

## Chelate Extraction of Metals into Ionic Liquids

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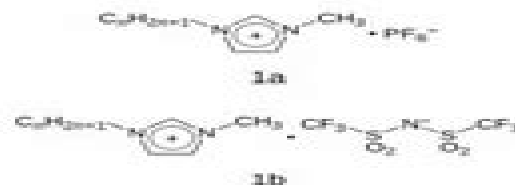
In the solvent extraction of metal cations into ionic liquids, use of Brønsted acid-type chelate extractants has some advantages including simplicity in controlling extraction selectivity by selecting suitable aqueous phase pH values and simple back-extraction recovery of the extracted metals using acid solutions. In this review, various fundamental and applied research on metal extraction using the “ionic liquid chelate extraction system” since 2001 are described in detail.

### 1. Introduction

Solvent extraction of metal cations is a very important technique for their mutual separation, recovery and preconcentration [1–6]. In solvent extraction, generally, various hydrophobic organic solvents are used as extraction phase solvents. However, most of the solvents are toxic, flammable and volatile, and it has been recommended that their use as solvents should be avoided.

Ionic liquids (ILs), hydrolytically stable salts with low melting points (ca. < 100 °C), have recently been noted as ‘green’ solvents mainly in organic chemistry and catalysis chemistry [7–22]. In particular, a series of ILs made from 1-alkyl-3-methylimidazolium cations ( $C_n\text{mim}^+$ ) and bulky fluorinated anions such as hexafluorophosphate ( $\text{PF}_6^-$ ), tetrafluoroborate ( $\text{BF}_4^-$ ) and bis(trifluoromethanesulfonyl)imide ( $\text{TiF}_2\text{N}^-$ ) have been assessed as valuable solvents because they have relative air and water stability and favorable viscosity and density as solvents. Furthermore, some of them such as  $[\text{C}_n\text{mim}][\text{PF}_6]$  (**1a**,  $n \geq 4$ ) and  $[\text{C}_n\text{mim}][\text{TiF}_2\text{N}]$  (**1b**,  $n \geq 2$ ) are immiscible with water and, therefore, can possibly be used as extraction solvents. In addition, many ILs have unique physical and chemical properties as solvents, such as high polarity and, therefore, are expected to be not only ‘alternative’ solvents but also ‘novel’ ones.

The use of ILs in solvent extraction was reported for organic materials by Huddleston et al. in 1998 [23] and for metal cations by Dai et al. in 1999 [24]. Many researchers have studied the use of ILs in extraction, and various reviews have been published [25–40]. Many of the metal extraction studies have



# Extraction Of Chelate Compounds

**Yu A. Zolotov**



## **Extraction Of Chelate Compounds:**

*Extraction of Chelate Compounds*, 1970      **Extraction of Chelate Compounds** Yu A. Zolotov, 1970      Extraction of Chelate Compounds Y. A. Zolotov, 1968      A Manual for the Chemical Analysis of Metals,      The Solvent Extraction of Metal Chelates Jiří Starý, 2013-10-22

The Solvent Extraction of Metal Chelates is a comprehensive account of the solvent extraction liquid liquid extraction of metal chelate complexes Topics covered include the composition and stability of metal chelates analytical applications of the solvent extraction of metal chelates and selective extraction procedures for metals A theoretical treatment of the solvent extraction of metal chelates is also given This book is comprised of six chapters and begins with an overview of solvent extraction and how it can be used to solve important theoretical problems concerning the composition and stability of soluble and insoluble metal complexes The next chapter examines the composition and stability of metal chelates based on the assumption that only uncharged complexes are dissolved and extracted by the organic solvents A theory of the solvent extraction of metal chelates is then described paying particular attention to a variety of factors that influence the extraction of metal chelates including acidity solubility and instability of the metal chelate and organic solvent Some analytical applications of the solvent extraction of metal chelates are also considered The last two chapters deal with systems and selective extraction procedures for metals This monograph will be of particular value to inorganic and analytical chemists      Preconcentration Techniques For Trace Elements Zeev Alfassi, Chien M. Wai, 1991-12-07

Accurate determination of trace elements is critical in various fields of science and technology Direct measurement of trace elements in samples with complex matrices is often impractical either due to analytical sensitivity limitations or matrix interferences Preconcentration procedures are generally needed to eliminate matrix interferences and or enrich minute amounts of analytes to a level for reliable measurements Preconcentration Techniques for Trace Elements provides up to date information on various preconcentration techniques and detailed discussions regarding such topics as the dissolution of matrices coprecipitation solvent extraction electrochemical means ion exchange sorption chromatographic methods flotation membranes volatilization polymer foam sorbents fire assay isotachopheresis and filter papers This comprehensive volume featuring contributions from 21 experts from nine countries will provide valuable reference material for all scientists and technicians dealing with trace analysis of real world samples      **The Chemistry of the Actinides** S. Ahrland, K. W. Bagnall, D. Brown, 2016-06-07

The Chemistry of the Actinides contains selected chapters from the Comprehensive Inorganic Chemistry to meet the needs of certain specialists in this field The book describes the 14 elements after actinium in the Periodic Table known as the actinide elements or the 5f transition series The book notes the occurrence separation chemical properties chemical structures and preparation of the metals In a discussion of analytical chemistry the radioactive properties of the actinides and the lanthanides are compared The text then describes the nuclear or radiochemical records and chemical properties of the different members of the actinide series such as thorium uranium

plutonium and einsteinium The book also explains the differences between the 5f shell and the 4f shell One paper then discusses the groups of alloy compounds including rare earths and intra actinides Another paper examines the general properties of actinide ions as to their electronic structure and oxidation states the stability and preparation of the different oxidation states and the applicability of solvent extraction in separating and purifying various substances The text is suitable for researchers in organic chemistry nuclear and atomic physicists scientists and academicians whose work involves radioactive materials

Extraction of Metals from Soils and Waters D. M. Roundhill, 2001-12-31 Extractions of Metals from Soils and Waters represents a new emphasis in the series Modern Inorganic Chemistry namely the impact inorganic chemistry can have on the environment Also this is the first volume ever to introduce the reader to all aspects of heavy metal extraction While the primary emphasis is on complexation chemistry attention is also paid to phase transfer aspects Particular methods of note include electrokinetics phytoremediation and sensors Aimed primarily at chemists this book will also appeal to engineers plant biochemists environmental health specialists and practitioners or students of environmental law

CRC Handbook of Organic Analytical Reagents Kuang Lu Cheng, Keihei Ueno, Toshiaki Imamura, 2017-09-29 The Handbook of Organic Analytical Reagents 2nd Edition is an indispensable source book of physico chemical properties preparation and analytical applications of the most commonly used organic reagents Updated from the 1st Edition this volume includes data on 40 new reagents such as ultra high sensitive azo dyes fluorescent calcium indicators and chromogenic crown ethers and porphyrin reagents a new Reagent Index listing reagents according to the elements to be assayed and completely updated references Each entry contains information on synonyms sources and methods of synthesis analytical applications complexation reactions and the properties of complexes purification and purity of the reagent and other reagents with a related structure The Handbook of Organic Analytical Reagents 2nd Edition is an invaluable bench side reference for professional analytical chemists and graduate students

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**Abstracts**, 1975-06      Extraction and Separation of Selected Lanthanides with a Tertiary Amine Donald J. Bauer, 1966

**Dictionary of Analytical Reagents** A. Townshend, D.T. Burns, Ryszard Lobinski, E.J. Newman, G. Guilbault, Z.

Marczenko, H. Onishi, 1993-06-17 This volume dictionary brings together accurate chemical structural and bibliographic data on the most commonly used reagents in the various branches of analytical chemistry Covering both organic and inorganic compounds the Dictionary of Analytical Reagents contains over 5 000 reagents significant in analytical chemistry grouped into 5 000 entries All the reagents included in the dictionary have been synthesized characterized by or are of proven use to analytical chemists Compiled by a distinguished board of leading figures in the world of analytical chemistry each an expert in their own specialist field the Dictionary of Analytical Reagents is a companion volume to the renowned Dictionary of Organic Compounds and follows a similar format The dictionary is arranged in such a way as to facilitate browsing with entries ordered alphabetically by entry name often its trivial name Clearly laid out in an easy to follow manner each entry contains a wealth of data invaluable to the analytical chemist including synonyms analytical applications extensive and up to date hazard toxicity data solubility dissociation constant and selected references labelled to indicate their content e g analytical application spectral data synthesis High quality structure diagrams are included to assist the analytical chemist in identifying the reagent needed and are drawn to standard orientations Coverage extends to metal extractants spectrophotometric reagents indicators fluorescence labelling reagents resolving agents nmr shift reagents and reference standards buffers gc and ms derivatisation reagents amperometric reagents titrimetric and gravimetric reagents biological stains and dyes Compounds are comprehensively indexed by Name Molecular Formula CAS Registry Number and Type of Compound The unique Type of Compound Index is particularly valuable as compounds are indexed by use eg NMR shift reagent by analyte eg nickel and by compound group eg formazan crown ether making the data accessible by a variety of criteria Thus chemists can use the dictionary to find information on how to analyze for a particular substance how a particular compound may be used as an analytical reagent or what other reagents are available for a specific analytical use Having located all appropriate reagents via the index the user can then browse through the entries to obtain specific data all fully referenced in the selective bibliography Analytical chemists be they in the manufacturing or pharmaceutical industry working in hospital laboratories as clinical chemists or pollution analysts monitoring heavy metal residues in waste water constantly need to make decisions about which reagent to choose for a particular application This dictionary fulfils that need by being the most comprehensive reliable and up to date compilation of reagents available This book should be of interest to analytical chemists in academic and industrial establishments forensic scientists chromatographers biochemists standards

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