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COMPREHENSIVE
NANOSCIENCE AND TECHNOLOGY

纳米科学与技术大全

5

自组装与纳米化学
Self-Assembly and Nanochemistry

David L. Andrews
Gregory D. Scholes
Gary P. Wiederrecht



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Comprehensive Nanoscience and Technology

纳米科学与技术大全 5

Self-Assembly and Nanochemistry

自组装与纳米化学

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David Andrews 是东英吉利亚大学化学物理教授，他领导的理论小组在基础光子学、荧光、能量输运、非线性光学和光机械力方面进行了广泛的研究。他发表了 250 篇研究论文和 10 本以他的名字出版的其他书籍，他经常应邀在国际会议上做报告。在北美和欧洲，他先后组织并主持了许多有关纳米科学和技术的国际会议。Andrews 教授是英国皇家化学学会（RSC）、物理研究所以及光学和光子学国际工程学会（SPIE）的成员。在业余时间，他很享受与家人朋友一起相处，他也是一个热衷于英国风景的画家。他的其他兴趣主要有音乐、绘画艺术和写作。

Greg Scholes 是多伦多大学化学系教授。他目前的研究集中在利用合成、理论和超快激光光谱学阐明决定纳米体系电子结构、光学性质和光物理性质的内在机制。基于他的突出贡献，2009 年入选加拿大皇家学会科学院，2007 年荣获加拿大皇家学会化学卢瑟福（Rutherford）奖章，2007 年获得国家自然科学基金（NSERC）Steacie 基金，2006 年获得加拿大化学学会 Keith Laidler 基金以及 Alfred P. Sloan 基金（2005～2006 年）。Scholes 博士现任物理化学杂志的资深主编和纳米光子学杂志副主编。他喜欢篮球、远足、摄影，喜欢和家人朋友相处。

Gary Wiederrecht 是阿贡国家实验室纳米材料中心的纳米光子学小组组长。他的研究兴趣集中在纳米粒子及其周期性组装体的光化学和光物理、杂化纳米结构、光化学能量转换以及光致电荷分离引起的非线性光学响应。在实验技术上，他擅长超快光谱和扫描探针显微技术，包括近场光学显微技术。他获得了能源部青年科学家 R&D100 奖和青年科学家和工程师总统奖。他撰写或合作撰写了约 80 篇同行评审的研究论文，并与世界多国的科学家都有合作研究。他喜欢旅游、自然，喜欢与家人相处。

（吴晓春 译）

序 言

自组装和纳米化学正携手并进。纳米化学运用化学的基本方法和原则来对纳米复合体系进行组装。以这种方式形成的新型材料体系具有集成的理想特性，对将来科研、革新以及制造业的发展起着至关重要的作用。其魅力之一在于能够将复杂功能的工程化调控在纳米材料中得以实现。例如，对优选出来的耐光荧光团，极易进行溶液化处理并实现其与特定的分析物结合。相信业余科学爱好者听说过许多相关的虚幻神奇的纳米材料，在本卷中，将对许多精致且最先进的例子进行介绍。自组装的威力就在于可通过调控分子间的作用力在不同尺寸上实现复杂系统的自动构建。然而，自组装难以以任何的方式在微尺寸下实现。高分子化学在这些重要基本概念的建立中起到了核心作用。这些概念已经经过发展和演化，且对化学进行不可思议的调控也在模板法这一支撑软光刻和介孔反光子晶体的方法中得到了显现。

在这一领域已发现的分子、化学以及材料的种类极其丰富。这卷《纳米科学与技术大全》将使读者对目前探究的“自组装与纳米化学”研究领域的前沿方向有全新的了解。同时，对这些方向进行了通俗易懂的介绍。专业人员将会从这些章节的详细说明中得到启发。这些章节涵盖了从分子尺寸的发光基团的结合和高分子的两亲性到富勒烯、纳米晶以及沸石的制备和功能化，再到复杂的囊泡、介孔结构、纳米复合物以及乳状液等的自组装多种主题。一般的读者将会理解为何对这一领域的投入在过去十几年中增加了许多倍，材料化学为何会发展成为一个充满生机、令人振奋的领域。

Gregory D. Scholes

(唐智勇 译)

前 言

纳米技术及其基础科学正以前所未有的速度发展。随着一系列纳米制造和操纵技术的发展,纳米科技正逐渐成熟为一个既能产生新的科学研究又能带来广泛商业应用的充满活力的领域,每年市场价值达万亿美元。在纳米尺度上制造和控制物质为探索量子、纳米光子以及纳米机电效应等奇特现象提供了前所未有的机遇。此外,因纳米材料将描述分子和宏观物质截然不同的理论联系起来,研究人员由此提出了许多关于物质电子和光学性质的新观点。表面现象的重要性越来越显著。在纳米尺度上,熟知的化学活性和比表面积之间的关系成为决定物理性质的主要因素。

在此背景下,这本旨在满足对一个动态的、权威的、容易获得信息来源且涵盖内容广泛的综合性著作问世了。全书共分五卷,包括材料科学、化学、物理学和生命科学等一系列学科,由国际专家组成的优秀团队进行撰写和编辑。针对广大的跨学科读者,每章旨在以权威、易读且客观的方式为跨学科领域的科学家和科技人员进入该领域提供不可或缺的入门切入点。本书从合成、结构和应用方面集中介绍了主要的纳米材料,对结构完整、综合性较强且广泛交叉引用的文章中的纳米材料和相关技术进行了综述。

随着纳米科技工作者数量的迅速攀升,有诸多受人高度尊敬的作者乐于为此书做出贡献,这给我们带来了不断的惊喜。此书是对现有文献的重要补充,作者们在精心准备每一个章节的同时抓住了本领域的兴奋点。在此谨对辛苦细致工作的各卷编辑、所有编写者及他们的如期完稿致以诚挚的感谢。最后,我们对参与这个项目的众多 Elsevier 工作人员的职业技能和敬业精神表示诚挚的感谢和赞赏,特别感谢 Fiona Geraghty、Megan Palmer、Laura Jackson、Greg Harris,尤其是 Donna De Weerd-Wilson 自始至终的督导。我们很喜欢与他们一起工作,彼此之间合作也很愉快。

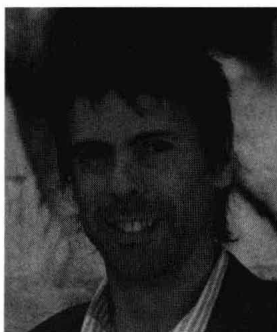
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(吴晓春 译)

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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 non-linear 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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