GaAs and Related Materials

Bulk Semiconducting and Superlattice Properties

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To

Yūki, Mai, and Kōya

PREFACE

The advent of techniques for growing semiconductor multilayer structures with layer thicknesses approaching atomic dimensions has proved new systems for both basic physics studies and various device applications. A prime example of this material system is the $Al_xGa_{1-x}As/GaAs$ heterostructure system. Since AlAs is quite well lattice-matched to GaAs, there is a possibility of preparing lattice-matched $Al_xGa_{1-x}As/GaAs$ heterointerfaces with variable AlAs mole fraction. This adds a degree of freedom in creating heterointerfaces with various band offsets and allows tailoring of the barrier heights for specific applications. The considerable amount of both fundamental and applied work done on this material system during the past 30 years has contributed greatly to our knowledge of semiconductor physics and device applications. These areas are recognized as now being the most interesting and active fields in materials science as well as device engineering.

Even though the basic AlGaAs/GaAs heterostructure concepts are understood at this time, some practical device parameters in this heterostructure system have been hampered by a lack of definite knowledge of many material parameters and properties.

The purpose of this book is twofold: (1) to present various material parameters and properties of bulk GaAs and related materials; and (2) to discuss key properties of artificial semiconductor microstructures, namely quantum wells and superlattices, made of these materials. A set of the material parameters and properties are considered in this book. They are: (1) structural properties; (2) thermal properties; (3) elastic and lattice vibronic properties; (4) collective effects and some response characteristics; (5) electronic energy-band structure and its consequences; (6) optical properties; (7) elastooptic and electrooptic properties; and (8) carrier transport properties. The host of effects associated with the presence of specific impurities and defects is, however, omitted from the coverage.

The book attemps to summarize, in graphical and tabular forms, most of the important theoretical and experimental results on such material parameters and properties. I felt that these have not been adequately covered in existing books. The extensive bibliography including both works important from the historical point of view and those published in the recent years is intended for those who wish to expand their knowledge.

The book is intended for scientists and engineers in the field of III-V compounds, in particular, GaAs and related materials. It is hoped that the book will be useful to both beginning and advanced specialists as well as to workers in related fields, thus, contributing to the further developments in the various fields of GaAs materials research.

SADAO ADACHI

Gunma, Japan
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