

Research In New Ionic Liquids

This comprehensive database on physical properties of pure ionic liquids (ILs) contains data collected from 269 peer-reviewed papers in the period from 1982 to June 2008. There are more than 9,400 data points on the 29 kinds of physicochemical properties for 1886 available ionic liquids, from which 807 kinds of cations and 185 kinds of anions were extracted. This book includes nearly all known pure ILs and their known physicochemical properties through June 2008. In addition, the authors incorporate the main applications of individual ILs and a large number of references. Nearly 50 tables include typical data, experimental and modelling or simulation comparison, and model parameters, enhancing the application of ILs 100 figures—from QSPR, EOS and gE models to quantum and molecular simulations—help readers understand ILs at molecular level. Applications illustrate the role of IL properties in industry, in particular the development of novel clean processes and products. Concerns with ionic liquids are one of the most interesting and rapidly developing areas in modern physical chemistry, materials science, technologies, and engineering. Increasing attention has also been paid to the use of ionic liquids in the research fields of biological aspects and natural resources. This book provides the forum for dissemination and exchange of up-to-date scientific information on theoretical, generic, and applied areas of ionic liquids. It, therefore, tends to review recent progresses in ionic liquid research on fundamental properties, solvents and catalysis in organic reactions, biological applications, providing energies and fuels, biomass conversions, functional materials, and other applications. I trust that this book will provide an active source of information for research in ionic liquid science and engineering.

This volume describes the most recent findings on the structure of ILs interpreted through cutting-edge experimental and theoretical methods. Research in the field of ionic liquids (ILs) keeps a fast and steady pace. Since these new-generation molten salts first appeared in the chemistry and physics landscape, a large number of new compounds has been synthesized. Most of them display unexpected behaviour and possess stunning properties. The coverage in this book ranges from the mesoscopic structure of ILs to their interaction with proteins. The reader will learn how diffraction techniques (small and large angle X-Ray and neutron scattering, powder methods), X-Ray absorption spectroscopies (EXAFS/XANES), optical methods (IR, RAMAN), NMR and calorimetric methods can help the study of ILs, both as neat and in mixtures with other compounds. It will enable the reader to choose the best method to suit their experimental needs. A detailed survey of theoretical methods, both quantum-chemical and classical, and of their predictive power will accompany the exposition of experimental ones. This book is a must read for postgraduate students, for post-docs, and for researchers who are interested in understanding the structural properties of ILs.

Written by experts who have been part of this field since its beginnings in both research and academia, this textbook introduces readers to this evolving topic and the broad range of applications that are being explored. The book begins by examining what it is that defines ionic liquids and what sets them apart from other materials. Chapters describe the various types of ionic liquids and the different techniques used to synthesize them, as well as their properties and some of the methods used in their measurement. Further chapters delve into synthetic and electrochemical applications and their broad use as "Green" solvents. Final chapters examine important applications in a wide variety of contexts, including such devices as solar cells and batteries, electrochemistry, and biotechnology. The result is a must-have resource for any researcher beginning to work in this growing field, including senior undergraduates and postgraduates.

Ionic Liquids in Lipid Processing and Analysis

Novel Catalytic and Separation Processes Based on Ionic Liquids

Recent Advances in Ionic Liquids

Critical Expert Overviews

New Generations of Ionic Liquids Applied to Enzymatic Biocatalysis

Ionic liquids (ILs) are a class of low melting point, ionic compounds which have a variety of properties allowing many of them to be sustainable green solvents. These non-molecular solvents possess high thermal stabilities and negligible vapour pressures making them attractive alternatives to environmentally unfriendly solvents that produce volatile organic compounds (VOCs). In this book, the authors present research on the properties, applications and hazards of ionic liquids. Some of the topics discussed include challenges and perspectives of ionic liquids vs. traditional solvents for cellulose processing; ionic liquids as sustainable extractants in petrochemical processing; bronsted acid-base ionic liquids and membranes as ion conducting materials; and, physical and chemical properties of ionic liquids.

Ionic Liquids in Separation Technology reports on the most important fundamental and technological advances in separation processes using ionic liquids. It brings together the latest developments in this fascinating field, supplements them with numerous practical tips, and thus provides those working in both research and industry with an indispensable source of information. The book covers fundamental topics of physical, thermal, and optical properties of ionic liquids, including green aspects. It then moves on to contexts and applications, including separation of proteins, reduction of environmental pollutants, separation of metal ions and organic compounds, use in electrochromic devices, and much more. For the specialist audience the book serves as a recompilation of the most important knowledge in this field, whereas for starting researchers in ionic liquid separation technology the book is a great introduction to the field. First book in the marketplace dedicated to ionic liquids in separation technology. Contributions from scientists in academia and researchers in industry ensure the coverage of both scientific fundamentals and industrial applications. Covers a broad collection of applications in separation technology which makes the book a single source of information. Includes many practical tips for researchers in industry and scientists who apply ionic liquids in their work.

The second, completely revised and enlarged edition of what has become the standard reference work in this fascinating field brings together the latest developments, supplemented by numerous practical tips, providing those working in both research and industry with an indispensable source of information. New contributions have been added, to reflect the fact that industrial processes are already established, and ionic liquids are now commercially available. A must for everyone working in the field.

An Overview of a Rapidly Expanding Area in Chemistry Exploring the future in chemical analysis research, Ionic Liquids in Chemical Analysis focuses on materials that promise entirely new ways to perform solution chemistry. It provides a broad overview of the applications of ionic liquids in various areas of analytical chemistry, in

Handbook of Ionic Liquids

Advanced Topics in Ionic Liquids

Ionic Liquids II

Applications of Ionic Liquids in Science and Technology

New Ionic Liquids

?The series Topics in Current Chemistry Collections presents critical reviews from the journal Topics in Current Chemistry organized in topical volumes. The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology, medicine and materials science. The goal of each thematic volume is to give the non-specialist reader, whether in academia or industry, a comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience. Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole. The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed.

The coverage is not intended to be an exhaustive summary of the field or include large quantities of data, but should rather be conceptual, concentrating on the methodological thinking that will allow the non-specialist reader to understand the information presented. Contributions also offer an outlook on potential future developments in the field. The chapters "Ionic Liquid–Liquid Chromatography: A New General Purpose Separation Methodology", "Proteins in Ionic Liquids: Current Status of Experiments and Simulations", "Lewis Acidic Ionic Liquids" and "Quantum Chemical Modeling of Hydrogen Bonding in Ionic Liquids" are available open access under a Creative Commons Attribution 4.0 International License via link.springer.com.

This book serves as a reference for those interested in state-of-the-art research on the science and technology of ionic liquids (ILs), particularly in relation to lipids processing and analysis. Topics include a review of the chemistry and physics of ILs as well as a quantitative understanding of structure-activity relationships at the molecular level. Further, chapter authors examine the molecular basis of the toxicity of ILs, the prediction of the properties of ILs, and the rationale and steps toward a priori design of ionic liquids for task-defined applications. Emerging research in developing lipid-inspired ILs and their prospective use in drug formulation is described. Among the highlights are the latest advances in IL-mediated biocatalysis and biotransformation, along with lipase production, purification, and activation. Reviews the state-of-the-art applications of ionic liquids in lipid processing and relevant areas from a variety of perspectives. Summarizes the latest advances in the measurement of the physical and chemical properties of ionic liquids and available databases of thermodynamic property data. Presents the tremendous opportunities provided and challenges faced from ionic liquids as a newly emerging technology for lipids processing area.

Critical overviews from the front line of ionic liquids research. Ionic Liquids Completely UnCOILed: Critical Expert Overviews concludes the discussion of new processes and developments in ionic liquid technology introduced in the previously published volumes, Ionic Liquids UnCOILed and Ionic Liquids Further UnCOILed. The goal of this volume is to provide expert overviews that range from applied to theoretical, synthetic to structural, and analytical to toxicological. The value of book lies in the authors' expertise, and their willingness to share it with the reader. Written by an international group of chemists, the book presents eleven overviews of specific areas of ionic liquid chemistry including: What is an Ionic Liquid? Molecular modelling. Crystallography. Chemical engineering of ionic liquid processes. Toxicology and Biodegradation. Organic reaction mechanisms. Edited by Professor Ken Seddon and Dr Natalia Plechkova, world leaders in the field of ionic liquids, this book is a must read for R&D chemists, educators, and students, and for commercial developers of environmentally sustainable processes. It offers insight and appreciation for the direction in which the field is going, while also highlighting the best published works available, making it equally valuable to new and experienced chemists alike.

This unique book gives a timely overview about the fundamentals and applications of supported ionic liquids in modern organic synthesis. It introduces the concept and synthesis of SILP materials and presents important applications in the field of catalysis (e.g. hydroformylation, hydrogenation, coupling reactions, fine chemical synthesis) as well as energy technology and gas separation. Written by pioneers in the field, this book is an invaluable reference book for organic chemists in academia or industry.

Ionic Liquids UnCOILed

Electrodeposition from Ionic Liquids

An Introduction to Ionic Liquids

Ionic Liquid-Based Technologies for Environmental Sustainability

Ionic Liquids Further UnCOILed

Ionic Liquids are a family of salts which by definition have very low melting points that are at or below the boiling point of water (

Although ionic liquids have only been studied in depth during the last decades, the field is now maturing to such a degree that the focus is on larger scale applications for use in real processes such as catalysis. Current information is scattered across the literature and Catalysis in Ionic Liquids provides a critical analysis of the research published to date on ionic solvents in all areas of the catalytic science. The book covers both catalyst synthesis using ionic liquids as solvents and green syntheses using both ionic liquids as well as mixtures of ionic liquids and carbon dioxide (as a subcritical and supercritical liquid), including enzymatic, homogeneous, and heterogeneous catalysis, electrocatalysis and organocatalysis. As well as the catalysis community, the book will also be of interest to postgraduates, postdoctoral workers and researchers in academia and industry working in organic synthesis, new materials synthesis, renewable sources of energy and electrochemistry. Written by leading experts in the field, this is the reference source to find about catalysis in ionic liquids.

The second edition is based on the original book, which has been revised, updated and expanded in order to cover the latest information on this rapidly growing field. The book begins with a description of general and electrochemical properties of ionic liquids and continues with a discussion of applications in biochemistry, ionic devices, functional design and polymeric ionic liquids. The new edition includes new chapters on Li ion Batteries and Actuators, as well as a revision of existing chapters to include a discussion on purification and the effects of impurities, adsorption of ionic liquids on interfaces and on the electrochemical double layer, among other topics.

As Chairmen of the Electrochemistry and Molten Salts Discussion Groups of the Chemical Society, it gave us great pleasure to welcome the confer ence Highly Concentrated Aqueous Solutions and Molten Salts, which our Groups cosponsored, at St. John's College, Oxford in July 1978. During the meeting the editors of the present volume, and those giving lectures, came to the conclusion that the verbal presentations deserved to be expanded and to be more widely disseminated in a permanent form. Thus the articles which appear in this volume were commissioned and prepared. A greater exchange of information between aqueous chemists and those concerned with molten salts is to be welcomed and to this end the present volume aims to focus attention on the borderline areas between the two in an attempt to facilitate a wider awareness of the concepts and methods appropriate to the respective specialities. Similarly, and partly cularly in the electrochemical field, a greater exchange of information be tween the academic and industrial practitioners of the subject is desirable. THe problems involved are not trivial but when the interactions in these largely (but not wholly) ionic liquids are better understood, this will surely be to the benefit of all concerned with solution chemistry. Douglas Inman, Imperial College Chairman, Electrochemistry Group David Kerridge, University of Southampton Chairman, Molten Salts Discussion Group v Preface A number of recent events led to the appearance of this text at this particu lar time.

Progress and Developments in

The Structure of Ionic Liquids

From Catalyst Synthesis to Application

From Chemistry to Applications

Ionic Liquids in Separation Technology

Ionic liquids in Analytical Chemistry: New Insights and Recent Developments focuses on the use of these materials in the field of chemical analysis, paying attention to different areas such as sample preparation, separation techniques, spectroscopy and electrochemical methods. Chapters describe the structure and properties of new ionic liquids and eutectic solvents that are widely used in analytical chemistry, review ionic liquids in sample preparation, liquid, micellar liquid and gas chromatography, and capillary electrophoresis. Final chapters are devoted to spectroscopic and electrochemical techniques. The whole volume provides a broad overview of recent applications of ionic liquids. The book will serve as a valuable resource to researchers and laboratory technicians working in the field, as well as instructors and students of analytical chemistry. Gathers the contributions of leading authorities on the use of ionic liquids in analytical science. Describes the structure and properties of the newer ionic liquids used in chemical analysis of ionic liquids in analytical chemistry applications.

Sustainability, defined as the way to meet the needs of the present generation without compromising the ability of future ones to meet their own, is one of the main challenges of modern society. Within this context, chemistry plays a significant role, and solvent nature as well as its environmental impact are pivotal issues frequently addressed. Ionic liquids, i.e. organic salts that have melting temperatures lower than 100 °C, have been frequently hailed as alternatives to conventional organic solvents. Their greenness has been mainly ascribed to their low vapor pressure and flammability. However, in addition to this, their high solubilizing ability and low miscibility with conventional organic solvents frequently allow for reducing the amount used, as well as for their recycling. Ionic liquids, especially the ones featured by aromatic cations, are frequently described as "polymeric supramolecular fluids" constructed through the establishment of feeble but cooperative supramolecular interactions like Coulomb and π-π interactions, as well as hydrogen bonds. In general, ionic liquids are also indicated as "designer solvents" as it is possible to tailor their features to specific applications by simply modifying their cation or anion structure. In this way, small changes in the ion's structure can give rise to solvents showing very different properties. The above premises widely justify the growing interest in the properties and applications of ionic liquids, seen in recent literature (according to Scopus, more than 27,000 papers published in the last five years have "ionic liquids" as a keyword). Thanks to their properties, they have been variously used as solvent media, solvents for the obtainment of gel phases, components in the building of dye-sensitized solar cells, media for the preparation of thermochemical materials, etc. This Research Topic aims to present how structural features can determine not only the properties of ionic liquids, but also their possible employment. In this latter case, the interest arises from their ability to affect the outcome of a given reaction in terms of rate, yield, and nature of the products obtained for general use in the field of materials chemistry. This article collection is dedicated to Prof. Kenneth R. Seddon for his outstanding contribution to the formation and development of the ionic liquids community.

Ionic liquids, including the newer subcategory of deep eutectic solvents, continue to attract a great deal of research attention in an even increasing number of areas, including traditional areas such as synthesis (organic and materials), electrochemistry, and physical property studies and predictions, as well as less obvious areas such as lubrication and enzymatic transformations. In this volume, recent advances in a number of these different areas are reported and reviewed, thus granting some appreciation for the future that ionic liquid research holds and affording inspiration for those who have not previously considered the application of ionic liquids in their area of interest.

Ionic liquid-based Technologies for Environmental Sustainability explores the range of sustainable and green applications of IL materials achieved in recent years, such as gas solubility, biomass pre-treatment, bio-catalysis, energy storage, gas separation and purification technologies. The book also provides a reference material for future research in IL-based technologies for environmental and energy applications, which are much in-demand due to sustainable, reusable and eco-friendly methods for highly innovative and applied materials. Written by eminent scholars and leading experts from around the world, the book aims to cover the synthesis and characterization of broad range of ionic-liquids and their sustainable applications. Chapters provide cutting-edge research with state-of-the-art developments, including the use of IL-based materials for the removal of pharmaceuticals, dyes and value-added metals. Describes the fundamentals and major applications of ionic liquid materials. Covers up-to-date developments in novel applications of IL materials. Provides practical tips to aid researchers who work on ionic liquid applications

Electrochemical Aspects of Ionic Liquids

Ionic Liquids Completely UnCOILed

Ionic Liquids in Synthesis

Thermophysical Properties and Applications

Research in New Ionic Liquids

While much research into the field of ionic liquids has described applications for which these new and facile materials can be used, the origins of the desirable physical properties (i.e. high ionic conductivity, large electrochemical windows, high thermal stability, etc.), remains subject to empirical understanding and guess-work. The investigation of new salts from these 1010 possibilities can be cumbersome as time is invested in either a wide range of promising materials that may yield limited success, or through systematic testing of whole families of ionic liquids to find the best performing material. Developing an understanding of the role different ions and functional groups play in the bulk physical properties of an ionic liquid is crucial in guiding future research to uncover modern materials for advanced practical applications. This work first analyses the physical properties of many different ionic liquids to gain insight into the liquid state of pure ionic liquids. Viscosity, ionic conductivity and density data are used to construct Walden Plots, to understand the freedom of movement of ions in the electrolyte, based on the Walden rule that states that the product of molar conductivity and viscosity is constant. It is proposed in this work that the observed deviation from this relationship is influenced by the size of the ions. Based on estimates of ion size using ab initio calculations, new deviations in molar conductivity in the Walden Plot (-W) are determined. Furthermore, using the Nernst-Einstein equation, ionicity values are determined from diffusion NMR analysis. The pure state IS also probed in detail for the ionic liquid trihexyltetradecylphosphonium chloride ([P6,6,6,14](Cl)) using wide angle X-ray scattering coupled with molecular dynamics simulations. Nanometer sized domains are observed in the liquid state, which is correlated by the computer simulations. These domains alternate between polar and non-polar, reflecting aggregation of the charged ions and aggregation of the uncharged alkyl chains on the phosphonium cation. While there are many new ionic liquids to explore, another avenue of research that is beginning to bloom is the study of mixtures of ionic liquids. The most obvious starting point is perhaps the study of ionic liquids combined with molecular solvents, as these latter materials have well documented and accurately measured properties. However, some of the properties that are so heavily sought after in ionic liquids are sacrificed in such mixtures. In contrast, ionic liquids mixed with other ionic liquids offer the possibility of improvement of undesirable properties without the loss of advantageous properties such as negligible volatility. As there is an overwhelmingly large range of ionic liquid in ionic liquid possible combinations, though, a guided and well constructed approach is required to make significant headway in the field. This work presents the study of a group of ionic liquids where the differences in constituent ions are chosen to yield significant information on how different ions interact, while the number of differences is kept to a minimum to avoid too many competing factors. The concept of "simple" mixing, in terms of the properties of ionic liquid mixtures, is clarified first in order to identify any unusual behaviour. Thus, equations for predicting viscosities in mixtures are confirmed, and analogous equations are used to describe molar conductivities. The greatest deviation from simple mixing is observed in mixtures of the N-methyl-N-propylpyrrolidinium ([C3mpyr1]+) cation and the large [P6,6,6,14]+ cation, used with the bis(trifluoromethylsulfonyl)amide ([Tf2P]+) anion. These mixtures exhibit an unusual window of crystallization in single phase mixtures, a large excess molar volume and significant departure from the expected viscosity. It is conjectured that the physical properties of this mixture is the result of alkyl-rich domains in the liquid state, and that when the composition of [C3mpyr1][Tf2P] is in the majority these domains cannot stay in solution and force the ionic liquids to separate. In order to accurately perform NMR diffusion analyses of the ionic liquid binary mixtures, the exact procedure for the NMR diffusion experiments needed to be explored and clarified. It is observed that the standard pulse sequence traditionally used for diffusion experiments, the Hahn-Echo pulse sequence, yields anomalous results in high viscosity ionic liquids. As only the most fluid of ionic liquids give consistent results with this standard procedure a different pulse sequence is required. The stimulated echo sequence is shown to have no viscosity dependence and is therefore recommended for PFG-NMR studies on ionic liquids. Finally, mixtures of ionic liquids and molecular solvents will provide materials that are useful in some applications, and this work presents a study comparing analysis based on transport properties (i.e. the Walden plot) against studies of the vapour pressure (i.e. osmotic coefficient and activities). It is shown that both techniques give evidence of ion aggregation at low concentrations, but deviate from one another above ~0.3 mole fraction ionic liquid. This is attributed to breakdown of the validity of osmotic coefficient measurements at high salt concentrations. An effect of solvent polarity on ion aggregation is also observed. This work gives significant advances in the probing of the state of ions within an ionic liquid, and gives insights into how ions interact with each other, other ionic liquids and molecular solvents. The findings here can serve as a basis for developing new ionic liquids, as well as direct investigations for new ionic liquid mixtures.

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Critical overviews from the front line of ionic liquidsresearch. Ionic Liquids Further UnCOILed: Critical Expert Overviewscontinues the discussion of new processes and developments in ionicliquid technology introduced in the first volume. Written by aninternational group of key academic and industrial chemists, thisnext book in the series includes eleven overviews of specific areasof ionic liquid chemistry including: Physicochemical properties of ionic liquids. A patent survey. Ionic liquid membrane technology. Engineering simulations. Molecular simulations. The goal of this volume is to provide expert overviews thatrange from applied to theoretical, synthetic to analytical, andbiotechnological to electrochemical, while also offering consistentabbreviations of ionic liquids throughout the text. The value of Ionic Liquids Further UnCOILed: Critical Expert Overviews lies in the authors' expertise and theirwillingness to share it with the reader. Included in the book isinsight into topical issues and the variety of problems related to experimental techniques,selection of liquids, and variability of data—all of whichwere overseen by Professor Ken Seddon, one of the book'seditors and a world leader in ionic liquids. This book is a mustread for R&D chemists in industrial, governmental, and academiclaboratories, and for commercial developers of environmentallysustainable processes. It offers insight and appreciation for thedirection in which the field is going, while also highlighting thebest published works available, making it equally valuable to newand experienced chemists alike.

In the late 1990s, there was an explosion of research on ionic liquids and they are now a major topic of academic and industrial interest with numerous existing and potential applications. Since then, the number of scientific papers focusing on ionic liquids has risen exponentially, including a few edited multi-author books covering the latest advances in ionic liquids chemistry and several volumes of symposium proceedings. Much of the content in these books and volumes is written using technical jargon that only scientists at the cutting edge of ionic liquids research will understand and ionic liquids are hardly covered in most modern chemistry textbooks. This is the first single-author book on ionic liquids and the first introductory book on the topic. It is written in a clear, concise and consistent way. The book provides a useful introduction to ionic liquids for those readers who are not familiar with the topic. It is also wide ranging, embracing every aspect of the chemistry and applications of ionic liquids. The book draws extensively on the primary scientific literature to provide numerous examples of research on ionic liquids. These examples will enable the reader to become familiar with the key developments in ionic liquids chemistry over recent years. The book provides an introduction to: ionic liquids; their nomenclature; history; physical, chemical and biological properties; and their wide ranging uses and potential applications in catalysis, electrochemistry, inorganic chemistry, organic chemistry, analysis, biotechnology, green chemistry and clean technology. Notable and important chapters include "The Green Credentials of Ionic Liquids" and "Biotechnology." The chapter on "Applications" includes sections with brief descriptions of recent research on the development of ionic liquids: - for the construction of a liquid mirror for a moon telescope - for use as rocket propellants - for use as antimicrobial agents that combat MRSA - as active pharmaceutical ingredients and antiviral drugs - for embalming and tissue preservation. Science students, researchers, teachers in academic institutions and chemists and other scientists in industry and government laboratories will find the book an invaluable introduction to one of the most rapidly advancing and exciting fields of science and technology today.

Supported Ionic Liquids

Fundamentals of Ionic Liquids

New Insights and Recent Developments

Catalysis in Ionic Liquids

Physicochemical Properties

This book presents an overview on latest advancements in the study and research of ionic liquids. Ionic liquids are a rapidly evolving field of study in physical chemistry, material science, technology and engineering. Use of ionic liquids for research in biology and natural resource domain has received significant attention. This book presents updated scientific developments in theoretical, specific and applied domains of ionic liquid. It encompasses the latest developments in ionic liquid research on basic properties, energy, fuels and biomass conversion. It is a valuable source of information for scientists, engineers and academicians engaged in the research related to ionic liquids.

The purpose of this book is to provide an update on some of the latest research and applications in the broad field of ionic liquids. This volume spans research and development activities ranging from fundamental and experimental investigations to commercial applications. A brief history of the field is included, as well as both new developments and reviews organized in the general topical areas of applications, materials, biomass processing, and fundamental studies. This book attempts to propel the field forward by bringing together contributions from some of the foremost researchers on ionic liquids. Recent products and new large-scale processes using ionic liquids, both in operation and being announced, indicate that an exciting new chapter in this field is about to begin.

The authors summarize some of the history, applications, conferences, books, databases, issues related to data quality and toxicity for researchers working in the field of ionic liquids and includes an overview for each proceeding chapter with an introduction about the authors.

Over its past twenty years, ionic liquids have shown little signs of having genuine applications in fields as wide-ranging as biotechnology, bioenergies, catalysis, pharmaceuticals, renewable fuels, and sustainable energy. This book highlights several commercial products and processes that use or will soon be using ionic liquids.

This book contains the lecture notes for the NATO Advanced Research Workshop on Green Industrial Applications of Ionic Liquids held April 12th, 16, 2000 in Heraklion, Crete, Greece. This was the first international meeting devoted to research in the area of ionic liquids (salts with melting points below 100 0c), and was intended to explore the promise of ionic liquids as well as to set a research agenda for the field. It was the first international meeting dedicated to the study and application of ionic liquids as solvents, and forty-one scientists and engineers from academia, industry, and government research laboratories (as well as six industry observers and four student assistants) met to discuss the current and future status of the application of ionic liquids to new green industrial technologies. It was immediately clear that the number of organic chemists and engineers working in the field needed to be increased. It was also clear that the declining interest in high temperature molten salts and subsequent increase in low melting ionic liquid solvents had not yet taken hold in Eastern Europe. Participants from NATO Partner Countries contributed significant expertise in high temperature molten salts and were able to take back a new awareness and interest in ionic liquid solvents.

Novel Catalytic and Separation Process Based on Ionic Liquids presents the latest progress on the use of ionic liquids (ILs) in catalytic and separation processes. The book discusses the preparation of ILs, the characterization of IL catalysts by spectroscopic techniques, catalytic reactions over IL catalysts, separation science and technology of ILs, applications in biomass utilization, and synthesis of fine chemicals. Scientists, engineers, graduate students, managers, decision-makers, and others interested in ionic liquids will find this information very useful. The book can be used as a springboard for more advanced work in this area as it contains both theory and recent applications, research conducted, and developments in separation techniques and catalysis using ionic liquids. Presents new preparation and advanced characterization of ionic liquids catalysts. Outlines catalytic reactions using ionic liquid, thus showing higher yields and selectivity. Presents novel separation science and technology based on ionic liquids and non-thermal processes. Recent Advances in Ionic Liquids contains research on the preparation, characterization, and potential applications of stable ionic liquids (ILs). ILs are a class of low- and stable-melting-point, ionic compounds that have a variety of properties allowing many of them to be sustainable green solvents. It is promising novel research from top to bottom and has received a lot of interest over the last few decades. It covers the advanced topics of physical, catalytic, chemical, polymeric, and potential applications of ILs. This book features interesting reports on cutting-edge science and technology related to the preparation, characterization, polymerization, and potential applications of ILs. This potentially unique work offers various approaches on the R

Fundamentals and Applications

Current State and Future Directions

Ionic Liquids in Analytical Chemistry

Properties, Applications, and Hazards

Green Industrial Applications of Ionic Liquids

Theoretical and Computational Approaches to Predicting Ionic Liquid Properties highlights new approaches to predicting and understanding ionic liquid behavior and selecting ionic liquids based on theoretical knowledge corroborated by experimental studies. Supported throughout with case studies, the book provides a comparison of the accuracy and efficiency of different theoretical approaches. Sections cover the need for integrating theoretical research with experimental data, conformations, electronic structure and non-covalent interactions, microstructures and template effects, thermodynamics and transport properties, and spectro-chemical characteristics. Catalytic and electrochemical properties are then explored, followed by interfacial properties and solvation dynamics. Structured for ease of use, and combining the research knowledge of a global team of experts in the field, this book is an indispensable tool for those involved with the research, development and application of ionic liquids across a vast range of fields. Highlights new approaches for selecting ionic liquids by combining theoretical knowledge with experimental and simulation-based observations. Discusses how theoretical simulation can help in selecting specific anion-cation combinations to show enhanced properties of interest. Compares the accuracy and efficiency of different theoretical approaches for predicting ionic and liquid characteristics

Reflecting the dramatic rise in interest shown in this field over the last few years, this book collates the widespread knowledge into one handy volume. It covers in depth all classes of ionic liquids thus far in existence, with the individual chapters written by internationally recognized experts. The text is written to suit several levels of difficulty, containing information on basic physical chemistry in ionic liquids, a theory on the conductivity as well as plating protocols suited to undergraduate courses. The whole is rounded off with an appendix providing experimental procedures to enable readers to experiment with ionic liquids for themselves.

This volume, of a two volume set on ionic liquids, focuses on the applications of ionic liquids in a growing range of areas. Throughout the 1990s, it seemed that most of the attention in the area of ionic liquids applications was directed toward their use as solvents for organic and transition-metal-catalyzed reactions. Certainly, this interest continues on to the present date, but the most innovative uses of ionic liquids span a much more diverse field than just synthesis. Some of the main topics of coverage include the application of RTILs in various electronic applications (batteries, capacitors, and light-emitting materials), polymers (synthesis and functionalization), nanomaterials (synthesis and stabilization), and separations. More unusual applications can be noted in the fields of biomass utilization, spectroscopy, optics, lubricants, fuels, and refrigerants. It is hoped that the diversity of this volume will serve as an inspiration for even further advances in the use of RTILs.

Properties of Ionic Liquids and Ionic Liquid Mixtures

Ionic Liquids

Commercial Applications of Ionic Liquids

Theoretical and Computational Approaches to Predicting Ionic Liquid Properties