Two-dimensional systems: physics and new devices

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Two-Dimensional Systems: Physics and New Devices. Eds. G. Bauer, F. Kuchar, and H. Heinrich. Springer-Verlag, Berlin; Heidelberg; New York; London; Paris; Tokyo, 1986. pp. 327 (Springer Series in Solid-State Sciences V. 67).

It will not be an exageration to say that the physics of semiconductors is at present undergoing a new period of vigorous development. This renaissance is associated first of all with the advances in technology which makes it possible to produce microstructures and superlattices with characteristic dimensions (or periods) of the order of a de Broglie electron wave length. Such structures are not simply new devices, but also qualitatively new objects for investigation. Essentially they are new handmade semiconductor materials.

In spite of the existence of a large number of original articles, so far there are no monographs devoted specially to superlattices and microstructures. Only recently a small book was published in the GDR (M.A. Herman, Semiconductor Superlattices, Akademie-Verlag, Berlin, 1986) which deals primarily with the experimental and technological aspects of semiconductor superlattices. This is understandable, since it is a risky business to write a book devoted to such a rapidly developing field. Therefore the operative publication of proceedings of conferences or lectures at different schools is so far the most effective method of filling this gap.

The current 67th volume of the series "Solid-State Physics" under the general editorship of Klaus von Klitzing is a collection of lectures at the international Winter School held in February 1986 is Austria. Of the four such schools the last two were devoted to the physics of two-dimensional systems. (The materials of the previous school have also been published in the series "Solid-State Physics," volume 53).

The book contains all 30 invited papers. Since of the 179 participants of the school 40% were students, the presentation of material in the majority of the lectures is simple, clear and systematic. At the same time practically all the latest achievements in the physics of semiconductor microstructures and superlattices have been described.

The book is divided into seven parts. The first part contains lectures on the epitaxial technology of the growth of structures and the methods of control. The technology is presented not only of the traditional GaAs/AlGaAs structures (Y. Horikoshi *et al.*; H. Luth and G. Weinmann) but also of the Si/Ge structures (E. Kasper *et al.*) and of the

$Hg_{1-x}Cd_xTe$/CdTe superlattices (J. P. Faurie *et al.*) that have been attracting considerable attention recently.

The second part—"Band discontinuities at heterojunctions"—begins with a lecture by W. A. Harrison. On the basis of the empirical method of strong coupling with universal parameters which in application to diamond-like semiconductors and A^3B^5 compounds was being developed by Harrison over many year the author proposed a simple semi-empirical procedure which makes it possible to predict band discontinuities and the magnitudes of Schottky barriers.

The second lecture of this part (T. W. Hickmott) is devoted to the methods for experimental determination of band discontinuities. The third lecture (H. Heinrich, J. M. Langer) presents an interesting empirical method of determining band discontinuities based on the assumption that a discontinuity in the valence band coincides with the difference in the position of deep levels of transition-metal impurities in semiconductors forming the heterojunction.

The third part consists of lectures on resonance tunneling (L. Eaves *et al.*), quantum wells (P. Voisin, M. Voos), optical properties of Si/Ge superlattices (G. Abstreiter, H. Brugger *et al.*; S. Luryi, F. Capasso). The calculation of the energy spectrum of superlattices by the method of the enveloping function is illustrated in the lecture by M. Kriechbaum on the example of the PbTe/PbSnTe superlattice.

The fourth part is devoted to bound states in quantum wells. The first lecture (B. D. McComboe *et al.*) deals with the optics of shallow donors in quantum wells based on GaAs-AlCaAs, the second deals with their properties in an external magnetic field (A. Raymond *et al.*); the third deals with the so-called $\delta(z)$ impurity layers (F. Koch *et al.*) which are monatomic doped planes within the bulk semiconductor.

The fifth part of the book contains lectures concerning the quantum-Hall effect and the density of states at the Landau levels. Four lectures are devoted to the experimental and two to the theoretical aspects.

Lectures on new structures and devices form the sixth part. Here one should note particularly the detailed and clear lecture by G. H. Dohler on doped superlattices.

Finally, the seventh concluding part of the book contains three lectures on transport in heating electric fields and on the spectroscopy of hot electrons in semiconductor microstructures.

Undoubtedly this collection of lectures given at the fourth Winter School on Solid-State Physics is a needed and very timely book. It will bring the greatest benefit to upper year undergraduates, to graduate students and to scientific research workers embarking on research in the field of semiconductor microstructures.