Book Review

Book Review of Probes and Tags to Study Biomolecular Function for Proteins, RNA, and Membranes

Sergey N. Krylov

J. Am. Chem. Soc., **2009**, 131 (4), 1621-1622• DOI: 10.1021/ja809727x • Publication Date (Web): 05 January 2009

interest in the past few years has been in the additional information about these functions that comes from new structural data, with structures for the green plant — or cyanobacterial — reaction centers and the Cytochrome b_6f complexes providing the primary focus. The recent higher resolution structures from the bc_1 complex from *Rhodobacter* were unfortunately too recent to be included. The interpretation of the structures of green plant reaction centers and their function still depend heavily on prior work on bacterial reaction centers, and this aspect is covered in a nice review of the earlier work and recent advances by Lancaster. I particularly enjoyed the discussion of the Q_B-site. Parson follows this with a succinct and lucid summary of functional aspects. The structure and function of photosystem I are nicely covered by Fromme and colleagues and by Sétif and Leibl, respectively. Gernot Renger has a nice account of photosystem II function, and in another chapter with Messinger, they provide a beautiful review of recent progress in the mechanism of O_2 evolution. Recent structures of photosystem II are covered by Zouni, who also includes some recent information suggesting that radiative reduction has changed the state of the Mn-cluster, which is also covered by Messinger and G. Renger. The remainder of the volume is devoted to chapters on intermediate electron transfer systems and phosphorylation, with bacterial systems covered nicely by Verméglio and cyanobacteria by Peschek. There are also stellar contributions by Cramer et al. on the b_6f complex and by Junge on the ATP-synthase.

I can certainly recommend the set to colleagues and would think it a "must" for any library serving a scientific community with serious interests in this area. My only quibble is that some of the chapters were clearly submitted earlier than others and are a bit dated, likely because those who met a target deadline suffered at the expense of the tardier. References in most chapters finish in 2004, but a few include work up to 2007.

Antony R. Crofts, *University of Illinois at Urbana−Champaign*

JA809545U

10.1021/ja809545u

Nanostructured Design: Methods and Protocols. Methods in Molecular Biology, 474. Edited by Ehud Gazit and Ruth Nussinov (Tel Aviv University, Israel). Humana Press (a part of Springer + Business Media, LLC): New York. 2008. xiv + 268 pp. $79.95. ISBN 978-1-934115-35-0.

Nanostructured Design: Methods and Protocols represents a new volume in the well-established *Methods in Molecular Biology* series. The principal stated goal of this book is to bring together in a single reference the major experimental, theoretical, and computational techniques for the design, characterization, and technological development of well-defined nanosized materials based on biological motifs. This approach to nanoscale design is maturing into an established field; therefore such an undertaking at this time is warranted.

The volume is divided into two major sections: "Experimental approach" (Chapters 1−6) and "Computational approach" (Chapters 7−12). The first three chapters deal with the preparation of protein/peptide fibers, Chapter 4 covers the preparation of nanoparticle−bimolecular conjugates, and Chapter 6 reviews the preparation of gold nanoparticle−DNA scaffolds. Although the subject of Chapter 5 formally concerns the synthesis of self-assembled peptide-based hydrogels, the authors mostly explore general aspects of automated solid-phase peptide synthesis and purification. The protocols in these chapters should be easily followed by those with experience in general biochemical procedures, peptide synthesis, and purification. However, I would suspect that those not familiar with these techniques may have difficulty in successfully performing the protocols, and more discussion may have been warranted.

The remaining chapters concern theoretical aspects of biomolecular nanostructured design. Many of these chapters concern the use of theory to direct experimental investigations. Chapter 7 is an insightful and useful tutorial on constructing RNA-based structures, whereas Chapter 8 explores protocols for fusing homo-oligomers to construct three-dimensional structures. Chapter 11 is a broad overview of computer modeling in biotechnology and nanoengineering, which, although lacking in protocols, is probably the most engaging chapter in the text. The final chapter concerns the investigation of β-rich structures for the design of interfaces. The other two chapters in this section (9 and 10) are concerned with computational methods to probe amyloid formation and properties. Although there is a substantial amount of theory in this section, the chapters are relatively easily understood by the nontheoretician. It should be noted that, as with the experimental protocols, nonexperts in the field may have difficulty in actually *performing* the computational protocols outlined.

The text is well referenced and up-to-date, with many of the references dating from 2004 on. As with other compilations containing chapters written by different authors, there is a dramatic difference in writing style from chapter to chapter. Although effort was taken to ensure a consistent format, the actual content of the chapters range wildly from short recipe-like protocols to full-on review articles.

There are two major weaknesses of the monograph. One is the fact that several key aspects of bioinspired nanostructure design are absent. For example, there is no mention of the use of virus particles for the production of semiconductors and other constructs or of biomineralization. Another weakness is that the text is divided into two major sections: experimental and computational approaches. Although this field requires both experimental and theoretical insights for fully exploiting the power of using biological constructs in nanostructured design, the two sections are largely orthogonal to their respective target audiences. Both of these failings could have been circumvented if the present work had been expanded or if two different volumes—a theoretical and experimental volume, for example—had been compiled.

Jason Shearer, *University of Nevada*

JA809618Z

10.1021/ja809618z

Probes and Tags to Study Biomolecular Function for Proteins, RNA, and Membranes. Edited by Lawrence W. Miller (University of Illinois, Chicago). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2008. xvi + 178 pp. $130. ISBN 978-3-527-31566-6.

Four types of biopolymers—proteins, nucleic acids, polysaccharides, and lipids—are pivotal to a cell's storing and processing of biological information at levels ranging from gene expression

to cell recognition. In order to understand how the biopolymers function inside cells, it is essential to know the rates of biopolymer production and degradation, their intracellular localization, as well as their partners in biomolecular interactions and the dynamics of such interactions. The major approach to comprehensive studies of biopolymers in living cells is fluorescent microscopy, in which only molecules of interest are visualized by attaching fluorophores to them. Attaching a fluorophore to a biopolymer with high selectivity may seem like a technical step; however, this step is often so challenging that it becomes the sole focus of many research groups in molecular and cell biology and organic chemistry. In general, this operation can be achieved in three ways: (i) covalent attachment of a fluorophore, (ii) noncovalent attachment of an affinity probe, covalently labeled with a fluorophore, and (iii) genetic fusion with a polypeptide tag that either is fluorescent, e.g., a fluorescent protein, or can be made fluorescent through covalent or affinity labeling. The area of fluorescent labeling of biopolymers is well established but continues to develop rapidly with novel interesting approaches emerging with surprising regularity. The body of literature describing different methods is large, but there is a continuous need for reviews and generalizations to keep up with new works.

This book is a valuable addition to the body of literature on fluorescent labeling of biopolymers. It focuses on a few selective new methods for fluorescent labeling of lipids, proteins, and mRNA. It should be noted that "a probe" is used in this book solely as a fluorescently labeled lipid that retains the function of an unlabeled lipid. This meaning is very narrow and different from that of an affinity probe, e.g., molecular probe, hybridization probe, antibody, aptamer, etc., mentioned above. The methods described in this book have been previously reviewed; however, this is the first collection of them in a single volume in which basic principles, state-of-the-art procedures, useful examples, and detailed protocols are described. The literature citations in the book are comprehensive and mostly limited to recent articles. I think the book will be useful to a wide readership including researchers currently practicing in the area, novices in the area interested in microscopy studies of fluorescently labeled biopolymers, and graduate students studying relevant subjects. I personally learned quite a bit from the book and recommended selective chapters to my graduate students for examples of how the knowledge of molecular biology and biochemistry can fuel the area of fluorescent labeling of biopolymers. In my view, the book is important and timely.

I have a few critical comments that I hope will help the reader to adjust expectations and experience more efficient reading. The title of the book is somewhat nondescriptive. First, it misses two words that are key to the subject: "living cell". Novel probes and tags for visualizing membrane components, proteins, and RNA in *living cells* are described here. In only a single instance, when describing protein modification with non-natural functionalities in a cell-free *in vitro* protein expression system, do the authors deviate from living cells. Also, although the title mentions "biomolecular function", some chapters do not refer to biomolecular function or at least do not refer to it explicitly. There is an imbalance among the three subjects—membranes, proteins, and RNA—as well: three chapters on membranes take up nearly half of the nine-chapter book, whereas the visualization of RNA is addressed in a single chapter and only a single method is described. I am guessing this imbalance reflects, to some extent, both the personal interests of the editor and the status of the area. The book reads more as a collection of independent works rather than as a set of logically linked chapters. For example, the introductions to the five protein chapters are very similar. The book would gain considerably from an editorial introduction to the three parts—lipids, protein, and RNA—of the book. The reader should also be prepared to find some nondefined abbreviations and sentences with missing words. The quality of the chapters is not even.

Despite the above criticism, the overall quality of the book is good and its importance to the chemical community is high. I congratulate the editor on his first book. I am sure I will return to this book many times in the future.

Sergey N. Krylov, *York University*

JA809727X

10.1021/ja809727x