

# Preface

Written by an outstanding group of experts in the field, this book presents an exciting and fresh compilation of the last advances and developments in one of the most popular nanostructured materials, nanoporous anodic alumina. The electrochemical and synthetic methods, as well as characterization techniques and applications will be discussed in detail throughout this book.

Nanoporous anodic alumina was discovered during the first decades of the twentieth century and widely used in industry for corrosion protection, car industry, and metal decoration purposes for almost a century. The advent of high resolution scanning electron microscopy and other surface characterization techniques revealed the unique structural properties of this nanomaterial, which after a short time became one of the most explored nanostructures across a broad range of disciplines and fields. As an example, more than 3000 journal papers on nanoporous anodic alumina were published in last 20 years. This intensive research work can be explained by its simplicity of fabrication, unique self-ordered nanoporous structure, and a plethora of outstanding properties, which have spread the use of nanoporous anodic alumina in a broad range of applications and disciplines, including optics and photonics, electronics, membrane science, fundamental research, materials science, engineering, medicine, and industry.

The aim of this book is to present the recent progress in nanoporous anodic alumina, with special focus on the understanding of its properties, preparation methods, structural engineering, and applications. The book covers selected topics with 11 Chapters that we believe will be the most significant contribution to this emerging and fast developing field.

Chapter 1 presents the mechanisms of nanoporous alumina formation and self-organized growth, with special focus on the different concepts and aspects involved in this unresolved process. A more detailed insight into the theoretical models describing this electrochemical process is presented in Chap. 2. Chapter 3 is devoted to the synthesis of nanoporous anodic alumina by electrochemical anodization of low purity aluminum substrates, which is a critical factor for spreading the use of this nanomaterial in industrial applications. Chapter 4 compiles an outstanding insight into the different electrochemical approaches used to tailor the

internal pore structure of nanoporous anodic alumina. The applicability of this nanomaterial is highly dependent on its surface chemistry. In that respect, Chap. 5 presents the different soft and hard modifications of nanoporous anodic alumina aimed to improve its chemical and physical properties. The fundamental aspects of the optical properties of nanoporous anodic alumina are shown in Chap. 6 and Chap. 7 compiles a variety of examples of applicability of nanoporous anodic alumina as optical biosensing platform, which is recognized as one of the most promising applications for this nanomaterial. Chapter 8 is devoted to optofluidic applications using nanoporous anodic alumina. The applicability of this nanomaterial as a platform to develop electrochemical sensors, which is a very promising area to develop cost-competitive and simple devices for point-of-care biomedical and environmental analysis, is presented in detail in Chap. 9.

Another exciting topic on the application of nanoporous anodic alumina is presented in Chap. 10, where nanoporous alumina membranes for chromatography and molecular transporting are presented. Finally, Chap. 11 presents the most recent advances in the use of nanoporous anodic alumina for drug delivery and biomedical applications. This chapter shows new concepts and future perspectives towards advanced medical therapies including orthopedic and dental implants, heart/coronary/vasculature stents, immunoisolation, skin healing, tissue engineering, and cell culture.

As a result of the highly interdisciplinary nature of this book, it should be of profound and immediate interest for a broad audience, including undergraduate students, academics and industrial scientists and engineers across many disciplines, ranging from physics, chemistry, engineering, materials science, bioengineering, and medicine. We believe that this book will also be valuable to many entrepreneurial and business people, who are in the process of trying to better understand and value nanotechnology and new nanomaterials for future high-tech emerging applications and disrupting industries.

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Nanoporous Alumina

Fabrication, Structure, Properties and Applications

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