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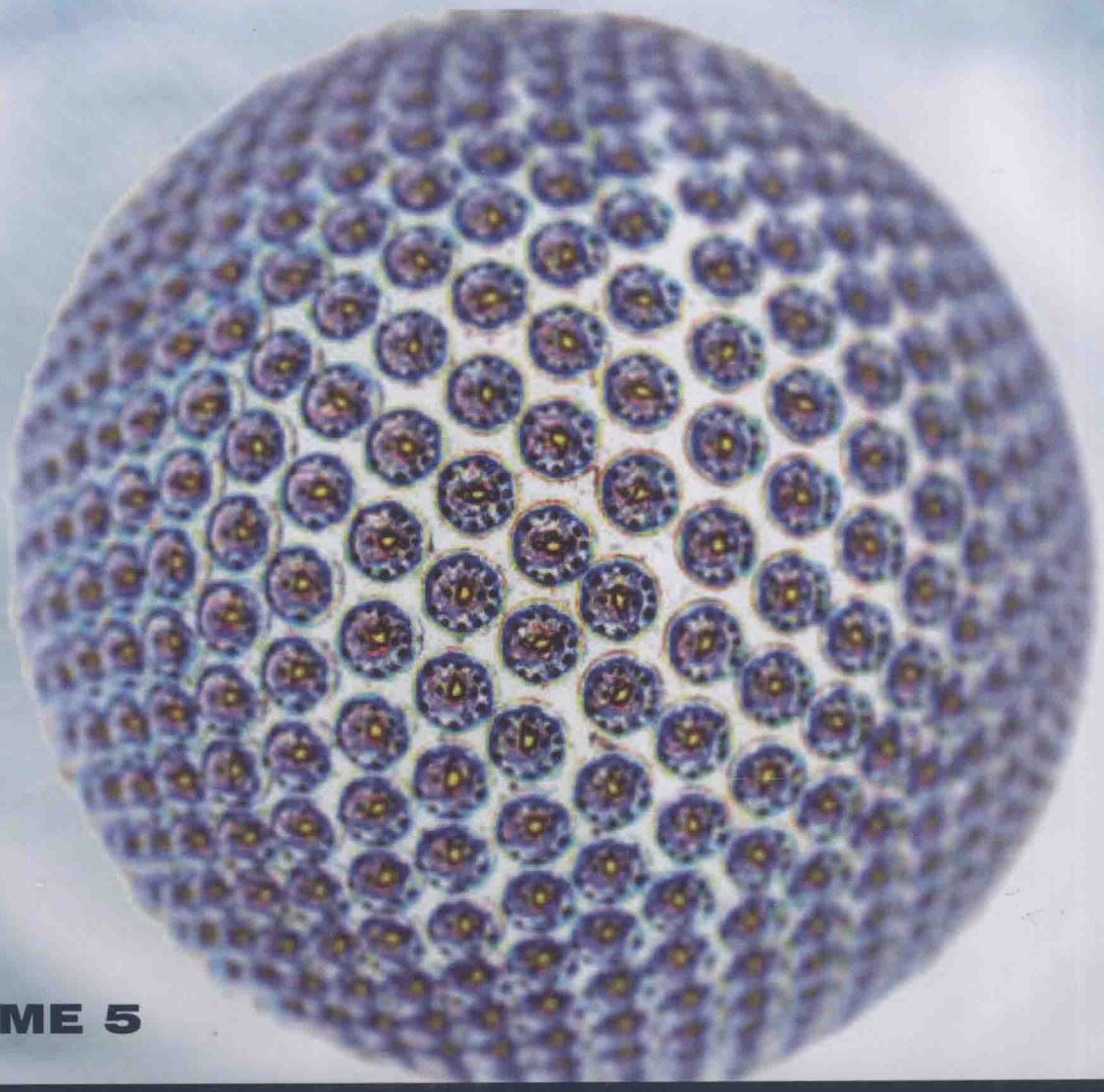

VOLUME 5

COMPREHENSIVE NANOSCIENCE AND TECHNOLOGY

SELF-ASSEMBLY AND NANOCHEMISTRY

COMPREHENSIVE NANOSCIENCE AND TECHNOLOGY

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COMPREHENSIVE NANOSCIENCE AND TECHNOLOGY

Editors-in-Chief Biographies

David Andrews is Professor of Chemical Physics at the University of East Anglia, where he leads a theory group conducting wide-ranging research on fundamental photonics, fluorescence and energy transport, nonlinear optics and optomechanical forces. He has 250 research papers and ten other books to his name, and he is a regularly invited speaker at international meetings. In North America and Europe he has organized and chaired numerous international conferences on nanoscience and technology. Professor Andrews is a Fellow of the Royal Society of Chemistry, the Institute of Physics, and the SPIE – the international society for optics and photonics. In his spare time he enjoys relaxing with family and friends; he also is a keen painter of the British landscape. His other interests generally centre on music, art and graphics, and writing.

Greg Scholes is a Professor at the University of Toronto in the Department of Chemistry. His present research focuses on elucidating the principles deciding electronic structure, optical properties, and photophysics of nanoscale systems by combining synthesis, theory, and ultrafast laser spectroscopy. Recent awards honoring his research achievements include election to the Academy of Sciences, Royal Society of Canada in 2009, the 2007 Royal Society of Canada Rutherford Medal in Chemistry, a 2007 NSERC Steacie Fellowship, the 2006

Canadian Society of Chemistry Keith Laidler Award, and an Alfred P. Sloan Fellowship (2005–2006). Dr. Scholes serves as a Senior Editor for the Journal of Physical Chemistry and Associate Editor for the Journal of Nanophotonics. He enjoys basketball, hiking, photography, family and friends.

Gary Wiederrecht is the Group Leader of the Nanophotonics Group in the Center for Nanoscale Materials at Argonne National Laboratory. His research interests center on the photochemistry and photophysics of nanoparticles and periodic assemblies, hybrid nanostructures, photochemical energy conversion, and nonlinear optical responses resulting from photoinduced charge separation. His experimental expertise is in the areas of ultrafast optical spectroscopy and scanning probe microscopy, including near-field scanning optical microscopy. He has received an R&D100 award, the Department of Energy Young Scientist Award, and the Presidential Early Career Award for Scientists and Engineers. He has authored or co-authored approximately 80 peer-reviewed research articles, and works collaboratively with scientists around the world. He enjoys traveling, nature, and spending time with his family.

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Self-Assembly and Nanochemistry

Preface

Volume 5: Self-Assembly and Nanochemistry

Self-assembly and nanochemistry go hand-in-hand. Nanochemistry uses the principles and methods of chemistry to assemble complex nanoscale systems. New materials formed in this manner are envisioned to play an important role in future directions of research, innovation, and manufacturing because these material systems can be produced with desirable properties integrated. Part of the attraction is the sophistication of functionality that can be engineered into nanoscale materials. For example, optimized, photostable fluorophores have been demonstrated that are easily solution processed and functionalized to bind specific analytes. While the amateur scientist will have heard of many (so far) fictional wonder nanomaterials in this vein, many exquisite state-of-the-art examples are described in this volume. The power of self-assembly is that such sophisticated systems can be constructed automatically, over a hierarchy of length scales, through the control of intermolecular forces. Assembly could not otherwise be achieved in any practical fashion because of the tiny dimensions involved. Polymer chemistry has played a central role in establishing important underlying concepts. These ideas have evolved and diversified, and the incredible control of the chemist is evident in templating methods underpinning soft lithography and mesostructured inverse opal materials.

The breadth of molecules, chemistry, and materials that are being discovered in this field is stunning. This volume of *Comprehensive Nanoscience and Technology* will give the reader a sense of the cutting-edge directions presently being explored in the area classified as 'self-assembly and nanochemistry'. At the same time, accessible introductions to these topics are provided. The specialist will be inspired by the detailed accounts presented in these chapters, with topics ranging from the molecular-scale organization of mesogens, amphiphiles and polymers, to the preparation and functionalization of fullerenes, nanocrystals, and zeolites, to the assembly of sophisticated capsules, mesostructures, nanocomposites, and emulsions. The general reader will appreciate why contributions to this field have multiplied many times over the past decade, transforming materials chemistry into the vivid and exciting field it is today.

Gregory D. Scholes

Foreword

Nanotechnology and its underpinning sciences are progressing with unprecedented rapidity. With technical advances in a variety of nanoscale fabrication and manipulation technologies, the whole topical area is maturing into a vibrant field that is generating new scientific research and a burgeoning range of commercial applications, with an annual market already at the trillion dollar threshold. The means of fabricating and controlling matter on the nanoscale afford striking and unprecedented opportunities to exploit a variety of exotic phenomena such as quantum, nanophotonic, and nanoelectromechanical effects. Moreover, researchers are elucidating new perspectives on the electronic and optical properties of matter because of the way that nanoscale materials bridge the disparate theories describing molecules and bulk matter. Surface phenomena also gain a greatly increased significance; even the well-known link between chemical reactivity and surface-to-volume ratio becomes a major determinant of physical properties, when it operates over nanoscale dimensions.

Against this background, this comprehensive work is designed to address the need for a dynamic, authoritative, and readily accessible source of information, capturing the full breadth of the subject. Its five volumes, covering a broad spectrum of disciplines including material sciences, chemistry, physics, and life sciences, have been written and edited by an outstanding team of international experts. Addressing an extensive, cross-disciplinary audience, each chapter aims to cover key developments in a scholarly, readable, and critical style, providing an indispensible first point of entry to the literature for scientists and technologists from inter-disciplinary fields. The work focuses on the major classes of nanomaterials in terms of their synthesis, structure, and applications, reviewing nanomaterials and their respective technologies in well-structured and comprehensive articles with extensive cross-references.

It has been a constant surprise and delight to have found, among the rapidly escalating number who work in nanoscience and technology, so many highly esteemed authors willing to contribute. Sharing our anticipation of a major addition to the literature, they have also captured the excitement of the field itself in each carefully crafted chapter. Along with our painstaking and meticulous volume editors, full credit for the success of this enterprise must go to these individuals, together with our thanks for (largely) adhering to the given deadlines. Lastly, we record our sincere thanks and appreciation for the skills and professionalism of the numerous Elsevier staff who have been involved in this project, notably Fiona Geraghty, Megan Palmer, Laura Jackson, and Greg Harris, and especially Donna De Weerd-Wilson who has steered it through from its inception. We have greatly enjoyed working with them all, as we have with each other.

David L. Andrews
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