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Synthetic modulated structures. Edited by LEROY L. CHANG and B. C. GIESSEN. Pp. xi + 502. Academic Press, 1985. Price US $87.00, £76.00.

This book presents a range of contributions from active researchers in this rapidly progressing field. Because of this, the book provides a very useful summary of previous work, but will become outdated. This book, although 500 pages in length, is a small subset of the much wider subject of modulated structures. It covers synthetic semiconductor and metal multilayers, their growth, characterization and theoretical aspects of their properties and some device results and predicted future trends. Each chapter is written by a different author and is packed with useful references, but there is very little cross referencing between chapters, making the book more like a series of monographs. Furthermore, the words 'multilayers' and 'superlattices' are not clearly distinguished or used in a consistent manner throughout the book.

The book is in three parts, including a general overview, semiconductor and metal systems. It is unfortunate that the first chapter concentrates purely on the history and perspective of semiconductor superlattice structures, since metal systems are of great interest and should be included in the historical survey. This chapter gives a very good introduction to Part II of the book, that is the growth of semiconductor multilayers, the concept of the mean free path leading to the observation of quantum states as well as unusual electronic and optical properties. There is significant concentration on the AlGaAs system including I–V characteristics for predicting device possibilities (including the high-electron-mobility transistor and avalanche photodiodes) and structural assessment techniques, with a very short section on attempts at one-dimensional device fabrication. InAs/GaSb (/AlSb) structures are also reviewed, as is the way in which this system can be grown to produce further possibilities in the form of polytype multilayers. Other multilayer structures are covered very briefly. The second chapter concentrates on the structural aspects of semiconductor and metal systems, and gives a good introduction to these aspects and definitions of what is measured by X-ray diffraction. The main emphasis is on X-ray diffraction methods of characterization, although lattice imaging, transmission electron microscopy, backscattering, channeling and Auger electron spectroscopy are very briefly mentioned. Included in this chapter are surveys of semiconductor systems (GaAs/GaAsP, GaAs/AlAs, GaAlAs/Ge and a few others) and metal systems (multilayers with the same structure, with different structures, as well as polycrystalline and amorphous systems).

Part II of the book concentrates on semiconductors, with chapters on the theoretical aspects, characterization and devices. The theoretical aspects include the influence of band folding on the electronic properties and the inadequacy of the Krönig–Penney model in predicting the energy levels, and the use of the Kane formulism, tight binding and pseudopotential methods for improving the agreement for explaining experimental results. The characterization of multilayers by electronic and optical properties as well as electron and X-ray scattering are covered very fully, and this is a useful chapter for deciding the technique for the information of interest. A chapter is devoted to the *n-i-p-i* structure (*n*-type and *p*-type doped semiconductors separated by intrinsic semiconductor regions), and illustrates the possibilities of tunable absorption coefficients and luminescence, although work in this field only started in 1980. The principles of modulation doping to reduce impurity scattering are covered, including the measurement of mobility and transport properties. The methods of tailoring the multilayers to fabricate quantum-well lasers are given in the final chapter of Part II, for the material systems AlGaAs/GaAs, InGaAsP/InP and InAlGaAs.

Part III is devoted to metal multilayers, and starts with a chapter on growth methods to produce this 'atomic-scale engineering' and the applications of these structures (dispersion elements for soft X-rays). The electrical and magnetic properties of metal multilayers including possibilities in two-dimensional magnetism clearly show great promise. It is unfortunate that the submission date for this chapter was 1982, and therefore it does not include more recent advances in this field. The CuNi magnetic multilayer structures are extensively covered with a brief mention of other systems which have not been so thoroughly explored. Two other chapters in this part are on superconducting superlattices and diffusion, both of which are very comprehensive; the latter is equally applicable to semiconductor and metal multilayer systems. The modification of superconducting properties arises from the similarity in magnitude between the superconducting coherence length and the layer thicknesses, and the importance of understanding diffusion in any of these synthetic modulated structures is crucial in defining the extent of the interfaces.

In summary this book certainly does a lot to promote X-ray diffraction as a characterization tool, and is a valuable introduction to the field of multilayer systems, giving a wealth of references (for those who require greater detail), and is suitable for anyone working or entering research in this field.

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