Research & Reviews in Biotechnology & Biosciences **ISSN No: 2321-8681**
Website: www.biotechjournal.in **Mini-Review**
Volume: 9, Issue: 1, Year: 2022 **PP: 9.13**
DOI: https://doi.org/10.5281/zenodo.6619038 **Peer Reviewed Journal**

Ionic Liquids: Eco-friendly Solvent

Akshata T. Walkoli[1] & Dr. Pramod D Sonawane*[1]

Department of Chemistry, MES Abasaheb Garware College, Pune 411004.

***Corresponding author: Email:pds.agc@mespune.in**

Article History

Received: 19/01/2022
Accepted: 12/02/2022

Article ID: RRBB/117

Corresponding Author:
E-Mail:
pds.agc@mespune.in

Abstract:

Environment pollution caused by chemical and energy industries has increased from last two decades. So that so many engineers and scientists try to design sustainable chemical process and to produce less hazardous and more environmentally friendly source of energy. So that Ionic liquids are alternative for other organic solvent. Main interest of ionic liquids in green solvent because of their low pressure and high thermal stability and environment friendly which follows chemistry green principles.

Keywords: Green solvent, Chiral, Protic Ionic Liquids, Green Chemistry

Introduction:

Ionic liquid (IL) is an organic salt that are liquid below 100°C or at room temperature. It has significant attention as an alternative to volatile organic solvents. They are non-flammable, non-volatile and recyclables, so that they are classified as green solvent due to negligible vapour pressure, low viscosity, good lubricating and hydraulic properties and are polar in nature i.e. hydrophilic nature and rarely hydrophobic na ture [1-5]. ILs made up of cation and anion. ILs have low tendency to crystalized due to bulky and asymmetrical cation structure. There are infinite combination of anion and cation which are leads to IL properties, with anion it responsible for qualities like air and water stability and with cation it responsible for melting temperature and organic solubility. Nanotechnology is also coupled with ionic liquids for many applications to create flexible properties. Graphene wonder material goes with Ils for catalysis application as well [6-9].

Synthesis of Ionic liquids:

First room temperature IL Ethyl ammonium nitrate was synthesized in 1994 (Melting Point 12°C). Generally Ionic liquids having two main categories one is simple salts and other binary ionic liquids and two stage synthesis [10-11].

Formation of desired cation:

Synthesis of desired cation is carried out either by protonation with free acid or

Research & Reviews in Biotechnology & Biosciences
Website: www.biotechjournal.in
Volume: 9, Issue: 1, Year: 2022
DOI: https://doi.org/10.5281/zenodo.6619038
ISSN No: 2321-8681
Mini-Review
PP: 9.13
Peer Reviewed Journal

quaternization of amine, phosphine or sulfide with haloalkane or dialkyl sulphate. For the formation of salts like Ethyl ammonium nitrate protonation reaction is used in which nitric acids adds to cooled aqueous solution of ethylamine [12]. In the quaternization reaction, amine is mixed with alkylating agent and then mixture is stirred and heated [13].

Anion Exchange:

Generally, anion exchange reaction of ionic liquids carried out by two methods: reaction of halide salts with Lewis acid and anion metathesis [14]. Ionic liquids are formed by reaction of halide salts with Lewis acids. Mostly $AlCl_3$ is used in Lewis acid base ionic liquids. General reaction is quaternary halide salts Q^+X^- reacts with the Lewis acid MX_n gives more than one anion species. Example of metal halides are $FeCl_3$, BCl_3, CuCl, $SnCl_2$. [15-18]

Anion metathesis method is used for the preparation of air and water stable Ionic liquids which is based on 1,3-dialkylmethylimidazolium cations. In this metathesis halide salts reacts with silver/sodium/potassium salts of NO_2^-, NO_3^-, BF_4^-, SO_4^{2-} and $CO_2CH_3^-$.

Anion	Anionic Sources	Chemical Compound	Reference
$[N(CN)_2]$	$NaN(CN)_2$	Sodium dicyanamide	28
[SCN]	NaSCN	Sodium thiocyanate	28
$[NO_3]$	$AgNO_3$, $NaNO_3$	Silver nitrate, sodium nitrate	29
$[AuCl_4]$	$HAuCl_4$	Chloroauric acid	30

Several new and upgrade on conventional methodologies have been developed for synthesis of Ionic liquids such as irradiation with microwave, sonication, ring opening, acid-base neutralization, power ultrasound and many more [19-21]. Combination of anion and cations and their biological, physical, chemical and thermal properties ionic liquids classified into several categories [22-24].

Physico-Chemical Properties of ILs:

There are several Physico-chemical properties such as density, melting point, acidity, viscosity, polarity, vapour pressure, surface tension, thermal stability and many more [25-27]. Physicochemical properties of ionic liquids changes with structure of anion and cations. Melting point of ionic liquids is below 100° C and most of them are liquid are room temperature. Ionic liquid and its melting point have significant relationship between the structure and chemical composition. As increase anion size decreases the melting point. As increase in branching on alkyl chain increases melting point. Ionic liquids are nonvolatile so that at ambient temperature their vapour pressure is negligible. Thermal stability for many ionic liquids is above 400°C. Viscosity of ionic is relatively high as compared to other solvents. Viscosity of ionic liquids are measured by van der Waals forces, hydrogen bonding, and electrostatic forces. Density of ionic liquids is greater than the other organic solvent and water. Its density value ranging from 1 to 1.6 g cm^{-3}.

Applications of Ionic liquids:

Ionic liquids have wide range of applications in solvent and catalyst, biological, physical, analytical, engineering

ISSN No: 2321-8681
Mini-Review
PP: 9.13
Peer Reviewed Journal

chemistry, electrochemistry and many more. Ionic liquids are alternative in green chemistry due to their physical and chemical properties. It is used as solvent in synthesis and catalyst application. Ionic liquids are chemical compound but it have been developed in biological activities such antimicrobial, cytotoxic etc. and drug synthesis application as well. Ionic liquids possesses unique Physico-chemical properties so that it has main advantage in Engineering field. They have complex interplay results of molecular hydrogen bonding and van der Waals interactions [24]. Ionic liquids have wide range of applications in analytical chemistry. Ionic liquids show application in chromatography, spectrometry, isolation, extraction, electro- analysis and many more [25-28]. Ionic liquids are widely used in electrochemistry because of the their unique Physico-chemical properties like conductivity, viscosity, thermal stability etc. [29].

Conclusions

Volatile solvents are harmful to environment. It causes adverse effects to environment. Volatile solvents increase air pollution. They are difficult to remove from desired product and they are unable to recycle. So that it's big challenge to reduce environmental pollution causes due to organic solvent. Therefore, interest in ionic solvent is increased because of its low pressure, high thermal stability. It is used as green solvent. Variety of formation of ionic liquids and its large no. of application, play vital role in future green chemistry and science and technology. Nano functionalized Ils are good for many applications like catalysis, sensor etc.

Conflict of Interest: Authors declares no conflict of interest

Authors Contributions: Each and every author had contributed to the manuscript.

Funding Info- No funding involved.

Acknowledgement – authors like to thank management, for support

References

1. P. T. Anastas and T. C. Williamson, (1998) Green Chemistry: FrontiersIn Benign Chemical Syntheses and Processes, Oxford University Press.
2. D. J. Adams, P. J. Dyson, and S. J. Tavener, (2004) Chemistry in Alternative Reaction Media, John Wiley & Sons, Chichester, UK.
3. Gemmell V (1990) VOC reduction. Solvent cleaning and paint stripping. Trans Soc Auto Eng 99:64–76
4. T. Welton, (1999) "Room-Temperature Ionic Liquids. Solvents For Synthesis and Catalysis," Chemical Reviews, Vol. 99, No. 8, pp. 2071-2084.
5. Imperato G, Konig B, Chiappe C (2007) Ionic green solvents from renewable resources. Eur J Org Chem 2007: 1049–1058.
6. Deepali Butala & Shobha Waghmode, (2020) Graphene Foam: Next Generation Graphene Analogue, Butala Deepali and Waghmode Shobha, Research Journal of Chemistry and Environment Vol. 24 (8) August, 1-11.

7. Preeti Nigam, Shobha Waghmode, Michelle Louis, Shishanka Wangnoo, Pooja Chavan and Dhiman Sarkar.(2014), Graphene quantum dots conjugated albumin nanoparticles for targeted drug delivery and imaging of pancreatic cancer. J. Mater. Chem. B, 2, 3190-3195, DOI: 10.1039/C4TB00015C.
8. Kalyankar V. K., Dagade P. M, Dagade S.P and Waghmode S. A (2015) Biosynthesis of Silver nanoparticles using isolated superoxide dismutase enzyme from novel source *Papaverum somniferum L.* Vol. 19 (3) March *Res. J. Chem. Environ.*
9. Omkar Pawar, Neelima Deshpande, Sharada Dagade, Preeti Nigam-Joshie, Shobha Waghmode. (2015) Green synthesis of silver nanoparticles from purple acid phosphatase apo-enzyme isolated from a new source Limonia acidissima. J.of Expt.Nanoscience.,doi.org/10.1080/17458080.2015.1025300.
10. Evans DF, Yamouchi A, Wei GJ et al (1983) Micelle size in ethylammonium nitrate as determined by classical and quasi-elastic light scattering. J Phys Chem 87:3537.
11. P. Wasserscheid and W. Keim,2000 "Ionic liquids—new "solutions" For transition metal catalysis," Angewandte Chemie InternationalEdition, vol. 39, no. 21, pp. 3773–3789.
12. Robinson and R. A. Osteryoung, (1979) "An electrochemical andSpectroscopic study of some aromatic hydrocarbons in theRoom temperature molten salt system aluminum chloride-n-Butylpyridinium chloride," Journal of the American Chemical Society, vol. 101, no. 2, pp. 323–327.
13. S.K. Singh and A.W. Savoy, (2018) Ionic liquids synthesis and Applications: An overview, Journal of Molecular Liquids
14. M. Deetlefs, K.R. Seddon, (2003) Improved preparations of ionic liquids using microwave irradiation, Green Chem., 5 , 181-186.
15. J.M. Leveque, J.L. Luche, C. Petrier, R. Roux, W. Bonrath, (2002) An improved preparation of ionic Liquids by ultrasound, Green Chem., 4 357-360.
16. J.-M. Lévêque, S. Desset, J. Suptil, C. Fachinger, M. Draye, W. Bonrath, G.Cravotto, (2006) A general Ultrasound-assisted access to room-temperature ionic liquids, Ultrasonics Sonochemistry, 13 189-193.
17. A.R. Hajipour, F. Rafiee, (2015) Recent Progress in Ionic Liquids and their Applications in Organic Synthesis, Organic Preparations and Procedures International, 47 249-308.
18. T.H. Scott, (2005) Room Temperature Ionic Liquids: Different Classes and Physical Properties, Current Organic Chemistry, 9 959-988.
19. H. Olivier-Bourbigou, L. Magna, D. Morvan, (2010) Ionic liquids and catalysis: Recent progress from Knowledge to applications, Applied Catalysis A: General, 373 1-56.
20. T.L. Greaves, C.J. Drummond, (2008) Protic Ionic Liquids: Properties and Applications, Chemical Reviews, 108, 206-237.

ISSN No: 2321-8681
Mini-Review
PP: 9.13
Peer Reviewed Journal

21. J.P. Hallett, T. Welton, (2011)Room-Temperature Ionic Liquids: Solvents for Synthesis and Catalysis. 2, Chem. Rev., 111, 3508-3576.
22. K.S. Egorova, E.G. Gordeev, V.P. Ananikov, (2017)Biological Activity of Ionic Liquids and Their Application in Pharmaceutics and Medicine, Chem. Rev., 117 7132-7189.
23. S. Werner, M. Haumann, P. Wasserscheid, (2010) Ionic Liquids in Chemical Engineering, Annual Review of Chemical and Biomolecular Engineering, 1 203-230.
24. M. Opallo, A. Lesniewski, (2011)A review on electrodes modified with ionic liquids, Journal of Electroanalytical Chemistry, 656, 2-16.
25. S. Liu, P.K. Dasgupta, (1995)Liquid Droplet. A Renewable Gas Sampling Interface, Analytical Chemistry, 67, 2042-2049.
26. H. Liu, Y. Liu, J. Li, (2010) Ionic liquids in surface electrochemistry, Phys. Chem. Chem. Phys., 12 1685-1697.
27. H. Srour, H. Rouault, C.C. Santini, Y. Chauvin, (2013)A silver and water free metathesis reaction: a Route to ionic liquids, Green Chem., 15 1341-1347.
28. P. Bonhôte, A.-P. Dias, N. Papageorgiou, K. Kalyanasundaram, M. Grätzel, (1996) Hydrophobic, Highly Conductive Ambient-Temperature Molten Salts, Inorganic Chemistry, 35 1168-1178.
29. M. Hasan, I.V. Kozhevnikov, M.R.H. Siddiqui, A. Steiner, N. Winterton,(1999) Gold Compounds as Ionic Liquids. Synthesis, Structures, and Thermal Properties of N,N-