



- (51) **International Patent Classification:**
B01D 53/14 (2006.01) *C07D 233/56* (2006.01)
B01D 53/54 (2006.01)
- (21) **International Application Number:** PCT/IB2016/054021
- (22) **International Filing Date:** 5 July 2016 (05.07.2016)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:** 2580/MUM/2015 6 July 2015 (06.07.2015) IN
- (71) **Applicant:** **RELIANCE INDUSTRIES LIMITED** [IN/IN]; 3rd Floor, Maker Chambers-IV, 222, Nariman Point, Mumbai, Maharashtra 400021 (IN).
- (72) **Inventors:** **SALVI, Prathmesh Pradeep**; G9, Aboli, K.K.V. Quarters, Shivaji Nagar, Dapoli, Dist. Ratnagiri, Maharashtra 415712 (IN). **RAJE, Vivek**; C/O Prabhakar Raje, Wara Jahagir, Tq. Washim, Dist. Washim, Maharashtra 444409 (IN). **UPPARA, Parasuveera**; Pent House No:3, Plot 150, Anmol Heights, Sec 26/27, Parsik Hill, CBD Belapur, Navi Mumbai, Maharashtra 400614 (IN).
- (74) **Agent:** **DEWAN, Mohan**; R. K. Dewan & Co. Podar Chambers, S. A. Brelvi Road, Fort, Mumbai, Maharashtra 400001 (IN).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).
- Declarations under Rule 4.17:**
- as to the identity of the inventor (Rule 4.17(i))
 - of inventorship (Rule 4.17(iv))
- Published:**
- with international search report (Art. 21(3))

(54) **Title:** IONIC LIQUIDS FOR CARBON DIOXIDE ABSORPTION AND PREPARATION THEREOF

(57) **Abstract:** The present disclosure relates to ionic liquids for carbon dioxide absorption. The present disclosure relates to an ionic liquid comprising a cation derived from nitrogen containing heterocyclic compound and an anion. The nitrogen containing heterocyclic compound is substituted with a dihydroxyalkyl group selected from 1,2-dihydroxyalkyl, and 1,3-dihydroxyalkyl. The present disclosure also provides a process for the preparation of the ionic liquid. The ionic liquid disclosed in the present disclosure has carbon dioxide absorption capacity in the range of 0.05 mole to 2.0 mole of carbon dioxide per mole of the ionic liquid.



IONIC LIQUIDS FOR CARBON DIOXIDE ABSORPTION AND PREPARATION THEREOF

FIELD

The present disclosure relates to ionic liquids for carbon dioxide absorption.

5 BACKGROUND

Increasing carbon dioxide (CO₂) levels in the atmosphere and the associated environmental hazards have instigated extensive research and development for methods aimed at reversing this condition.

10 Industries and manufacturing plants, nowadays, have in-house air purification units, which other than decontaminating the air of particulate contaminants, effectively remove gases such as carbon dioxide and provide clean air. Developing excellent technologies for capturing carbon dioxide in the industries is important.

Chemical absorption of carbon dioxide using different organic solvents is a frequently used method for the removal of carbon dioxide from air. Use of the organic solvents, however, are
15 accompanied with drawbacks such as low solubility of carbon dioxide, high costs for solvent regeneration, need for use of absorption activators, and the like.

Thus, there is felt a need to provide compounds for carbon dioxide absorption that are economical and easy to regenerate.

OBJECTS

20 Some of the objects of the present disclosure, which at least one embodiment herein satisfies, are as follows:

It is an object of the present disclosure to ameliorate one or more problems of the prior art or to at least provide a useful alternative.

It is another object of the present disclosure to provide compounds for carbon dioxide
25 absorption.

It is yet another object of the present disclosure to provide compounds for carbon dioxide absorption which are easy to synthesize, economical and reusable.

Other objects and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

5 SUMMARY

In one aspect, an ionic liquid for absorption of carbon dioxide is disclosed. The ionic liquid comprises a cation derived from nitrogen containing heterocyclic compound and an anion. The nitrogen containing heterocyclic compound is substituted with a dihydroxyalkyl group selected from 1,2-dihydroxyalkyl, and 1,3-dihydroxyalkyl.

- 10 The nitrogen containing heterocyclic compound is at least one selected from the group consisting of 1-methylimidazole, pyridine, 4-aminopyridine, 2-aminopyridine, 4-methylpyridine, 4-(dimethylamino)pyridine (DMAP), and 1,4-diazabicyclo[2.2.2]octane (DABCO).

- 15 The dihydroxyalkyl group is at least one selected from the group consisting of 1,2-dihydroxypropyl, and 1,3-dihydroxypropyl.

The anion is at least one selected from the group consisting of hydroxyl, phosphate, carbonate, and phenoxide.

- 20 In accordance with another aspect of the present disclosure, there is provided a process for the preparation of the ionic liquid. The process for the preparation of the ionic liquid comprises the following steps.

- 25 The nitrogen containing heterocyclic compound is reacted with a dihydroxyalkyl halide in at least one first fluid medium at a temperature in the range of 55 °C to 80 °C for 5 hours to 30 hours to obtain halide salt of dihydroxyalkyl substituted nitrogen containing heterocyclic compound. The halide salt is reacted with at least one source of anion in at least one second fluid medium at a temperature in the range of 10 °C to 50 °C for 5 hours to 15 hours to obtain a suspension. The suspension is filtered to obtain a residue and a filtrate, and the filtrate is evaporated to obtain the ionic liquid.

The dihydroxyalkyl halide is selected from the group consisting of 2-chloro-1,3-propanediol, and 3-chloro-1,2-propanediol.

The first fluid medium is at least one selected from the group consisting of methanol, ethanol, and toluene. The second fluid medium is at least one selected from the group consisting of
5 methanol, ethanol, propanol, acetone, and methylene chloride.

The source of anion is at least one compound selected from the group consisting of potassium hydroxide, tripotassium phosphate, potassium carbonate, sodium carbonate, sodium hydroxide, potassium phenoxide, and sodium phenoxide.

In accordance with another aspect of the present disclosure, there is provided a process for
10 absorbing carbon dioxide using the ionic liquid. The process for absorbing carbon dioxide comprises the following steps.

The ionic liquid is mixed with water in the pre-determined weight ratio to obtain a first mixture. The carbon dioxide gas or a gas containing carbon dioxide is purged in the first mixture at a flow rate of 0.1 liter/minute to 5 liter/minute at a temperature in the range of 0 °C
15 to 40 °C for 20 minutes to 60 minutes to obtain a second mixture containing absorbed carbon dioxide.

The pre-determined weight ratio of the ionic liquid and water is in the range of 5:1 to 1:10.

The amount of carbon dioxide absorbed using the ionic liquid is in the range of 0.05 mole to 2.0 mole of carbon dioxide per mole of the ionic liquid.

20 BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWING

The ionic liquids of the present disclosure will now be described with the help of the accompanying drawing, in which:

Figure 1 illustrates ¹H-NMR of 4-amino-1-(2,3-dihydroxypropyl)pyridinium hydroxide, [ADPPY][OH]; and

25 **Figure 2** illustrates ¹³C-NMR of 4-amino-1-(2,3-dihydroxypropyl)pyridinium hydroxide, [ADPPY][OH]

DETAILED DESCRIPTION

The carbon dioxide (CO₂) level in the atmosphere is increasing, which has instigated extensive research and development for methods aimed at reversing this condition. Industries and manufacturing plants, nowadays, are employing various methods to absorb carbon dioxide from exhaust or air. Use of organic solvents, have certain drawbacks such as low solubility of carbon dioxide, high cost for solvent regeneration, need for use of absorption activators, and the like.

The present disclosure envisages a new approach for carbon dioxide absorption to mitigate the drawbacks mentioned herein above.

- 10 In one aspect, the present disclosure provides an ionic liquid comprising a cation derived from nitrogen containing heterocyclic compound and an anion. The cation of the ionic liquid of present disclosure is derived from nitrogen containing heterocyclic compound, which is substituted with a dihydroxyalkyl group selected from 1,2-dihydroxyalkyl, and 1,3-dihydroxyalkyl. The alkyl chain in the dihydroxyalkyl group of the ionic liquid of the present disclosure can be in the range of C₂ to C₂₈. The presence of the dihydroxy substituents on the alkyl group affords desirable carbon dioxide absorption properties to the ionic liquid of the present disclosure.

- In accordance with the embodiments of the present disclosure, the nitrogen containing heterocyclic compound of the ionic liquid is at least one selected from the group consisting of 1-methylimidazole, pyridine, 4-aminopyridine, 2-aminopyridine, 4-methylpyridine, 4-(dimethylamino)pyridine (DMAP), and 1,4-diazabicyclo[2.2.2]octane (DABCO).

In accordance with one embodiment of the present disclosure, the nitrogen containing heterocyclic compound is 4-aminopyridine.

- In accordance with another embodiment of the present disclosure, the nitrogen containing heterocyclic compound is pyridine.

In accordance with still another embodiment of the present disclosure, the nitrogen containing heterocyclic compound is 1-methylimidazole.

The ionic liquid of the present disclosure prepared from nitrogen containing heterocyclic compound substituted with an amino group show more carbon dioxide absorption capacity as

compared to the ionic liquid prepared from nitrogen containing heterocyclic compound that does not have amino group substitution.

In accordance with an embodiment of the present disclosure, the dihydroxyalkyl group of the ionic liquid is at least one selected from the group consisting of 1,2-dihydroxypropyl, and
5 1,3-dihydroxypropyl.

In accordance with one embodiment of the present disclosure, the dihydroxyalkyl group is 1,2-dihydroxypropyl.

The anion of the ionic liquid is at least one selected from the group consisting of hydroxyl, phosphate, carbonate, and phenoxide.

10 In accordance with one embodiment of the present disclosure, the anion is hydroxyl group.

In accordance with another embodiment of the present disclosure, the anion is phosphate group.

The choice of the cation and the anion has a large impact on the solubility of the carbon dioxide in the ionic liquid.

15 In accordance with another aspect of the present disclosure, there is provided a process for the preparation of the ionic liquid. The process for the preparation of the ionic liquid comprises the following steps.

The nitrogen containing heterocyclic compound is reacted with a dihydroxyalkyl halide in at least one first fluid medium at a temperature in the range of 55 °C to 80 °C for 5 hours to 30
20 hours to obtain halide salt of dihydroxyalkyl substituted nitrogen containing heterocyclic compound. The halide salt is reacted with at least one source of anion in at least one second fluid medium at a temperature in the range of 10 °C to 50 °C for 5 hours to 15 hours to obtain a suspension. The suspension is filtered to obtain a residue and a filtrate. The filtrate is evaporated to obtain the ionic liquid.

25 The dihydroxyalkyl halide of the present disclosure is selected from the group consisting of 2-chloro-1,3-propanediol, and 3-chloro-1,2-propanediol.

In accordance with one embodiment of the present disclosure, the dihydroxyalkyl halide is 3-chloro-1,2-propanediol.

In accordance with the embodiments of present disclosure, the first fluid medium is at least one selected from the group consisting of methanol, ethanol, and toluene.

In accordance with one embodiment of the present disclosure, the first fluid medium is absolute ethanol.

- 5 The second fluid medium of the present disclosure is at least one selected from the group consisting of methanol, ethanol, propanol, acetone, and methylene chloride.

In accordance with one embodiment of the present disclosure, the second fluid medium is methylene chloride.

- 10 The source of anion of the ionic liquid is at least one compound selected from the group consisting of potassium hydroxide, tripotassium phosphate, potassium carbonate, sodium carbonate, sodium hydroxide, potassium phenoxide, and sodium phenoxide.

In accordance with one embodiment of the present disclosure, the source of anion is potassium hydroxide.

- 15 In accordance with another embodiment of the present disclosure, the source of anion is tripotassium phosphate.

The process for preparation of the ionic liquid of the present disclosure is simple, and uses readily available chemicals or reagents. Therefore, the process for the preparation of ionic liquid of the present disclosure is economic. Further, the ionic liquid used for carbon dioxide absorption can be recycled and reused.

- 20 In accordance with another aspect of the present disclosure, there is provided a process for absorbing carbon dioxide using the ionic liquid. The process for absorbing carbon dioxide comprises the following steps.

- 25 The ionic liquid is mixed with water in the pre-determined weight ratio to obtain a first mixture. The carbon dioxide gas or a gas containing carbon dioxide is purged in the first mixture at a flow rate of 0.1 liter/minute to 5 liter/minute at a temperature in the range of 0 °C to 40 °C for 20 minutes to 60 minutes to obtain a second mixture containing absorbed carbon dioxide.

In accordance with an embodiment of the present disclosure, the pre-determined weight ratio of the ionic liquid and water is in the range of 5:1 to 1:10.

In accordance with one embodiment of the present disclosure, the pre-determined weight ratio of the ionic liquid and water is 1:1.

In accordance with an embodiment of the present disclosure, the amount of carbon dioxide absorbed using the ionic liquid is in the range of 0.05 mole to 2.0 mole of carbon dioxide per mole of the ionic liquid.

In accordance with preferred embodiment of the present disclosure, the amount of carbon dioxide absorbed using the ionic liquid is in the range of 0.20 mole to 0.80 mole of carbon dioxide per mole of the ionic liquid.

In accordance with one embodiment of the present disclosure, the amount of carbon dioxide absorbed using the ionic liquid is 0.65 mole of carbon dioxide per mole of the ionic liquid.

In accordance with another embodiment of the present disclosure, the amount of carbon dioxide absorbed using the ionic liquid is 0.40 mole of carbon dioxide per mole of the ionic liquid.

In accordance with another embodiment of the present disclosure, the amount of carbon dioxide absorbed using the ionic liquid is 0.28 mole of carbon dioxide per mole of the ionic liquid.

The ionic liquid of the present disclosure show excellent carbon dioxide absorption capacity using a simple process for carbon dioxide absorption.

The present disclosure is further described in light of the following experiments which are set forth for illustration purpose only and not to be construed for limiting the scope of the disclosure. The following experiments can be scaled up to industrial/commercial scale and the results obtained can be extrapolated to industrial scale.

EXPERIMENT:

Dihydroxyalkyl substituted Pyridine-based Ionic Liquids:

Experiment 1: 4-amino-1-(2,3-dihydroxypropyl)pyridinium hydroxide [ADPPY][OH]

A] Process of preparation:

Step-I: Synthesis of 4-amino-1-(2,3-dihydroxypropyl)pyridinium chloride [ADPPY][Cl]

A mixture of 4-aminopyridine (4.7 gm, 50 mmol) and 3-chloro-1,2-propanediol (4.15 mL, 50 mmol) was charged into a reactor. The mixture was stirred at 68 °C for 24 hours in absolute ethanol. The solvent was removed under reduced pressure to obtain a residue. The residue was washed with ethyl acetate (3 x 10 mL) and dried under reduced pressure to obtain
5 [ADPPY][Cl].

Step – II: Synthesis of [ADPPY][OH]

Potassium hydroxide (1.12 gm, 20 mmol) and [ADPPY][Cl] (6.08 gm, 20 mmol) were introduced in methylene chloride (20 mL) followed by vigorous stirring at 25 °C for 10 hours. The resultant mixture was filtered to separate precipitated KCl and the filtrate was
10 evaporated to obtain [ADPPY][OH] as viscous liquid.

¹H-NMR and ¹³C-NMR as shown in **Figure 1** and **Figure 2** respectively indicate the formation of [ADPPY][OH].

B) Carbon dioxide absorption:

The solubility of carbon dioxide in the ionic liquid (IL), as prepared in **Step-I**, was
15 determined by applying the weight gain – loss method. In this experiment, a pre-determined mass of [ADPPY][OH] was loaded into an absorption vessel. As the viscosity of the ionic liquid was high, it was mixed with water in the weight ratio of 1:1 for effective carbon dioxide absorption. The experimental determination of the gas solubility in the liquid was based on the bubble point method.

20 1 gm of [ADPPY][OH] and 1 gm of water were charged into a glass reaction vessel (open system). Carbon dioxide gas was purged by 1.5 lit/min flow rate into the reaction vessel at 25 °C for 30 minutes.

It was observed that after 30 minutes 0.65 mole of carbon dioxide was absorbed into per mole of [ADPPY][OH].

25 Experiment 2: 4-amino-1-(2,3-dihydroxypropyl)pyridinium phosphate [ADPPY][PO₄]

A) Process of preparation:

Step – I: Synthesis of [ADPPY][Cl]

The process for the preparation of [ADPPY][Cl] was similar to Step – I of **Experiment 1**.

Step – II: Synthesis of [ADPPY][PO₄]

5 Tripotassium phosphate (4.24 gm, 20 mmol) and [ADPPY][Cl] (6.08 gm, 20 mmol) were introduced in methylene chloride (20 mL) followed by vigorous stirring at 25 °C for 10 hours. The resultant mixture was filtered to separate precipitated KCl and the filtrate was evaporated to obtain [ADPPY][PO₄] as viscous liquid product.

B] Carbon dioxide absorption:

10 The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [ADPPY][PO₄] is given in **Table 1**.

Experiment 3: 1-(2,3-dihydroxypropyl)pyridinium phosphate [DHPPy][PO₄]

A] Process of preparation:

The process for the preparation of [DHPPy][PO₄] was similar to Step – I and Step – II of **Experiment 2**.

15 B] Carbon dioxide absorption:

The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [DHPPy][PO₄] is given in **Table 1**.

Dihydroxyalkyl substituted Imidazole-based Ionic Liquids:

20 Experiment 4: 3-(2,3-dihydroxypropyl)-1-methylimidazolium phosphate [DHPMIM][PO₄]

A] Process of preparation:

The process for the preparation of [DHPMIM][PO₄] was similar to Step – I and Step – II of

Experiment 2.

B] Carbon dioxide absorption:

The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [DHPMIM][PO₄] is given in **Table 1**.

Table 1: Carbon dioxide absorption capacity of ionic liquids

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Ionic liquids	4-amino-1-(2,3-dihydroxypropyl)pyridinium hydroxide [ADPPY][OH]	4-amino-1-(2,3-dihydroxypropyl)pyridinium phosphate [ADPPY][PO ₄]	1-(2,3-dihydroxypropyl)pyridinium phosphate [DHPPy][PO ₄]	3-(2,3-dihydroxypropyl)-1-methylimidazolium phosphate [DHPMIM][PO ₄]
Observed carbon dioxide absorption	0.65 mole of carbon dioxide was absorbed into per mole of [ADPPY][OH]	0.40 mole of carbon dioxide was absorbed into per mole of [ADPPY][PO ₄]	0.28 mole of carbon dioxide was absorbed into per mole of [DHPPy][PO ₄]	0.28 mole of carbon dioxide was absorbed into per mole of [DHPMIM][PO ₄]

The comparative study of **Table 1** indicates that the ionic liquid prepared from nitrogen containing heterocyclic compound substituted with an amino group (4-aminopyridine) show more carbon dioxide absorption capacity as compared to the ionic liquid prepared from nitrogen containing heterocyclic compound that does not have amino group (pyridine).

COMPARATIVE EXPERIMENTS

For comparison the dihydroxypropyl substitution was replaced by butyl substitution.

Butyl substituted Pyridine-based Ionic Liquids:

Comparative Experiment 5: 1-butyl-4-amino pyridinium hydroxide [BAPy][OH]

A] Process of preparation:

The process for the preparation of [BAPy][OH] was similar to Step – I and Step – II of **Experiment 1**. The alkylating agent used in **comparative experiment 5** for the preparation of [BAPy][OH] is butyl chloride instead of dihydroxyalkyl halide.

B] Carbon dioxide absorption:

- 5 The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [BAPy][OH] is given in **Table 2**.

Butyl substituted Imidazole-based Ionic Liquids:

Comparative Experiment 6: 1-butyl-3-methylimidazolium hydroxide [BMIM][OH]

- 10 A] Process of preparation:

The process for the preparation of [BMIM][OH] was similar to Step – I and Step – II of **Experiment 1**. The alkylating agent used in **comparative experiment 6** for the preparation of [BMIM][OH] is butyl chloride instead of dihydroxyalkyl halide.

B] Carbon dioxide absorption:

- 15 The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [BMIM][OH] is given in **Table 2**.

Comparative Experiment 7: 1-butyl-3-methylimidazolium phosphate [BMIM][PO₄]

A] Process of preparation:

- 20 The process for the preparation of [BMIM][PO₄] was similar to Step – I and Step – II of **Experiment 2**. The alkylating agent used in **comparative example 7** for the preparation of [BMIM][PO₄] is butyl chloride instead of dihydroxyalkyl halide.

B] Carbon dioxide absorption:

- 25 The process for determining the solubility of carbon dioxide in the ionic liquid was similar as that of **Experiment 1**. The observed value of carbon dioxide absorption using [BMIM][PO₄] is given in **Table 2**.

Table 2: Carbon dioxide absorption capacity of ionic liquids prepared using butyl chloride instead of dihydroxyalkyl halide

	Comparative Experiment 5	Comparative Experiment 6	Comparative Experiment 7
Ionic liquids	1-butyl-4-amino pyridinium hydroxide [BAPy][OH]	1-butyl-3-methylimidazolium hydroxide [BMIM][OH]	1-butyl-3-methylimidazolium phosphate [BMIM][PO ₄]
Observed carbon dioxide absorption	0.23 mole of carbon dioxide was absorbed into per mole of [BAPy][OH]	0.17 mole of carbon dioxide was absorbed into per mole of [BMIM][OH]	0.23 mole of carbon dioxide was absorbed into per mole of [BMIM][PO ₄]

The comparison of examples 1,2,3,4 and 5,6,7 (**Table 1** and **Table 2**) indicates that the ionic liquids substituted with dihydroxyalkyl group show more carbon dioxide absorption capacity as compared to the ionic liquid substituted with butyl group.

TECHNICAL ADVANCES AND ECONOMICAL SIGNIFICANCE

The present disclosure described herein above has several technical advantages including, but not limited to, the realization of an ionic liquid:

- having carbon dioxide absorption capacity in the range from 0.05 mole to 2.0 mole of carbon dioxide per mole of the ionic liquid; and
- that is
 - easy to synthesize,
 - economical, and
 - reusable.

Throughout this specification the word “comprise”, or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated element, integer or step,

or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the disclosure to achieve
5 one or more of the desired objects or results.

Any discussion of documents, acts, materials, devices, articles or the like that has been included in this specification is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as
10 it existed anywhere before the priority date of this application.

The numerical values mentioned for the various physical parameters, dimensions or quantities are only approximations and it is envisaged that the values higher/lower than the numerical values assigned to the parameters, dimensions or quantities fall within the scope of the disclosure, unless there is a statement in the specification specific to the contrary.

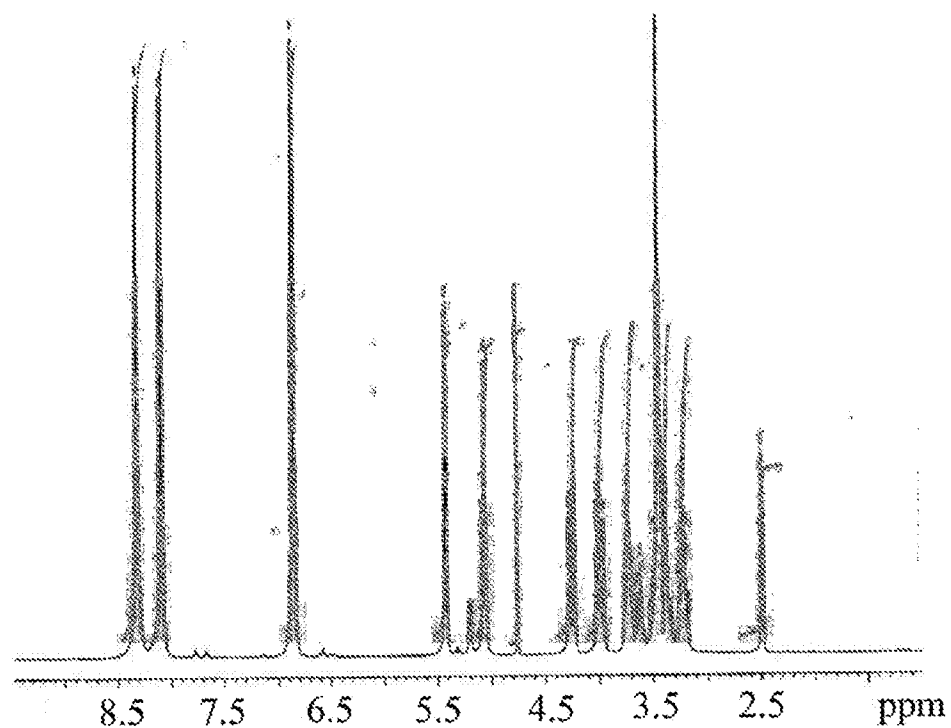
15 While considerable emphasis has been placed herein on the components and component parts of the preferred embodiments, it will be appreciated that many embodiments can be made and that many changes can be made in the preferred embodiments without departing from the principles of the disclosure. These and other changes in the preferred embodiment as well as other embodiments of the disclosure will be apparent to those skilled in the art from the
20 disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the disclosure and not as a limitation.

CLAIMS:

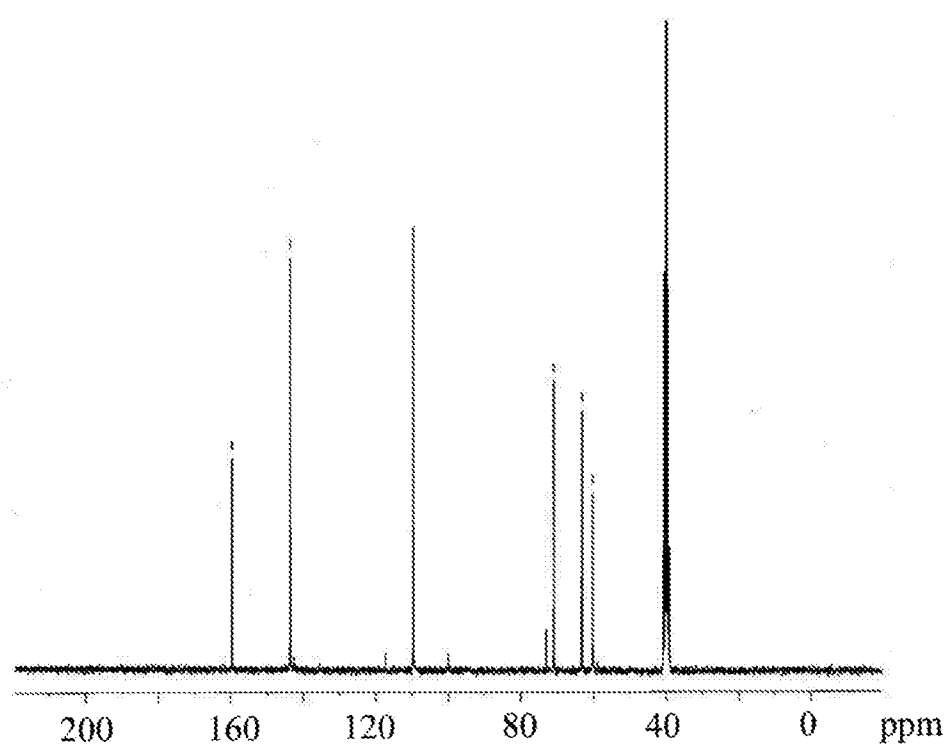
1. An ionic liquid comprising a cation derived from a nitrogen containing heterocyclic compound and an anion, wherein the nitrogen containing heterocyclic compound is substituted with a dihydroxyalkyl group selected from 1,2-dihydroxyalkyl, and 1,3-dihydroxyalkyl.
5
2. The ionic liquid as claimed in claim 1, wherein said nitrogen containing heterocyclic compound is at least one selected from the group consisting of 1-methylimidazole, pyridine, 4-aminopyridine, 2-aminopyridine, 4-methylpyridine, 4-(dimethylamino)pyridine, and 1,4-diazabicyclo[2.2.2]octane.
- 10 3. The ionic liquid as claimed in claim 1, wherein the dihydroxyalkyl group is at least one selected from the group consisting of 1,2-dihydroxypropyl, and 1,3-dihydroxypropyl.
4. The ionic liquid as claimed in claim 1, wherein said anion is at least one selected from the group consisting of hydroxyl, phosphate, carbonate, and phenoxide.
- 15 5. A process for preparing the ionic liquid as claimed in claim 1, said process comprising the following steps:
 - i. reacting the nitrogen containing heterocyclic compound with a dihydroxyalkyl halide in at least one first fluid medium at a temperature in the range of 55 °C to 80 °C for 5 hours to 30 hours to obtain a halide salt of dihydroxyalkyl substituted nitrogen containing heterocyclic compound;
20
 - ii. reacting said halide salt with at least one source of anion in at least one second fluid medium at a temperature in the range of 10 °C to 50 °C for 5 hours to 15 hours to obtain a suspension; and
 - iii. filtering said suspension to obtain a residue and a filtrate, and evaporating said
25 filtrate to obtain the ionic liquid.
6. The process as claimed in claim 5, wherein said dihydroxyalkyl halide is selected from the group consisting of 2-chloro-1,3-propanediol, and 3-chloro-1,2-propanediol.

7. The process as claimed in claim 5, wherein said first fluid medium is at least one selected from the group consisting of methanol, ethanol, and toluene; and said second fluid medium is at least one selected from the group consisting of methanol, ethanol, propanol, acetone, and methylene chloride.
- 5 8. The process as claimed in claim 5, wherein said source of anion is at least one compound selected from the group consisting of potassium hydroxide, tripotassium phosphate, potassium carbonate, sodium carbonate, sodium hydroxide, potassium phenoxide, and sodium phenoxide.
- 10 9. A process for absorbing carbon dioxide using the ionic liquid as claimed in claim 1, said process comprising the following steps:
- i. mixing said ionic liquid and water in a pre-determined weight ratio to obtain a first mixture; and
 - ii. purging carbon dioxide gas or a gas containing carbon dioxide in the first mixture at a flow rate of 0.1 liter/minute to 5 liter/minute at a temperature in the range of 0 °C to 40 °C for 20 minutes to 60 minutes to obtain a second mixture containing absorbed carbon dioxide.
- 15
10. The process as claimed in claim 9, wherein the pre-determined weight ratio of the ionic liquid and water is in the range of 5:1 to 1:10.
- 20 11. The process as claimed in claim 9, wherein the amount of carbon dioxide absorbed using the ionic liquid is in the range of 0.05 mole to 2.0 mole of carbon dioxide per mole of said ionic liquid.

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**Figure 1**

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**Figure 2**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/054021

A. CLASSIFICATION OF SUBJECT MATTER
B01D53/14, B01D53/54, C07D233/56 Version=2016.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01D; C07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Patseer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	D1: CN101935311B; CHOI SEOK JIN , CHUNG SUNG YEUP , KANG JE EUN , KIM HOON SIK, LEE KI CHUN , PALGUNADI JELLIARKO; 10-Jun-2015 Abstract ;page 5, [0010-0011]; [0018]; (See working examples) -----	1-10
Y	D2: WO2013147369A1; BAEK IL-HYUN[KR], NAM SUNG-CHAN[KR], PARK JUNG HOON[KR], YOON YEOIL[KR], JEONG SOON-KWAN[KR], PARK SUNG-YEOUL[KR], PARK KI-TAE[KR], PARK SANG-DO[KR], CHOI SOO HYUN[KR], 3 October 2013; Claims 1-10	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

12-09-2016

Date of mailing of the international search report

12-09-2016

Name and mailing address of the ISA/

Indian Patent Office
Plot No.32, Sector 14, Dwarka, New Delhi-110075
Facsimile No.

Authorized officer

Latika Dawara

Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2016/054021

Citation	Pub.Date	Family	Pub.Date
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