Electrodeposited Nanowires and Their Applications

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Preface

Within the last years, the nanomaterials science and technology represented one of the most attractive subjects for physicists, chemists, biologists, medical doctors and engineers. These materials present a special interest from the point of view of basic scientific understanding, but also their potential applications are very attractive. Additionally, nanomaterials and nanostructures represent the basis for the development of new technologies, systems and equipments. The continuous development of miniaturized devices for different applications is demanding novel multifunctional materials which can perform different functions simultaneously.

Natural connections between physics, chemistry and life sciences are becoming much closer by means of nanotechnology, leading to complex and very useful applications. Biomedical sciences, which by their special social status are occupying the first place in the hierarchy of the priorities, benefit in unitary and almost completely way by the other sciences support, especially physics and experimental chemistry. The detection and quantification of the biological and chemical species represents the main objective of medicine, starting with certain diseases diagnosis and ending with the discovery of new drugs. Nanostructures, such as nanowires, carbon nanotubes or nanoparticles, exhibit new and sometimes unique opportunities for medical purposes. Some metallic nanowires are presenting electrical, optic and magnetic unique properties that can be exploited for (bio)detection and imagistics.

Nanowires are among the nanomaterials playing an important role in nanoscience and nanotechnologies, due to their specific behaviour as well as the number of their potential applications: optical and electronic components, connectors in electronics, high density magnetic recording media, biotechnology, etc.

Nowadays, nanowires are of interest for both fundamental research and potential applications. Nanowires arrays can be produced using different templates and methods, one of them being the electrochemical deposition into nanoporous templates. The fabrication of such complex simple and multilayered nanowires arrays (specific stacks of metallic nanowires, both crystalline and amorphous, as well as wafer structures of nanowire arrays having different compositions and physical properties) by electrodeposition, mainly in polycarbonate and anodized aluminium templates, opened up new directions in what concerns the applications of such complex nanostructures in spintronics, engineering and bioengineering.

This book describes some nanowires fabrication by electrodeposition technique and their potential applications. Understanding the design, size dependent properties and working principles of electrodeposited nanowires described here, requires a multidisciplinary background of physics, chemistry, materials science, electrical engineering, or bioengineering.

The book is organized in nine chapters. In the first two chapters, some theoretical considerations concerning the computational tools to study and predict the stability, as well as to model the properties and potential applications of nanowires are presented. Then, the fabrication of functional metallic nanowires using electrodeposition technique is described in detail pointing out the most important factors to be considered during the preparation process. The annealing effect on the metal and semiconductor electrodeposited nanowires in alumina template as well as the influence of the template on the electrodeposition process and the macroscopic behaviour of the nanowires are presented in the next chapter. After that, the electrochemical alumina template synthesis and the fabrication of both single-component and multilayered/superlattice metallic nanowires and nanotubes and their major applications are described. The importance of understanding both the individual and global properties of magnetic nanowire arrays, in order to implement them adequately in devices, is described in detail in the next chapter by means of the very promising first-order reversal curve (FORC) method. Finally, some applications of electrodeposited nanowires in magnetorheological fluids, elastomer composites and biomedical applications are described.

The book offers a new and complex perspective on the fabrication and use of electrodeposited nanowires for the design of efficient and competitive applications. While not pretending to be comprehensive, the book is addressing not only to researchers specialized in this field, but also to Ph.D. students, postdocs and experienced technical professionals.

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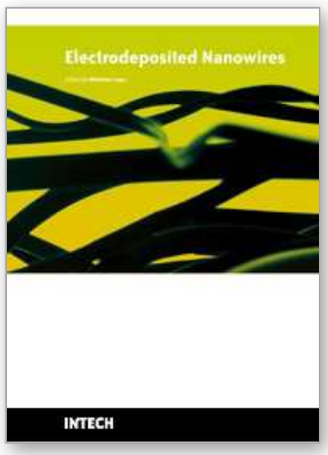
Contents



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