Preface

In nanotechnology to date, much emphasis is placed on the creation of the nanostructures by means of micro- and atomic manipulations. This research field has been highly respected and promoted by the society, polytics, and economics. Rapid progress in this field has been greatly stimulated by more fundamental study on nano- and micromaterials. In this respect, the scientists and engineers in different fields of physics, chemistry, materials science, and information technology including experimentalists, theorists, and also researchers doing computer simulations have collaborated to form a new interdisciplinary field.

This book covers the recent advances in this growing research field, in particular, those developed mainly in the interdisciplinary research project named "Materials science for nano- and microscale control: Creation of new structures and functions," which was formed in 2004 in the Graduate School of Engineering of Yokohama National University in collaboration with the Institute for Materials Research, Tohoku University and other universities. The topics described in this book are as follows.

In computational materials design, first-principles calculations and simulations can give reliable guidelines for structural and functional controls of nanomaterials. In this respect, the development of new computational methods, in particular, for the excited states of materials, is highly desirable to investigate atomic and electronic dynamics on the nano- and microscales. The state-of-the-art GW and T-matrix calculations, transport calculations, and lattice dynamics calculations will be explained in detail in this book. From experimental point of view, in particular from the viewpoint of structural controls, the use of the self-organization of surface or local nanostructures controlled by light or heat is described in detail, in which a variety of useful structures appear through grain boundary motions on submicron scales. Such novel nanointegration technologies are particularly useful to create quantum dots or quantum well devices, and such applications are also described in detail. Also a variety of interesting optically controlled chemical or catalytic reactions, and phase transitions are described in detail for

particular interesting systems. Moreover, the functionalities of quantum dots, the creation of micro-/nanomachines using microstereolithography, and the development of new techniques of laser spectroscopy to observe dynamical processes related to optic functionalities are described in detail.

We hope that this book would be benefit to not only the scientists or engineers in this field but also the researchers in other fields to see what is going on in the researches of nano- and micromaterials.

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