EXTRACTION BEHAVIOR OF Cu(II) AND Fe(III) FROM CHLORIDE MEDIUM TO THE HYDROPHOBIC IONIC LIQUIDS USING 1,10-PHENANTHROLINE

NURUL YANI BINTI RAHIM

FACULTY OF SCIENCE
UNIVERSITY OF MALAYA
KUALA LUMPUR

2011

EXTRACTION BEHAVIOR OF Cu(II) AND Fe(III) FROM CHLORIDE MEDIUM TO THE HYDROPHOBIC IONIC LIQUIDS USING 1,10-PHENANTHROLINE

NURUL YANI BINTI RAHIM

DISSERTATION SUBMITTED IN FULL RESEARCH FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF CHEMISTRY
FACULTY OF SCIENCE
UNIVERSITY OF MALAYA
KUALA LUMPUR

2011

ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Nurul Yani Binti Rahim (I.C/Passport No: 851121-03-5652)
Registration/Matric No: SGR 090117
Name of Degree: Masters
Title of Project Paper/Research Report/Dissertation/Thesis ("this work"):
EXTRACTION BEHAVIOR OF Cu(II) AND Fe(III) FROM CHLORIDE MEDIUM TO THE HYDROPHOBIC IONIC LIQUIDS USING 1,10-PHENANTHROLINE

Field of Study: Analytical Chemistry

I do solemnly and sincerely declare that:

(1) I am the sole author/writer of this Work:
(2) This Work is original;
(3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work:
(4) I do not have any actual knowledge nor ought I reasonably to know that the making of this work constitutes an infringement of any copyright work:
(5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained:
(6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate's Signature Date

Subscribed and solemnly declared before,

Witness's Signature Date

Name:

Designation:

EXTRACTION BEHAVIOR OF Cu(II) AND Fe(III) FROM CHLORIDE MEDIUM TO THE HYDROPHOBIC IONIC LIQUIDS USING 1,10-PHENANTHROLINE

ABSTRACT

The study of liquid-liquid extraction of Cu(II) and Fe(III) ion was carried out using a series of hydrophobic ionic liquid; 1-butyl-3-methylimidazolium hexafluorophosphate ($[C_4mimPF_6]$), 1-hexyl-3-methylimidazolium hexafluorophospahate ($[C_6mimPF_6]$), 1-butyl-3-methylimidazolium bistrifluoromethylsulfonyl imide ($[C_4mimNTf_2]$) and 1-hexyl-3-methylimidazolium bistrifluoromethylsulfonyl imide ($[C_6mimNTf_2]$) as the extraction phase. Cu(II) showed a preferential extraction into less hydrophobic ionic liquid, $[C_4mimPF_6]$. The extraction behavior of Cu(II) ions depend on the type of counter ion present. The extraction process of Cu(II) ion in ionic liquid proceeded via similar mechanism to that of a molecular organic solvent. From the results obtained, an ion pair mechanism is proposed for the extraction of Cu complexes from chloride medium. Fe(III) favors extraction into $[C_6mimNTf_2]$, the most hydrophobic ionic liquid. Anion exchange is the mode of extraction of Fe complexes from chloride medium.

PERANGAI PENGEKSTRAKAN Cu(II) DAN Fe(III) DARIPADA MEDIA KLORIDA KEPADA CECAIR IONIK HIDROFOBIK MENGGUNAKAN 1,10-PHENANTHROLINE

ABSTRAK

Kajian pengekstrakan pelarut untuk Cu(II) dan Fe(III) ion dijalankan dengan menggunakan satu siri cecair ionik yang hidrofobik di mana 1-butyl-3-methylimidazolium hexafluorophosphate ([C_4mimPF_6]), 1-hexyl-3-methylimidazolium hexafluorophospahate ([C_6mimPF_6]), 1-butyl-3-methylimidazolium bistrifluoromethylsulfonyl imide ([C_4mimNTf_2]) dan 1-hexyl-3-methylimidazolium bistrifluoromethylsulfonyl imide ([C_6mimNTf_2]) sebagai fasa pengekstrakan. Pengekstrakan Cu(II) mencapai tahap tertinggi oleh [C_4mimPF_6] iaitu cecair ionik yang paling kurang hidrofobik. Pengekstrakan Cu(II) ion bergantung kepada jenis ion Lawan yang hadir. Pengekstrakan ion Cu(II) dalam sistem cecair ionik berlaku melalui mekanisme yang sama seperti dalam pelarut organik molekul. Daripada keputusan yang diperolehi, mekanisme yang dicadangkan untuk pengekstrakan kompleks Cu daripada media klorida adalah mekanisme ion berpasangan. Fe(III) lebih berminat untuk ekstrak ke dalam [C_6mimNTf_2] iaitu cecair ionik yang paling hidrofobik. Penukar anion dikenalpasti sebagai mod pengekstrakan kompleks Fe daripada media klorida.

ACKNOWLEDGEMENTS

I would like to express my thanks and deepest gratitude to Allah S.W.T. because without HIS blessing, I could not have done my research project successfully. I also would like to acknowledge all the people who were directly or indirectly involved in supporting and encouraging me to finish my research.

I am forever grateful to my supervisor Dr. Sharifah Mohamad for her great guidance, advice and continuous support throughout this research. She has been an inspiring leader and has taught me to never give up even when the circumstances seem dire. Once again, I would like to thank her for her understanding, patience and sense of humor. I also would like to thank my co-supervisor, Professor Dr. Yatimah Alias for her support to my research.

A special thank you to my lab mates, Fairuz Liyana Mohd Rasdi, Nurul Huda Mohd Yusof, Siti Nurur Raihan Mohd Kamal and Nur Hayati Hussein who were very supportive and were always ready to help me with any questions that I had. I would also like to take this opportunity to express gratitude to all the members of UMCIL group.

Last but not least, I would like to thank my family for their continuous support throughout my research.

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLES

LIST OF ABBRREVATIONS

BF_4^-	Tetrafluoroborate
C_4mimBr	1-butyl-3-methylimidazolium Bromide
C_4mimNTf_2	1-butyl-3-methylimidazolium bis(trifluoromethylsulfony)limide
C_4mimPF_6	1-butyl-3-methylimidazolium hexafluorophosphate
C_6mimCl	1-hexyl-3-methylimidazolium Chloride
C_6mimNTf_2	1-hexyl-3-methylimidazolium bis(trifluromethylsulfonyl)imide
C_6mimPF_6	1-hexyl-3-methylimidazolium hexafluorophosphate
FAAS	Flame Atomic Absorption Spectroscopy
F-NMR	Fluorin-Nuclear Magnetic Resonance
H NMR	Proton –Nuclear Magnetic Resonance
H_2SO_4	Sulfuric Acid
HCl	Hydrochloric Acid
HNO_3	Nitric Acid
IC	Ion Chromatography
ILs	Ionic Liquids
KBr	Potassium Bromide
KCl	Potassium Chloride

KPF_6	Potassium hexafluorophosphate
LiBr	Lithium Bromide
$LiNTf_2$	Lithium bis(trifluromethylsulfonyl)imide
mins	minutes
Na_2CO_3	Sodium Carbonate
$NaHCO_3$	Sodium Hydrogen Carbonate
NO_3^-	Nitrate
NTf_2^-	Bis(trifiluoromethylsulfonyl)imide
OAc^-	Acetate
PF_6^-	Hexafluorophosphate
Phen	1,10-phenanthroline
TfO^-	Trifluoromethylsulfonate
UV-VIS	Ultra Violet-Visible Spectroscopy
X^-	Halide