such that very thin epitaxial semiconductor layers can be grown. These thin layers offer new horizons in future device structures for tailoring the physical properties for optical and electronic devices. This paper will illustrate how X-ray diffraction has been used to determine the important structural parameters in Multiple Quantum Well (MQW) layers (well width, barrier width and composition, and interface grading), and in thin layered structures (e.g. 200Å buried $Al_xGa_{1-x}As$ layer in GaAs) where the thickness/composition can be determined. Both kinematic and dynamical diffraction theories are used to interpret the reflectivity profiles.

The MQW X-ray diffraction profiles are collected on a powder diffractometer to achieve measurable intensities for the high order satellites. The low order satellites give the general modulation waveform and the high order satellites give the interface profile. The interface for the GaAs (binary) to AlAs (binary) and vice versa have been found to be similar, whilst for the AlGaAs (ternary) to GaAs (binary) this interface appears to be rougher than the binary to ternary for a range of samples. This information is obtained by modelling with the kinematic theory.

Structural information on thin buried layers has been achieved using dynamical modelling. Excellent agreement has been achieved in matching the simulated profiles to the experimental high resolution diffraction profiles.

The determination of mismatch by measuring the peak separation in thin epitaxial layers has also been shown to lead to significant errors and it will be shown how profile modelling leads to the correct interpretation.

07.8-2 ON THE EFFECTIVE ELECTRON MASS IN BISMUTH IN THE PRESENCE OF A QUANTIZING MAGNETIC FIELD. By K. P. Ghatak, Advanced Study Centre of Radio Physics and Electronics, 1, Girish Vidyaratna Lane, Calcutta-700009, West Bengal, India, S. Bhattacharyya, Consulting Engineering Services Pvt. Ltd., 591, Block 'O', New Alipur, Calcutta-700053, West Bengal, India and S. Biswas, Department of Electronics and Telecommunication Engineering, Bengal Engineering College, Howrah-711103, West Bengal, India.

It is well-known that the effective mass of the carriers in semiconductors, which is strongly connected with the carrier mobility, is known to be one of the most important device parameters. We should note that among the various definitions of the effective electron mass, it is the momentum effective mass (hereafter referred to as MEM) that should be regarded as the basic quantity since it is the MEM that appears in the description of the transport phenomena and all other properties of the electron gas in a band with arbitrary band nonparabolicity. It can be shown that it is the MEM which enters into various types of transport co-efficients and plays the most dominant role in explaining the experimental results of different scattering mechanisms. In recent years, various E - k dispersion relations for different semiconducting compounds have been proposed and extensive work has already been done in the literature. Keeping this in view, an attempt is made for the first time to investigate the MEM in Bismuth in the presence of a quantizing magnetic field by using the generalised dispersion relation of the conduction electrons as proposed by McClure and Choi in the presence of electron spin and the broadening of Landau levels. McChure and Choi model of bismuth gives very good fit to various experimental results, including those of de Haas Van Alphen effect and cyclotron resonance measurements. It is found that the oscillatory quantum number dependent behaviour of the MEM at the Fermi level in bismuth is solely due to band non-parabolicity and is a characteristic feature of the above model. Besides, the theoretical formulation is in good agreement with the experimental observations as reported elsewhere and the corresponding well-known results for parabolic semiconductors are also shown as special cases of our generalised expressions.