Ceramic Materials for Electronics Processing, Properties, and Applications

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(Marcel Dekker, Inc., 1986)

This book provides an overview of several major topics in electronic ceramics. Eight chapters, each by a different author, cover topics from theoretical discussions of defect chemistry to practical explanations of the processing of alumina substrates for multilayer packaging. Because of the diversity of subjects and individual authors' different interests (applied vs. theoretical), the chapters rarely overlap.

The first four chapters discuss insulators, capacitors, piezoelectric and electro-optic ceramics, and ferrites. The chapter on insulators reviews basic dielectric properties and describes insulators such as triaxial porcelains and glasses. The second chapter covers various multilayer capacitor synthesis techniques, boundary layer capacitors, and relaxor dielectrics. Practical problems with dielectric-metal electrode interactions and packaging of ceramic capacitors are addressed. The third chapter, written by G. Haertling, emphasizes PLZT materials for electro-optic applications. Basic properties and materials synthesis for piezoelectric materials are also reviewed, with excellent examples of devices made from piezoelectric and electro-optic ceramic materials. The chapter on ferrites is highlighted by a detailed description of commercial synthesis techniques.

The last four chapters discuss ceramic sensors, ZnO varistors, multilayer ceramic packaging for microelectronics, and highly conductive ceramics. The difference in viewpoints resulting from multiple authors is quite evident here. For example, the multilayer packaging chapter is application oriented, whereas the highly conductive ceramics chapter is mostly theoretical. Although varistors are depicted in a slightly provincial form, both theory and experiment are nicely combined. Devices such as negative and positive temperature coefficient thermistors and gas sensors are described in the chapter on sensors.

I strongly recommend this book to anyone entering the electronic ceramics field or desiring a general reference. Because available texts in electronic ceramics are lacking, this type of book has been sorely needed. However, the book has some shortcomings. For example, few references after 1980 are cited, and there are none cited after 1983. Further, more recent areas of electronic ceramics research are not covered, such as high speed substrates, three-dimensional ceramic/polymer piezoelectric composites, and aluminum nitride substrates. Despite these minor flaws, the book offers an excellent overview of electronic ceramics and is worth owning.

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Two-Dimensional Systems: Physics and New Devices

Edited by G. Bauer, F. Kuchar, and H. Heinrich

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This book is a sequel to an earlier proceedings of the International Winter School on Heterostructures and Two-Dimensional Electronic Systems in Semiconductors published in 1984. While the earlier book was tutorial, the present volume focuses more on critical reviews of recent developments. The topics covered are epitaxial growth, band discontinuities, resonant tunneling, and other physics with quantum wells, quantum Hall effects, and new devices.

Many of the papers' introductions mention that the rapid progress in epitaxial growth technology, particularly molecular beam epitaxy (MBE), has made possible many interesting physics studies and novel device applications with two-dimensional systems. Part I is devoted to recent advances in the capability and understanding of MBE and metal-organic chemical vapor deposition (MO-CVD). Among these advances are MO-CVD with flow-rate modulation, metal-organic MBE (MO-MBE) with gaseous sources instead of elemental sources, planar or δ doping technique (in Part VI), and *in situ* study of MBE growth mechanisms by reflection high-energy electron diffraction. MBE of II-VI compounds and SiGe/Si structures are also reviewed. These are all very timely topics.

Two of three chapters in Part II deal with theoretical understanding of band discontinuity, but only one chapter describes electrical measurements of band discontinuity. It would be more comprehensive and balanced to include an additional chapter on the rich variety of optical techniques to determine the band discontinuity, although one aspect was briefly mentioned in Part III.

Parts III, IV, V, and VII cover various aspects of physics of quantum wells and superlattices: resonant tunneling, shallow impurities in quantum wells, carrier transport, plasmon excitation, hot-carrier dynamics, and quantum Hall effects. A number of material systems are used in these studies, reflecting the versatility of the MBE technique. The GaAs/AlGaAs combination is most extensively studied due to its high quality and very abrupt interfaces. Strained-layer superlattices of GaSb/AlSb, InAs/GaAs (large lattice-mismatch), InAs/GaSb (spatial separation of the electron and hole wave functions), as well as Si/SiGe are studied. Part V has a broad theoretical and experimental summary of both the integer and fractional quantum Hall effects and density of states of Landau levels.

Part VI on new structures and devices is perhaps the weakest section because few new devices are covered. The chapter on the selectively doped heterostructure transistor (SDHT, or MODFET, TEGFET, HEMT) only superficially covers the microwave and digital performance of conventional structures. Although multiple-channel MODFET and heterojunction bipolar transistors are briefly mentioned, they are hardly "new" devices compared to other heterostructure devices. Superlattice MODFET, pseudomorphic single-quantum-well MODFET, GaAs-gate FET, and heterostructure-insulated-gate FET could also have been mentioned. The chapter on doping superlattices does provide some examples of new optical devices possible with such superlattices. Some new devices, such as resonant tunneling devices and GeSi/Si superlattice infrared detectors, are covered in Part III.

In summary, most of the chapters not only provide a review of recent advances in the topics covered but also begin with a brief tutorial description, thus achieving the spirit of the School. The book bridges the gap between solid state physics textbooks and journal papers fairly well. It also presents the sentiment that although very interesting results have been achieved in two-dimensional systems, the field still offers many more exciting avenues to explore. In short, the book should be very useful for those who are interested in the recent developments of the physics of two-dimensional systems.

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