Ionic Liquids for Better Separation Processes

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...
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Ionic Liquids: Properties and Applications

Ionic liquids are attractive because they offer versatility in the design of organic salts. As ion-rich media, ionic liquids can control the systems properties by tuning the size, charge, and shape of the composing ions. Whilst the focus has mainly been on the potential applications of ionic liquids as solvents, they also provide innovative opportunities for designing new systems and devices. Limitations from the high viscosity and expensive purification of the ionic liquids are also not a barrier for applications as devices. Written by leading authors, Ionic Liquid Devices introduces the innovative applications of ionic liquids. Whilst the first chapters focus on their characterization, which can be difficult in some instances, the rest of the book demonstrates how ionic liquids can play substantial roles in quite different systems from sensors and actuators to biomedical applications. The book provides a comprehensive resource aimed at researchers and students in materials science, polymer science, chemistry and physics interested in the materials and inspire the discovery of new applications of ionic liquids in smart devices.

Ionic Liquids in the Biorefinery Concept

This book summarizes the latest knowledge in the science and technology of ionic liquids and polymers in different areas. Ionic liquids (IL) are actively being investigated in polymer science and technology for a number of different applications. In the first part of the book the authors present the particular properties of ionic liquids as speciality solvents. The state-of-the-art in the use of ionic liquids in polymer synthesis and modification reactions including polymer recycling is outlined. The second part focuses on the use of ionic liquids as speciality additives such as plasticizers or antistatic agents. The third part examines the use of ionic liquids in...
the design of functional polymers (usually called polymeric ionic liquids (PIL) or poly(ionic liquids)). Many important applications in diverse scientific and industrial areas rely on these polymers, like polymer electrolytes in electrochemical devices, building blocks in materials science, nanocomposites, gas membranes, innovative anion sensitive materials, smart surfaces, and a countless set range of emerging applications in different fields such as energy, optoelectronics, analytical chemistry, biotechnology, nanomedicine or catalysis.

Ionic Liquids in Synthesis

This book is a synthesis of recent research on the ionic liquids that both represents how the field is progressing and evolving and stimulates new interdisciplinary research activities.

Applications of Ionic Liquids in Polymer Science and Technology

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.

Electrochemical Aspects of Ionic Liquids
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The conventional solvents used in chemical, pharmaceutical, biomedical and separation processes represent a great challenge to green chemistry because of their toxicity and flammability. Since the beginning of “the 12 Principles of Green Chemistry” in 1998, a general effort has been made to replace conventional solvents with environmentally benign substitutes. Water has been the most popular choice so far, followed by ionic liquids, surfactant, supercritical fluids, fluorous solvents, liquid polymers, bio-solvents and switchable solvent systems. Green Solvents Volume I and II provides a throughout overview of the different types of solvents and discusses their extensive applications in fields such as extraction, organic synthesis, biocatalytic processes, production of fine chemicals, removal of hydrogen sulphide, biochemical transformations, composite material, energy storage devices and polymers. These volumes are written by leading international experts and cover all possible aspects of green solvents’ properties and applications available in today’s literature. Green Solvents Volume I and II is an invaluable guide to scientists, R&D industrial specialists, researchers, upper-level undergraduates and graduate students, Ph.D. scholars, college and university professors working in the field of chemistry and biochemistry.

Green Solvents II

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

Research into ionic liquids (ILs) has been a very rapidly growing discipline in recent years. ILs have attracted very considerable attention because of their unique properties, which may be useful in new processes and technologies. They have already been studied for a variety of applications such as alternative solvents in organic synthesis and catalysis, reaction media for biocatalysis and biotransformation, in the separation sciences, electrolytes in batteries and solar cells, alternative lubricants, and as media for tissue preservation. ILs have excellent solvation properties, are thermally, chemically and electrochemically stable, and their vapour pressure is negligible. Nevertheless, the same properties that make them attractive replacements for other volatile industrial compounds may render them hazardous to ecosystems. This book discusses several topics that include the pharmaceutical aspect of ILs; the application of ILs to lignin extraction and depolymerization; recent developments in ionic liquid toxicity assessments; the role temperature, irradiation and oxidation has on the stability of ILs; and analytical methods for determining the constituents of ILs.

Theoretical and Computational Approaches to Predicting Ionic Liquid Properties

The current book brings together the latest developments in the area of ionic liquids, including synthesis, purity
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control, toxicity, and scaling-up technologies. In addition, the authors explore the applications of ionic liquids in organic synthesis and catalysis, separation techniques and nanomaterials engineering. Written by key experts in the field, this book is an invaluable material for organic and green chemists in academia and industry.

Ionic Liquids in Biotransformations and Organocatalysis

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.

Novel Catalytic and Separation Processes Based on Ionic Liquids

The implementation of ionic liquids technologies in future biorefineries is challenging. Different approaches can be applied along the entire chain of biomass valorisation to achieve a specific target molecule, from biomass pretreatment and fractionation processes to extraction, downstream separation and purification methodologies of high value added products and pivot chemicals. This book summarises recent achievements in the use of ionic liquids in biomass processing as an alternative to conventional processes, particularly in the context of green chemistry. It features real-world case studies where high value-added products have been obtained using ionic liquid processing, demonstrating the practical applications of these technologies. The book concludes by assessing the development of further biorefineries with ionic liquids. The book is an important reference for researchers and practising chemists, bringing readers up-to-date with current research in this field.

Ionic Liquid-Based Surfactant Science
Increased environmental consciousness within the scientific community has spurred the search for environmentally friendly processes as alternatives to conventional organic solvents. In the past two decades, numerous advances—including the use of ionic liquids—have made it possible to develop substitutes for some toxic solvents. Ionic liquids are widely recognized as suitable for use in organic reactions and can also improve the control of product distribution, enhanced reactivity, ease of product recovery, catalyst immobilization, and recycling. Environmentally Friendly Syntheses Using Ionic Liquids presents the latest developments in the field. It also reviews the latest applications in a wide range of fields including biotechnology, nuclear science, medicine, pharmaceuticals, environmental science, and organic and inorganic chemistry—all from the standpoint of green sustainable chemistry. Growing interest in the field of ionic liquids will define newer and unexplored areas of applications, expanding possible use of these environmentally friendly chemicals. The information presented in this book will undoubtedly help motivate readers to further explore the field.

Application, Purification, and Recovery of Ionic Liquids

Analytical Applications of Ionic Liquids reviews the current research in analytic chemistry, covering subjects as diverse as separation science, chromatography, spectroscopy and analytical electrochemistry. As scientific developments have moved into the 21st century, they have increasingly had to take into account the effects on the environment, both locally and globally. Because of this, the search for applications of ionic liquids is growing in every area of analytical chemistry. Here, material is presented by specialists, giving a critical overview of the current literature surrounding this increasingly prominent topic. Analysis is carried out on latest achievements and applications, followed by critical discussion of possible future developments. As well as stimulating further research among established analytical chemists, this book can also be used for undergraduate and graduate courses on chemistry and chemical technology.
Fundamentals of Ionic Liquids

This book contains the lecture notes for the NATO Advanced Research Workshop on the 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°C), 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.

Ionic Liquids

This book provides an overview of the current and emerging industrial applications of ionic liquids, covering the core processes, the practical implementation and technical challenges involved, and exploring potential future directions for research and development. The introductory chapter describes the unique physical and chemical properties of ionic liquids, and illustrates the vast potential for application of these materials across the industrial landscape. Following this, individual chapters written by leading figures from industry and academia address specific processes and products, such as the development of a new chloroaluminate ionic liquid as an alkylation catalyst and a new class of capillary gas chromatography (GC) columns with stationary phases based on ionic liquids. Over the past twenty years, ionic liquids have moved from being considered as mere academic
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curiosities to having genuine applications in fields as wide-ranging as biotechnology, biorefineries, catalysis, pharmaceuticals, renewable fuels, and sustainable energy. This book highlights several commercial products and processes that use or will soon be using ionic liquids.

Application of Ionic Liquids in Biotechnology

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 \( \alpha \) 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 thermochromic 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.

Environmentally Friendly Syntheses Using Ionic Liquids

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 Examines the new performance of ionic liquids in analytical chemistry applications

Commercial Applications of Ionic Liquids

Application of Ionic Liquids in Liquid Chromatography.

Supported Ionic Liquids

This volume explores how ionic liquids are used in different areas of biotechnology. It also provides insights on the interaction of ionic liquids with biomolecules and biomaterials. Ionic liquids have become essential players in the fields of synthesis, catalysis, extraction and electrochemistry, and their unique properties have opened a wide range of applications in biotechnology. Readers will discover diverse examples of the application of ionic liquids.
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liquids as solvents for biomaterials extraction and pretreatment, in enzymatic and whole cell catalysed reaction, and as activation agents for biocatalysis. Particular attention is given to the biologically functionalized ionic liquids employed in medical and pharmaceutical applications. Although ionic liquids are considered “green solvents”, the contributing authors will also explore their environmental impact when applied to biotechnology. Chemical, biological and medical scientists interested in ionic liquids and biotechnology will find this work instructive and informative.

Catalysis in Ionic Liquids

Hydrogen, as an energy carrier, is widely regarded as a potential cost effective, renewable, and clean energy alternative to petroleum in order to mitigate energy shortage and global climate warming issues that the world is currently facing. However, storage of hydrogen is a substantial challenge, especially for applications in vehicles with fuel cells that use proton-exchange membranes (PEMs). Therefore, scientific community has started focusing their research activities on developing advanced hydrogen storage materials through nanotechnology. The book presents a wide variety of nanostructured materials used for application in hydrogen storage, covering chemical and physical storage approaches. The research topics include computational design, synthesis, processing, fabrication, characterization, properties and applications of nanomaterials in hydrogen storage systems.

Hydrogen Storage

Application of Ionic Liquids in Biocatalysis.

Energy Storage and Conversion Materials

The applications of ionic liquids can be enormously expanded by arranging the organic ions in the form a polymer architecture. Polymerized ionic liquids (PILs), also known as poly(ionic liquid)s or polymeric ionic liquids, provide almost all features of ionic polymers plus a rare versatility in design. Written by leading authors, the present book provides a comprehensive overview of this
Nanotechnology-Based Industrial Applications 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

Green Industrial Applications of Ionic Liquids

This book reflects recent developments in the rapidly-expanding field of ionic liquids, and looks ahead to its future. An exploration of new properties of ionic liquids, and their use in biochemistry, medicine, and nanochemistry, is included.

Ionic Liquids
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Showcasing recent developments in inorganic materials in an area of societal interest and importance, this book provides an up-to-date introduction to the contemporary use of functional solids in emerging technologies. Energy Storage and Conversion Materials describes the application of inorganic materials in the storage and conversion of energy, with an emphasis on how solid-state chemistry allows development of new functional solids for energy applications. Dedicated chapters cover co-electrolysis, low temperature fuel cells, oxide thermoelectric devices for energy conversion, solid-state Li batteries and thermochemical energy conversion. Edited and written by world-renowned scientists, this book will provide a comprehensive introduction for advanced undergraduates, postgraduates and researchers wishing to learn about the topic.

Polymerized Ionic Liquids

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

Nanocatalysis in Ionic Liquids

See Table of Contents (PMP)

Application of Ionic Liquids in Drug Delivery

This book discusses capital separation processes of industrial interest and explores the potential for substantial improvement offered by a promising class of substances: ionic liquids. These low melting point salts,
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with their unique characteristics, have been gaining relevance in the field of separation through a variety of approaches. The chapters are structured from an application perspective, and cover the utilisation of ionic liquids in different unit operation contexts (distillation, liquid-liquid extraction, and solid-liquid extraction), giving an idea of their remarkable versatility. The final chapters focus on the use of ionic liquids in analytical applications based on separation procedures. This volume combines the review of the main advances to date with the analysis of the potential future use of ionic liquids in separation processes across a variety of fields, ranging from enhancement of state-of-the-art technologies to a revolution in the technological bases currently in use. It provides a valuable resource for engineers and scientists working in the field of separation, as well as for all readers generally interested in ionic liquids, in particular from an application standpoint. Héctor Rodríguez is a faculty member of the Department of Chemical Engineering at the University of Santiago de Compostela, Spain.

Application of Ionic Liquids in Biocatalysis

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 Liquid Applications: Pharmaceuticals, Therapeutics, and Biotechnology

Numerous solvents used in chemical processes have poisonous and unsafe properties that pose significant ecological concerns ranging from atmospheric emissions to the contamination of water effluents. To combat these ecological threats, over the course of the past two decades, the field of green chemistry has grown to develop more natural reaction processes and techniques involving the use of
nonconventional solvents to diminish waste solvent production and thus decrease negative impact on the environment. Ionic liquids in particular are more environmentally friendly substitutes to conventional solvents, and as such, have seen more widespread use in the past decade. They have been used in such processes as extraction, separation, purification of organic, inorganic, and bioinorganic compounds, reaction media in biochemical and chemical catalysis, green organic and drug synthesis, among other industrial applications. Thus, in proving themselves a suitable greener media for economic viability in chemical processes, ionic liquids are leading to more sustainable development. This edition explores the application of ionic liquids as a green solvent. It contains a state-of-the-art overview on ionic liquids as green solvents for chemical processes and techniques, as well as some of their useful industrial applications.

Ionic Liquid-Based Technologies for Environmental Sustainability

Edited and written by renowned experts in the field, this is the first book to reflect the state of the art of nanocatalysis in ionic liquids. Divided into two core areas, the first part of the book describes the different classes of metal nanoparticles as well as their synthesis in ionic liquids, while the second focuses on such emerging issues as the application of such systems to energy and biomass conversion.

Applications of Ionic Liquids in Science and Technology

This book presents recent advances in the use of ionic liquids in medicine and pharmaceutics with particular emphasis on addressing critical pharmaceutical challenges, including the low solubility, polymorphism, and bioavailability of drugs. It also provides insights into the development of the biologically functionalized ionic liquids suitable for medical and pharmaceutical applications. Ionic liquids have been used as potential solvents or materials in the fields of pharmaceutical drug delivery and formulations because of their unique and tunable physicochemical and biological properties. Readers find explanations of the
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diverse approaches to the application of ionic liquids in drug solubility, active pharmaceutical ingredient (API) formulation, and drug delivery systems, such as topical, transdermal, and oral delivery, with particular emphasis on recent developments. Particular attention is given to the development of ionic liquid-assisted effective drug delivery techniques for sparingly soluble or insoluble drug molecules. This book also discusses the biological activities of ionic liquids for possible applications in drug formulation and drug delivery systems. Scientists in disciplines such as chemistry, biology, and pharmaceutics find this book instructive and informative for developing ionic liquid-based drug formulations or drug delivery systems.

Ionic Liquids

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

Ionic Liquids in Separation Technology

Theoretical and Computational Approaches to Predicting Ionic Liquid Properties highlights new approaches to predicting and understanding ionic liquid behavior and selecting ionic
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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

Recent Advances in Ionic Liquids

This volume will be summarized on the basis of the topics of Ionic Liquids in the form of chapters and sections. It would be emphasized on the synthesis of ILs of different types, and stabilization of amphiphilic self-assemblies in conventional and newly developed ILs to reveal formulation, physicochemical properties, microstructures, internal dynamics, thermodynamics as well as new possible applications. It covers: Topics of ionic liquid assisted micelles and microemulsions in relation to their fundamental characteristics and theories Development bio-ionic liquids or greener, environment-friendly solvents, and manifold interesting and promising applications of ionic liquid based micelles and micremulsions

Application of Ionic Liquids in Liquid Chromatography

This volume, of a two volume set on ionic liquids, focuses
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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.

Ionic Liquids in Analytical Chemistry

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 Liquid Devices

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
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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.

Analytical Applications Of Ionic Liquids

This book addresses the use of ionic liquids in biotransformation and organocatalysis. Its major parts include: an overview of the fundamentals of ionic liquids and their interactions with proteins and enzymes; the use of ILs in biotransformations; non-solvent applications such as additives, membranes, substrate anchoring, and the use of ILs in organocatalysis (from solvents to co-catalysts and new reactivities, as well as non-solvent applications such as anchoring and immobilization).

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