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Electron Transfer in Chemistry

Ed. Vincenzo Balzani, John Wiley & Sons Ltd, Federal Republic of Germany, vol. 1, lxxx + 592 pp., vol. ,2 xlvii + 1002 pp., vol. 3, xlvii + 714 pp., vol. 4, xlvii + 804 pp., vol. 5, xlvii + 800 pp., price £950 for five volumes, ISBN 3527-29912-2

Volume I: Principles, Theories, Methods and Techniques
- Part 1: Principles and Theories. Piotr Piotrowiak (ed.)
- Part 2: Methods and Techniques. Michael A. J. Rodgers (ed.)

Volume II: Organic, Organometallic, and Inorganic Molecules
- Part 1: Organic Molecules. Jochen Mattay (ed.)
- Part 2: Organometallic and Inorganic Molecules. Didier Astruc (ed.)

Volume III: Biological and Artificial Supramolecular Systems
- Part 1: Biological Systems. Harry B. Gray and Jay R. Winkler (eds.)
- Part 2: Artificial Supramolecular Systems. Vincenzo Balzani (ed.)

Volume IV: Catalysis of Electron Transfer, Heterogeneous and Gas-Phase Systems
- Part 1: Catalysis of Electron Transfer. Shunichi Fukuzumi (ed.)
- Part 2: Heterogeneous Systems. Thomas E. Mallouk (ed.)
- Part 3: Gas-Phase Systems. Yehuda Haas (ed.)

Volume V: Molecular-Level Electronics, Imaging and Information, Energy and Environment
- Part 1: Molecular-Level Electronics. A. Prasanna de Silva (ed.)
- Part 2: Imaging and Information. Ian R. Gould (ed.)
- Part 3: Energy and the Environment. Ian R. Gould (ed.)

This new series makes an admirable attempt to draw together the diverse aspects of electron transfer chemistry into a single reference work. As series editor, Vincenzo Balzani is a respected international presence in the field of inorganic and supramolecular photochemistry (exemplified by his contributed chapters in Volume III), and has gathered an impressive global list of contributors, whose contributions are grouped into 12 parts overseen by sub-editors that are leading researchers in their areas. The 78 chapters are pitched firmly at the level of research and are generally highly topical although some basic material is also included in order to provide a unified view. The series will provide useful introductory material for graduate students in many areas and will also be of interest to active researchers wishing to broaden their knowledge with some excellent overviews. Inevitably in such a collection there are occasional gaps in subjects covered, and some variability in the quality and pitch of the different chapters, but overall the series represents a valuable resource both for those entering the field and those seeking topical information in different areas. Since the 5 volumes bring together a large range of topics, from theory to experiment, from photochemistry to electrochemistry, and from pure chemistry through life sciences to applications, they provide a particularly useful sourcebook for fertilisation of cross-disciplinary ideas.

On occasion, the organisation of the books is a little frustrating since complementary chapters on similar topics are contained in different volumes: this is particularly noticeable for the biological and biomimetic material, and also the semiconductor/electrochemistry material. However, this is compensated by an excellent cross-referenced index which is printed in Volume V. In addition, each volume starts with a complete listing of the chapters and their contents which is also useful for tracking related contributions.

The first part of Volume I is strong on the theory of electron transfer and there is a thorough coverage of the subject, including interfacial and bulk phase systems. The only major area which did not seem to be covered was that of electron transfer at the liquid/liquid interface which has attracted much interest in the last 5 years. Volume I opens with a discussion by Newton of theoretical aspects of general electron transfer in donor–bridge–acceptor systems. In this chapter and the following six that deal with various theoretical aspects of electron transfer, quantum mechanical treatment is prominent and those shy of mathematical formulation may find them overwhelming at first glance. However, the text alone is well worth perusing since, as a body, these chapters provide an excellent fundamental basis for understanding electron transfer processes. Chapter 2 by Sumi describes adiabatic and non-adiabatic models whilst Chapter 3 by Skourtis and Beretan considers multielectron, multistate, and dynamic bridge effects. In Chapter 4, Vanmaekelbergh presents the theory of electron transfer at electrodes and interfaces. Chapters 5–7 return to the solution phase with discussions of proton-coupled electron transfer (Hammes–Schiffer), the relationship between electron and electronic excitation transfer (Piotrowiak) and charge transfer states of transition metal complexes (Endicott). Chapters 8–10 are more descriptive and discuss specific types of experimental approach in the context of many examples. In Chapter 8, Fox has written an interesting review of photoelectrochemical transformations. Radiative charge recombination and electrochemiluminescence are the topics of Chapter 9 by Andersson and Schmehl. Chapter 10 by Nelson provides an overview of electron transfer reactions in organic chemistry. These chapters might have been better grouped with similar topics in other volumes, and hopefully their placement will not result in them being overlooked because all three are excellent overviews.

The second part of Volume I deals with experimental techniques, containing chapters on classical kinetic methods (Bakac), electrochemical methods (Pedersen and Daasbjerg), radiation-chemical techniques especially pulse radiolysis (Buxton and Mulazzani), and photochemical techniques particularly transient absorption and fluorescence (Henbest and Rodgers). There is a good chapter in Volume II on ESR spectroscopy written from the perspective of inorganic chemistry, but a general chapter on this very relevant technique which receives only cursory mention in Chapter 3 might have been included here. Whilst these chapters present a thorough treatment of well-established experimental methods, there is little emphasis on more contemporary techniques. For example in Chapter 2, more than a passing mention of modern methods such as SECM, high frequency AC techniques and coulostatic experiments using nanosecond lasers to induce a temperature jump would have been appropriate, since they are not yet discussed in detail in many standard textbooks. Similarly in

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Chapter 4, greater discussion of specialised modern photochemical techniques that are increasingly encountered in the primary literature would have been welcome.

Volume II is a substantial work dealing with organic, inorganic, and organometallic systems. The first part consists of nine chapters that provide a comprehensive review of classical electron transfer reactions of organic molecules grouped by functionality, including more exotic species such as fullerenes and radicals. Chapters 1 (Schmittel and Ghorai) and 9 (Bietti and Steenken) are both devoted to radicals, each considering different aspects of how radicals can be used in synthesis. Chapters 2–4 deal with conventional organic systems: electron transfer reactions of linear and cyclic alkanes in Chapter 2 (Roth), carbon–carbon multiple bonds in Chapter 3 (Bauld and Gao), and aromatic compounds in Chapter 4 (Gescheidt and Khan). In Chapter 5, Fukuzumi and Guldi present an excellent review of the electron transfer reactions of fullerenes, which have attracted enormous interest in recent years since their redox properties make them excellent candidates for multiple electron processes, particularly reduction. This chapter covers all aspects of these compounds from single buckyballs and their substituents through to dyad, triad and supramolecular systems. The subsequent chapters of this section return to more classical systems with contributions on the electron transfer chemistry of heterocycles (Albini and Fagnoni), amines (Das and Suresh), and carbonyl compounds (Griesbeck and Schieffer). The second part of this volume starts with a theoretical chapter by Brunschwig and Sutin which seems displaced from Volume I, then swiftly moves to a description of organometallic systems followed by biologically relevant electron transfer chemistry. Metallocenes are the main focus of Chapters 2 (Hubig and Kochi), 3 (Tilset), and 4 (Astruc). Chapter 4 which considers such compounds as electron-reservoir complexes as well as their catalytic behaviour is particularly comprehensive. Chapter 5 (Vlcek) deals with mononuclear polypyridine coordination complexes, and provides an excellent foundation for the chapters in Volume III on supramolecular chemistry involving such compounds. This section then turns to biological systems with chapters on biological and biomimetic aspects of dinitrogen reduction by Shilov and hydrogenase action by Forde and Morris. A chapter by Fukuzumi and Imahori on the biomimetic electron transfer chemistry of porphyrins follows, which includes a lot of material repeated in Volume III on supramolecular porphyrin-based systems. The final chapter by Kaim discusses ESR spectroscopy of inorganic and organometallic radicals.

The biological theme continues in Part 1 of Volume III which includes insights into charge transport in DNA, proteins, and natural supramolecular assemblies such as the bacterial reaction centre. Unfortunately, there is no specific discussion of other assemblies such as photosystem 2 which has gained more emphasis recently, both in terms of the natural system and artificial mimics (although there is some mention in various chapters). Gray and Winkler open this volume with a short chapter summarising electron transfer in metalloproteins. More specific chapters then appear on photosynthesis in the bacterial reaction centre by Moser, Page and Dutton, cytochrome oxidase in respiration by the late Bo G. Malmström, and heme-containing oxygenases and peroxidases by Pond, Ledbetter, Sono, Goodin and Dawson. Chapter 5 by Lewis presents a good overview of electron transfer processes in DNA, focusing on photoinduced electron transfer in dye-modified systems which is the area of the authors own seminal contributions. This topic remains controversial and continues to produce exciting work as evidenced by the addendum highlighting important papers published since initial preparation of the review. The second part of Volume III concentrates on artificial supramolecular systems with chapters devoted to synthetic systems that attempt to understand and mimic biological electron transport processes. Paddon–Row opens with an overview of bridged donor–acceptor systems, including those containing metalloporphyrins and metal polypyridyl complexes as well as the organic components of the title. Covalent porphyrin-containing systems are the topic of Chapter 2 by Gust, Moore, and Moore which gives an excellent overview of the vast literature in this field, including their own seminal contributions. Similarly, Scandola *et al.* discuss metal complex-containing covalently-linked systems in Chapter 3. In Chapter 4, Nocera *et al.* review the various systems in which donors and acceptors are brought together through hydrogen bonding, an area which is not yet as developed as covalent bridging. Fabrizzi, Licchelli, and Taglietti then discuss host–guest and cage-type systems. The concluding chapters concentrate on more exotic molecular architectures including pseudorotaxanes (Venturi, Credi and Balzani), rotaxanes and catenanes (Ballardini, Gandolfi and Balzani), metal-assembled supramolecular structures (Sauvage *et al.*) and dendrimers (Juris). Many of these chapters contain excellent overviews of contemporary research by authors that have been prominent in the development of their respective areas. However, there is no specific discussion of electron transfer in polymeric systems, apart from biopolymers and one chapter on dendrimers, although conducting polymers receive cursory treatment in the chapter on batteries in Volume V.

The first part of Volume IV is concerned with electron transfer catalysis. The opening chapter by Fukuzumi gives a detailed overview of acid and base catalysis of electron transfer which provides a solid background. In the following chapter, Rotello discusses very contemporary material on redox modulation by molecular recognition with a selection of pertinent examples. Chapter 3 by Fujita and Brunschwig deals with artificial systems for CO_2 fixation and describes the variety of constructs developed for this purpose. The next chapter (Katz, Shipway and Willner) on electrochemical and photochemical activation of enzymes presents an excellent overview of this area, which deals with complex systems and processes that combine the molecular systems discussed in much of the series with biochemistry and interfacial phenomena. This is followed by a short chapter by Tollin on protein electron transfer that seems misplaced from Volume III and the section concludes with a chapter from Kisch and Hopfner on semiconductor photocatalysis, a recurrent theme throughout the series.

In part 2, the theme of semiconductors continues with an excellent opening chapter on semiconductor electrochemistry by Rajeshwar, dealing with the fundamentals of transport and charge transfer as well as systems of current interest such as size-quantized semiconductors, dye-sensitized films and chemically-modified semiconductors. However, there is considerable overlap with the chapter in Volume V by Graetzel and Moser and it is not clear why these two chapters are separated across volumes. This is complemented by Chapter 2 (Qu and Meyer) which deals with dye sensitization of semiconductor electrodes. The section then proceeds to non-electrochemical systems. Vaidyalingam, Coutant, and Dutta discuss electron transfer in zeolites and related mesoporous materials as well as mentioning sol-gels, while in Chapter 4 Bhat and Domen consider layered and intercalated materials such as titanates, niobdates, and clays which have catalytic potential when intercalated with reactive compounds. Also considered are multilayer structures synthesized by design. Chapter 5 by Clegg and Hutchison deals with all aspects of electron transfer in self-assembled monolayers and Langmuir–Blodgett films, and provides a good review up to the publication date, although in a vibrant and continually expanding area such as SAMs, particularly with respect to single molecule conductivity measurements, the subject has already advanced from the material presented. Chapter 6 (Hurst and Khairutdinov) deals with the more mature subject of electron transfer in surfactant assemblies such as micelles, liposomes and membranes.

The third part shifts to the gas-phase with emphasis on systems studied in supersonic jets. This is a less commonly

encountered topic than the others covered in this series. In the absence of solvation effects, analysis of electron transfer is much simpler and results can more readily be compared with theory which makes it an interesting subject in the context of this series. For those with little prior appreciation of the area, these chapters provide an excellent introduction. Following an introductory perspective chapter by Haas, Chapter 2 by Soep and Mestdagh is concerned with atoms, simple molecules (*e.g.* BaO), van der Waals complexes (*e.g.*, CaH), and clusters. In Chapter 3, Herbich and Brutschy describe gas phase studies of TICT molecules while Chapters 4 (Haas) and 5 (Ohshima, Kajimoto and Fuke) deal with electron transfer in larger systems such as exciplexes, EDA complexes and solvated clusters.

Volume V demonstrates the maturity of electron transfer chemistry as science enters the nano-realm. The first part on molecular electronics presents an excellent view of what has already been achieved and inspires contemplation of future developments. The first chapter by Launay and Coudret deals with bimetallic complexes containing bridging ligands and their relationship to metal–insulator–metal junctions or molecular wires. There is a detailed survey of the chemistry and a well written account of the relevant theory, *e.g.* intervalence charge transfer. Lukas and Wasielewski then discuss molecular systems which act as switches in response to the absorption of light. The photophysics and chemistry of these compounds are discussed in detail and the authors finish by emphasizing the importance of organising these isolated devices into larger assemblies. De Cola and Belser also discuss bimetallic complexes, the difference compared to Chapter 1 being mainly in the focus on photoinduced energy and electron transfer rather than intervalence charge transfer spectra. Brady and Sambles describe conduction in molecules, starting from an account of the early work of Aviram and Ratner and then moving on to a discussion of experiments based on LB films. de Silva, McClenaghan and McCoy survey various approaches to the construction of logic gates; in a fascinating chapter they cover molecular devices, oligonucleotides, quantum dots, NMR, cold-trapped ions and the use of spectral hole burning in organic molecules. Campagna, Serroni, Puntoriero, Di Pietro and Ricevuto cover various light-harvesting systems, including natural ones, purely from the perspective of molecules rather than semiconductor-based devices. In chapter 7, Irie and Matsuda deal with photochromic systems for information storage although there is a little overlap with Chapter 5. Finally, in Chapter 8, Houbrechts, Hendrickx, Verbiest, Clays and Persoons provide a clear introduction to the theory of nonlinear optical effects in molecules and discuss examples of organic systems.

The second part is concerned with information storage, from classical photography to more contemporary approaches. In the first chapter, Fyson, Twist and Gould provide a comprehensive introduction to the theory and chemistry of silver halides and photography. There is also a brief account of the history of the subject. In Chapter 2 (Weiss, Cowdery and Young) this is followed by a similarly detailed account of electrophotography and its beginnings with the "kitchen-lab" experiments of Chester Carlson. Chapter 3 by West and Rahn is concerned with the photorefractive effect, which is not yet of such commercial importance, but the authors describe the progress towards holographic data storage as well as the physics and chemistry of the effect. Chapter 4 by Paczkowski and Neckers describes the use of photoinduced electron transfer in the initiation of photopolymerisation.

Part 3 considers the environmental impact of electron transfer chemistry, in the form of solar energy conversion, batteries, and waste treatment. In Chapter 1, Graetzel and Moser are concerned with photochemical energy conversion and discuss briefly the various theoretical limitations on efficiency before giving detailed accounts of the present state of the art regarding molecular systems, dye-sensitized wide bandgap semiconductors (e.g., TiO_2) and analogs of photosystem II. Conventional semiconductor photovoltaics and water splitting are discussed briefly. The chapter concludes with a summary of outstanding scientific questions relating to electron transfer and transport in these systems. This chapter provides an excellent introduction to the field. In Chapter 2, Arbizzani, Mastragostino and Soavi review developments in battery technology. Conductive polymers, modern lithium batteries and other current topics are all covered, though the introduction dealing with very basic aspects of cells is probably not necessary at this level. In Chapter 3, Thurnauer, Rajh and Dimitrijevic discuss photocatalytic systems for water remediation. This relates mainly to colloidal semiconductors and there is some overlap with the chapter of Graetzel and Moser although the focus is different.

In summary, despite some chapters that cover textbook material and a few gaps in subject matter, this series provides an excellent overview of most of the topics of contemporary interest to researchers in the area of electron transfer chemistry. The whole collection will be an invaluable source of both introductory and advanced reading for all those working in, or thinking of entering, the general area of electron transfer.

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Organic Chemistry

G. Marc Loudon, Oxford University Press, UK, 4th edition, xxxiii + 1353 pp., price £39.99, ISBN 0-19-511999-1

The 4th edition of *Organic Chemistry* by G. Marc Loudon is a welcome addition to the large range of excellent introductory textbooks in this subject area. The text comprises 1353 pages divided into 27 chapters (which is about the standard length for a text of this sort), plus seven short appendices spanning a range of topics including nomenclature, spectroscopic data and synthetic methods. A comprehensive 34-page index completes the volume and a CD-ROM (Dynamic Organic Chemistry), containing original animations, accompanies the book.

The text is arranged along traditional functional group lines with extra chapters covering acid–base chemistry, stereochemistry and spectroscopy. The final chapters serve as introductions to the chemistry of amino acids, peptides and proteins (Chapter 26) and carbohydrates and nucleic acids (Chapter 27), but biological examples of organic chemistry are not restricted to these final chapters; they are to be found alongside the relevant chemistry throughout the text.

Within the functional group based format is a mechanistic approach to organic chemistry that is strongly emphasised. The use of curved-arrow notation is introduced in Chapter 3 (acids and bases) and is explained in more detail than is common for a text of this sort. (There is even an example of one of the more common errors made in 'arrow-pushing' which is labeled 'INCORRECT'.) Reaction mechanisms for functional groups are included in the appropriate chapter and reactive functionality within chemical equations is often, but not always, highlighted in blue. Unfortunately, it is not always easy to distinguish blue from black—perhaps the use of a different and/or additional color might be justified for this reason. Additional comments are often attached to the equations, highlighting the direction of electron flow or inversion of configuration. These notes become less frequent as the text progresses and it is assumed that the reader no longer requires them. Each chapter concludes with a 'key ideas' section, which summarises the most important concepts within the chapter in point form.

Frequent summaries are to be found throughout the text, *e.g.* lists of the carbon–carbon bond forming reactions encountered

earlier in the text are to be found on pages 486, 626, 715, 805, 822, 1057 and in Appendix VI. Mechanistic similarities to reactions described earlier in the text are also highlighted, *e.g*. the mechanism for the saponification of an ester is re-displayed alongside that of the Claisen condensation. This, together with continual references to material covered earlier in the text, serves to illustrate the interrelated nature of what might be seen as unrelated concepts by the commencing student.

Numerous problems (1536 in total) of varying levels of difficulty are scattered throughout the text and at the end of each chapter. However, the 'paired problem' approach taken in the previous edition has been abandoned. The 'study problems' in each chapter have solutions that are worked through in detail in a manner similar to that which would be used in a lecture or tutorial. The remaining in-text problems relate directly to the chemistry in the chapter, whilst those at the conclusion of each chapter require a knowledge of material covered in previous chapters. For solutions to these problems it is necessary to purchase the accompanying 'Study Guide and Solutions Manual'. This supplement also contains conceptual outlines and reaction summaries for each chapter, together with 'Study Guide Links' which provide either more in-depth information on marked topics in the text or additional instruction on important or particularly difficult areas. Topics discussed in the Study Guide are noted in the margins of the text, as are those topics that have an accompanying animation. The animations provided on CD-ROM serve to illustrate those areas, such as stereochemistry, which are difficult to grasp from two-dimensional drawings. However, I found the yellow text on a mottled blue and black background a little difficult to read at times and had to restart my computer (MACOS X) after using the disk.

The text is organised along similar, although not identical, lines to the previous edition, with several additions to keep pace with current activity in the field. The inclusion of 300 MHz proton NMR spectra, in a format in which splitting patterns are made clear, should aid students in developing the skills required to interpret NMR spectra. A particularly welcome addition is a brief section on transition metal organometallic reactions, in which both the Heck and Stille reactions are covered in some detail. Whilst it is impossible to cover much of this important area of chemistry in a basic organic chemistry textbook, it is vital that students are made aware of the existence of this powerful class of reactions. A brief description of combinatorial chemistry and high-throughput analysis is presented in Chapter 26, together with a simple example using peptide chemistry. The introduction of this section should serve to make students aware of the possibilities presented by this rapidly expanding area of organic chemistry.

There appear to be few errors, and those that I found were already listed on the publisher's website (ironically not the Internet address given for textbook corrections in the preface). Unfortunately, neither the study guide nor the CD-ROM are currently complete, but the most up-to-date versions can be found at an Internet address supplied with the textbook, together with the statement that new files will be posted frequently enough to 'stay ahead of those who are using the text for a first-semester organic chemistry course in the Spring Semester of 2002'. (Not so useful for those of us whose academic year commenced in March.)

Overall, the 4th edition of *Organic Chemistry* presents an accurate and up-to-date view of the subject. The text is well written and easy to follow and the inclusion of boxed historical vignettes and analogies, such as that of a slow toll-collector for a rate-determining step, make it very readable.

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Synthetic Macromolecules with Higher Structural Order

Ishrat M. Khan, Oxford University Press, USA, iii + 230 pp., price £95, ISBN 0-8412-3728-X

"*Synthetic Macromolecules with Higher Structural Order*" is the latest in the American Chemical Society Symposium series (number 812) and is a collection of 15 papers collated from a symposium organised under the auspices of the ACS Division of Polymer Chemistry, held at the 219th ACS National Meeting in San Francisco March, 2000.

The subject of higher ordering in macromolecules has been a subject of considerable fascination for a number of research groups across the globe over the past decade. In part this fascination with inducing specific secondary (and ideally tertiary and quaternary) structures upon synthetic macromolecular systems complements the drive by 'biologists' to understand how the primary and secondary structures of proteins influence the tertiary and quaternary structures. As the biologists study existing natural systems, chemists (predominantly) are designing synthetic systems that strive to achieve even a modicum of the complexity of form and function of most biomacromolecular systems. This is unsurprisingly, not a trivial problem. One of the most studied secondary structural motifs of proteins is the α-helix and nearly half of the papers in this book describe attempts to impose defined helical structures along synthetic polymer backbones.

The first section of the book deals predominantly with the imposition of helical conformations upon synthetic polymers. Whilst the earliest attempts to synthesise and record observations of chirality in helical synthetic macromolecules were being made as far back as the early 1960s by Pino and co-workers in Italy, the editor identifies the Okamato group as the current age's pioneers in this area. They have developed synthetic methodologies for the construction of a considerable range of polymethacrylates from bulky monomers. There are three main approaches to generating helical polymers: the polymerisation of monomers with bulky side-groups using chiral initiators and/or ligands; the synthesis of polymers with sterically demanding chiral groups; the induction of a helical structure through complexation with molecular or ionic guests. All three general approaches are covered by papers in the first section of the book entitled "*Higher Ordering in Synthetic Polymers*". The first paper of the first section of the book is a description of the Okamoto group's recent synthetic approaches to the generation of helical polymers. Khan *et al*. and Jaycox provide further examples of these synthetic approaches to helical vinyl polymers. The induction of helicity in polymers through complexation is represented by a paper from Yashima and Maeda. The Masuda and Fujiki groups present papers studying systems where helicity results from the covalent attachment of chiral groups to the polymer backbones.

Naturally, where helices occur chirality becomes an issue and the first section in many ways provides an illuminating example of the application of circular dichroism spectroscopy in contemporary supramolecular polymer chemistry. The impact of CD spectrometers on this field cannot be understated.

The next two sections of this book fit slightly less coherently within the overarching context of the title of the book. The second section is entitled *Synthetic Peptides* and contains two papers detailing attempts to stabilise peptide helices (α- and triple-helices); in both papers the generated helices are studied in relation to the generation of tertiary structures. Both papers are of good quality and illuminating to myself as a polymer chemist, but whilst the link between secondary structures (α-helices) and tertiary structures (aggregates and triple-helices) is apparent, the position of these papers between two sections dealing with predominantly synthetic homopolymer or random copolymer systems is somewhat curious. The intention may be however, to draw the attention of polymer and supramolecular

scientists to the approaches being taken and studied by peptide chemists. If so, it partly succeeds although more papers on the subject would have been beneficial for the section and the overall theme of the book.

The final section contains six papers ostensibly dealing with "Macromolecular Assemblies". This is an extremely large subject by any definition and this is partly reflected in the variety in the subject matter of the papers presented. The first paper in the section details the extension of some of the principles encountered in sections 1 and 2 (through the application of amino acid functionalised synthetic polymers) in developing macromolecular assemblies displaying a remarkable variety of morphologies in dispersions. Two papers deal with non-helical self-assembling synthetic polymers into colloidal aggregates. Manners *et al.* discuss the self-organisation and self-assembly of their remarkable ferrocenylsilane block copolymer systems in thin films and in aqueous systems respectively, and discuss some potential applications. Kakucji and Sugimoto show that carbohydrate terminated polystyrenes can also form micellar aggregates. The other three papers discuss metal complexation of terpyridine functionalised polyoxazolines, ultracentrifugal analysis of supramolecular components and the application of dendrimers in sol–gel materials. These three papers are of general interest, however their inclusion in this book and specifically this section as it stands, is slightly confusing as none strictly deal with macromolecular assemblies in the truest sense. It is this that makes the last section a somewhat disjointed reading experience. In many ways this section would have benefited from being split into at least two sections (perhaps a section entitled "Towards Macromolecular Assemblies") and more papers being included.

"*Synthetic Macromolecules with Higher Structural Order*" contains 15 papers presented by different authors and thus cannot be considered as a definitive text. However it does act as an effective 'snapshot' of a developing area of polymer and supramolecular chemical research and appears to represent a valid summation of a fascinating symposium. It is shame that the coherence of the first section was not maintained for the other two sections and the inclusion of more papers would have been of benefit. A greatly expanded introductory paper from the editor would also have been exceptionally welcome, ideally with a discussion of the work of prominent researchers in the field who did not contribute papers to this book. Researchers in the fields of supramolecular chemistry and macromolecular self-assembly should certainly read the book and researchers from other areas (such as organic chemists) may find some of the themes addressed of interest.

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