Characterization of Semiconductor Heterostructures and Nanostructures

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Edited by

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To the older trees, because that's from them that we came from but most importantly, to the young trees, because to them belongs the future.

In my naïve mind I like to think of knowledge dissemination as an old tree, with its roots strongly and deeply set in the ground, and with its seeds gently taken by a lovely wind that spreads them all around. Let the ground stick close to the old tree's roots and let the wind caress its branches, as long as possible... till new young trees grow up from the ground and become stronger and stronger and can finally replace the old one.

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Preface

After the publication of the review "C. Lamberti, The use of synchrotron radiation techniques in the characterization of strained semiconductor heterostructures and thin films, Surf. Sci. Rep., **53** (2004) 1–197", Elsevier contacted me for the coordination of a new book collecting the most used characterization techniques for the investigation of semiconductor heterostructures and nanostructures. After an initial inertia from my part, I accepted the task. The immediate enthusiastic replay of most of the contacted chapter coordinators has made my work easier than expected. I would like to express my gratitude to all these colleagues, as well as to all colleagues who have kindly acted as competent reviewers, as their hard work has importantly helped the chapter coordinators and myself to improve the quality of the final product. At the end of the task, looking to the final result, I am proud to count within the chapter coordinators dear friends and eminent scientists that are in the top positions in the ranking lists of the corresponding disciplines. I am even more proud to underline that, among such list of eminent scientists, women play an important role, leading four chapters.

"Characterization of Semiconductor Heterostructures and Nanostructures" is structured in chapters, each one devoted to a specific characterization technique used in the understanding of the properties (structural, physical, chemical, electrical, etc.) of semiconductor quantum wells and superlattices. A chapter is devoted to the ab initio modeling. The book has basically a double aim. The first one lies on the educational ground. The book provides the basic concept of each of the selected techniques with an approach understandable by master and Ph.D. students in Physics, Chemistry, Material Science, Engineering, and Nanotechnology. The second aim is to provide a selected set of examples from the recent literature of the TOP results obtained with the specific technique in understanding the properties of semiconductor heterostructures and nanostructures. Each chapter has consequently this double structure: a first part devoted to explain the basic concepts, serving the largest possible audience, and a second one to the discussion of the most peculiar and innovative examples, allowing the book to have the longest possible shelf life. So students should not get frustrated if they find more difficulties in the understanding of the second part of the chapters. My advice is to focus on the first parts; they can always came back to the second parts in the ensuing years, when their experience will be improved. Of course, the book is devoted also to the specialized community of scientists working in the fields of design, growth, characterization, and testing of heterostructures-based devices in both academic and industrial laboratories. Such readers should skip the first parts of the chapters, focusing on the final ones.

On top of this, the book has a further and somewhat even more ambitious goal. In this regard, the topic of quantum wells, wires, and dots should be seen as a pretext of applying top level characterization techniques in understanding the structural, electronic, etc. properties of matter at the nanometer (even sub-nanometer) scale. In this way, it is aimed to become a reference book in the much broader, and extremely hot, field of Nanotechnology.