

# Preface

As the title of this book implies, we examine the fabrication, properties, and different applications of highly ordered vertically oriented  $\text{TiO}_2$  nanotube arrays made by Ti anodization. Since the first report of the highly ordered  $\text{TiO}_2$  nanotube arrays by Gong et al. (J Mater Res 16:3331–3334, 2001), the field has grown so rapidly as to make it difficult to summarize the scope of all related work. Built upon a suite of synthesis chemistries that enable significant differences in nanotube morphologies, the  $\text{TiO}_2$  nanotube arrays have demonstrated remarkable properties that have successfully given rise to a large number of diverse applications that include, but are certainly not limited to, super capacitors, solar cells, drug eluting surfaces, hydrogen sensors, biofiltration membranes, and photoelectrochemical cells for the solar generation of hydrogen. It appears, for the moment, impossible to completely canvas the field as it moves more rapidly than one can report on it. Be that as it may we have tried to at least touch on key aspects of the field, reviewing the contributions made by various research groups to the fabrication, and application of the nanotube arrays, and apologize to those authors of significant work we may have overlooked.

The book is intended for researchers in the field, which could encompass undergraduate students, graduate students and beyond. It is meant as both an introductory work as well as a reference to the field. While the book could be read cover to cover by those having such energy and interest, the individual chapters are self-contained per their specific topic. Chapter 1 considers nanotube array synthesis techniques. Chapter 2 summarizes the structural, elemental, optical, mechanical, and electrical properties of the  $\text{TiO}_2$  nanotube arrays. Chapter 3 examines use of  $\text{TiO}_2$  nanotube arrays as hydrogen gas sensors. Chapter 4 considers use of the material architecture for photoelectrochemical water splitting. Chapter 5 considers application of  $\text{TiO}_2$  nanotube arrays to dye-sensitized solar cells and polymer-based solid state heterojunction solar cells. Chapter 6 discusses the use of  $\text{TiO}_2$  nanotubes in biological applications, including their use as a base for biosensors, drug eluting surfaces, osseointegration, biotemplating, enhanced blood clotting, and as biofiltration membranes.

We wish to thank Emeritus Professor Dale M. Grimes for helpful comments towards improving the manuscript, the anonymous reviewers of the book who put forth many helpful suggestions, and thank the many authors who generously granted us permission to use their figures in this book, with a particular nod to Dr. Radim Beránek, Department of Chemistry & Pharmacy, University of Erlangen-Nürnberg, who was willing to redraw some of his figures for use herein.

University Park, PA

Craig A. Grimes  
Gopal K. Mor

TiO<sub>2</sub> Nanotube Arrays

Synthesis, Properties, and Applications

Grimes, C.A.; Mor, G.K.

2009, XXVII, 358 p., Hardcover

ISBN: 978-1-4419-0067-8