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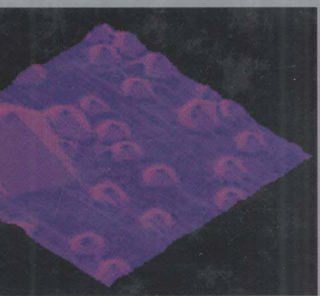

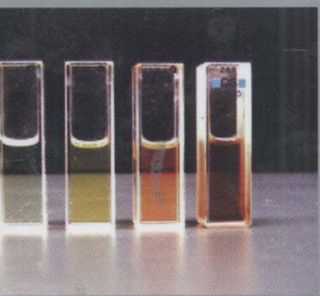

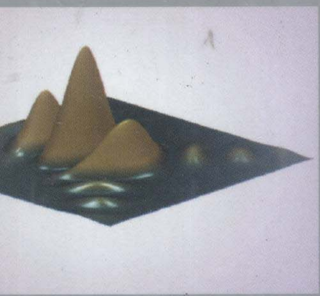

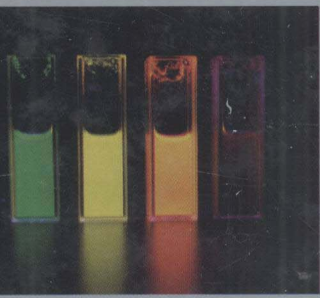

HANDBOOK OF Self Assembled Semiconductor Nanostructures for Novel Devices in Photonics and Electronics

Mohamed Henini

Handbook of Self Assembled Semiconductor Nanostructures for Novel Devices in Photonics and Electronics

Edited by

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Preface

In 1969, Leo Esaki (1973 Nobel Laureate) and Ray Tsu from IBM, USA, proposed research on "man-made crystals" using a semiconductor superlattice (a semiconductor structure comprising several alternating ultra-thin layers of semiconductor materials with different properties). This invention was perhaps the first proposal to advocate the engineering of a new semiconductor material, and triggered a wide spectrum of experimental and theoretical investigations. However, the study of what are now called low dimensional structures (LDS) began in the late 1970s when sufficiently thin epitaxial layers were first produced following developments in the technology of epitaxial growth of semiconductors, mainly pioneered in industrial laboratories for device purposes.

The LDS are materials structures whose dimensions are comparable with interatomic distances in solids (i.e. nanometre, nm). Their electronic properties are significantly different from the same material in bulk form. These properties are changed by quantum effects. At the inception of their investigation it was already clear that such structures were of great scientific interest and excitement and their novel properties caused by quantum effects offered potential for application in new devices. Moreover, these complex LDS offer device engineers new design opportunities for tailor-made new generation electronic devices. The LDS could be considered as a new branch of condensed matter physics because of the large variety of possible structures and the changes in the physical processes.

One of the promising fabrication methods to produce and study structures with a dimension less than one such as quantum dots, in order to realize novel devices that make use of low-dimensional confinement effects, is self-organization. The quantum dots are often referred to as *artificial atoms* due to their small size (typically $\sim$10 nm). The self-assembling mechanism allows the formation of tens of billions of dots per cm^2 with a high degree of uniformity in a single-step process. Self-assembled nanostructured materials offer a number of advantages over conventional material technologies in a widerange of sectors. The research on self-assembled nanostructures involves a strong interdisciplinary combination, for example material science, physics, chemistry, biology, electronics and optoelectronics.

Twenty-eight chapters is not a lot in which to convey the current successes of modern self-organization research. However, the topics covered will give the reader a comprehensive overview of the field of self-assembled nanostructures and a better evaluation of future trends.

The two parts of this book deal mainly with two fabrication methods, namely epitaxial and colloidal techniques that make feasible the design of artificial nanostructures. Each part introduces subjects on properties, characterization and applications of self-assembled nanostructures. We trust that this book will provide an excellent introduction to the self-organization of nanostructures to a large number of researchers and scientists active in the nanostructures science and technology area, and will fill an important gap in the market.

I would like to record my thanks to all the authors who have done so much hard work to achieve this successful book and acknowledge the invaluable help of the staff at Elsevier. Their efforts are greatly appreciated.

Finally, I would like to thank my family for their tolerance and understanding during the long hours and many mood swings accompanying my efforts as editor of this book.

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Contents