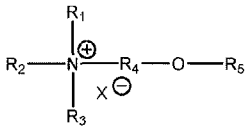
## CLAIMS

1. A zinc bromide electrolyte solution comprising one or more class A quat halides, each class A quat halide having a molecular structure selected from the group consisting of:

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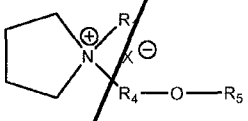


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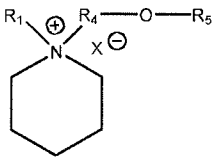


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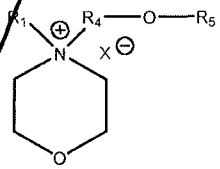


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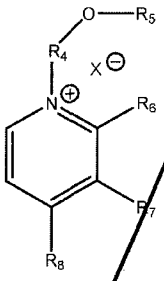


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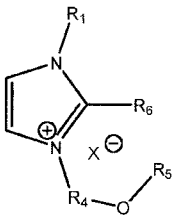



VI

wherein

$X^-$ is $Br^-$ or $Cl^-$, or the quat is a mixture of both bromides and chlorides;

$R_1$, $R_2$, $R_3$, are, independently, hydrogen or alkyl substituents having about 12 or fewer carbon atoms;

$R_4$ is an alkyl chain having in the range of about 1 to about 10 carbon atoms; and

$R_5$ is an alkyl group having in the range of about 1 to about 6 carbon atoms.

2. An electrolyte solution as in claim 1 wherein the one or more class A quat halides comprise at least one quat of structure I.

3. An electrolyte solution as in claim 2 wherein

$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof;

$R_1$, $R_2$ and $R_3$ comprise about 1 to about 4 carbon atoms; and

$R_4$ comprises about 1 to about 4 carbon atoms; and $R_5$ comprises about 1 to about 4 carbon atoms.

4. An electrolyte solution as in claim 3 comprising

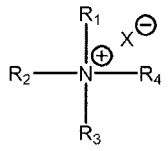
a first class A quat halide and a second class A quat halide:

wherein

in the first class A quat halide $R_1$, $R_2$ and $R_3$ are ethyl, $R_4$ is ethyl, and $R_5$ is methyl; and

in the second class A quat halide $R_1$ and $R_3$ are ethyl, $R_2$ is methyl, $R_4$ is ethyl and $R_5$ is methyl.

5. An electrolyte solution as in claim 1 wherein the electrolyte further comprises one or more tetra-alkyl quat halides of the following structure:




wherein

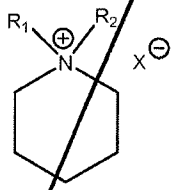
$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

the substituents $R_1$, $R_2$, $R_3$ and $R_4$ are independently alkyl groups comprising in the range of from about 1 to about 10 carbon atoms.

6. An electrolyte solution as in claim 5 wherein $R_1$, $R_2$, $R_3$ and $R_4$ are independently alkyl groups comprising in the range of from about 1 to about 4 carbon atoms.

7. An electrolyte solution as in claim 6 wherein the tetra-alkyl quat is triethylpropyl quat.

8. An electrolyte solution as in claim 5 wherein the electrolyte solution further comprises one or more alkylpiperidinyl quat halides of the following structure:




9. An electrolyte solution as in claim 8 wherein

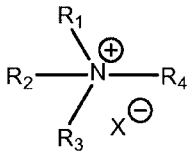
$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

$R_1$ and $R_2$, are, independently, alkyl substituents having 12 or fewer carbon atoms.

10. An electrolyte solution as in claim 9 wherein $X^-$ is $Br^-$ and $R_1$ and $R_2$, are, independently, ethyl, methyl or propyl.

11. An electrolyte solution as in claim 9 wherein $R_1$ and $R_2$ are both ethyl or are ethyl and propyl, respectively.

12. An electrolyte solution as in claim 1, wherein the electrolyte solution further comprises one or more compounds having a molecular structure selected from the group consisting of:

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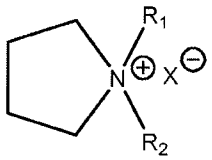


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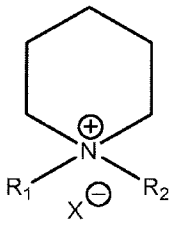


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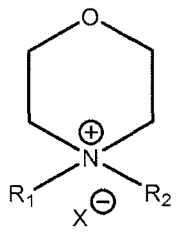

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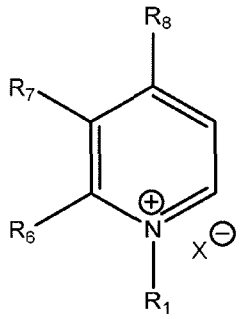

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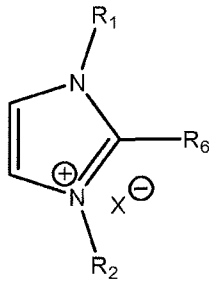


VI

wherein

$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

$R_1$, $R_2$, $R_3$ are, independently, hydrogen or alkyl substituents having about 12 or fewer carbon atoms; and

$R_4$ is an alkyl chain having in the range from about 1 to about 10 carbon atoms.

13. An electrolyte solution as in claim 1, wherein $R_1$, $R_2$, $R_3$ and $R_4$ are, independently, ethyl or methyl.

14. A bromine-containing flow cell battery comprising an electrolyte as in any one of claims 1-13.

15. A Zinc bromide-type flow cell battery, Vanadium bromide flow-type cell battery, Polysulfide bromine-type flow cell battery or Hydrogen bromine-type flow cell battery comprising an electrolyte as in any one of claims 1-13.

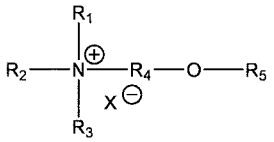
16. An electrolyte solution as in claim 12, wherein $R_1$, $R_2$, $R_3$ are, independently, hydrogen or alkyl substituents comprising in the range from about 1 to about 7 carbon atoms.

17. An electrolyte solution as in claim 16, wherein $R_1$, $R_2$, $R_3$ are, independently, hydrogen or alkyl substituents comprising in the range from about 1 or 2 to about 4 carbon atoms.

18. An electrolyte solution as in claim 17, wherein $R_4$ is an alkyl chain comprising in the range from 1 or 2 to 4, carbon atoms.

## CLAIMS

1. A zinc bromide electrolyte solution comprising one or more class A quat halides, each class A quat halide having a molecular structure selected from the group consisting of:



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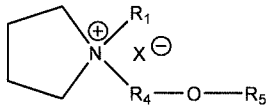

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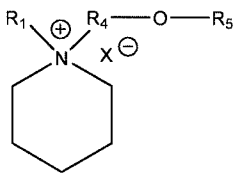

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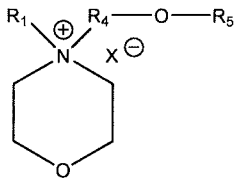

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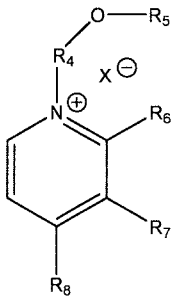

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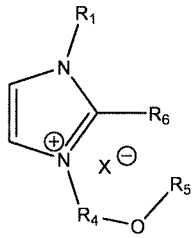


VI

wherein

$X^-$ is $Br^-$ or $Cl^-$, or the quat is a mixture of both bromides and chlorides;

$R_1$, $R_2$, $R_3$, are, independently, hydrogen or alkyl substituents having about 12 or fewer carbon atoms;

$R_4$ is an alkyl chain having in the range of about 1 to about 10 carbon atoms; and

$R_5$ is an alkyl group having in the range of about 1 to about 6 carbon atoms.

2. An electrolyte solution as in claim 1 wherein the one or more class A quat halides comprise at least one quat of structure I.

3. An electrolyte solution as in claim 2 wherein

$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof;

$R_1$, $R_2$ and $R_3$ comprise about 1 to about 4 carbon atoms; and

$R_4$ comprises about 1 to about 4 carbon atoms; and $R_5$ comprises about 1 to about 4 carbon atoms.

4. An electrolyte solution as in claim 3 comprising

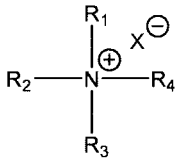
a first class A quat halide and a second class A quat halide:

wherein

in the first class A quat halide $R_1$, $R_2$ and $R_3$ are ethyl, $R_4$ is ethyl, and $R_5$ is methyl; and

in the second class A quat halide $R_1$ and $R_3$ are ethyl, $R_2$ is methyl, $R_4$ is ethyl and $R_5$ is methyl.

5. An electrolyte solution as in claim 1 wherein the electrolyte further comprises one or more tetra-alkyl quat halides of the following structure:




wherein

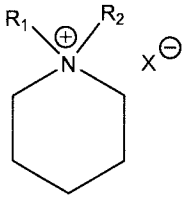
$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

the substituents $R_1$, $R_2$, $R_3$ and $R_4$ are independently alkyl groups comprising in the range of from about 1 to about 10 carbon atoms.

6. An electrolyte solution as in claim 5 wherein $R_1$, $R_2$, $R_3$ and $R_4$ are independently alkyl groups comprising in the range of from about 1 to about 4 carbon atoms.

7. An electrolyte solution as in claim 6 wherein the tetra-alkyl quat is triethylpropyl quat.

8. An electrolyte solution as in claim 5 wherein the electrolyte solution further comprises one or more alkylpiperidinyl quat halides of the following structure:




9. An electrolyte solution as in claim 8 wherein

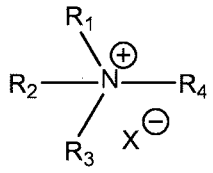
$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

$R_1$ and $R_2$, are, independently, alkyl substituents having 12 or fewer carbon atoms.

10. An electrolyte solution as in claim 9 wherein $X^-$ is $Br^-$ and $R_1$ and $R_2$, are, independently, ethyl, methyl or propyl.

11. An electrolyte solution as in claim 9 wherein $R_1$ and $R_2$ are both ethyl or are ethyl and propyl, respectively.

12. An electrolyte solution as in claim 1, wherein the electrolyte solution further comprises one or more compounds having a molecular structure selected from the group consisting of:

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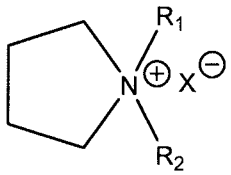


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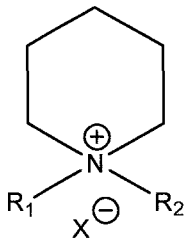


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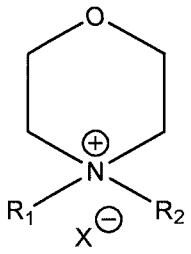


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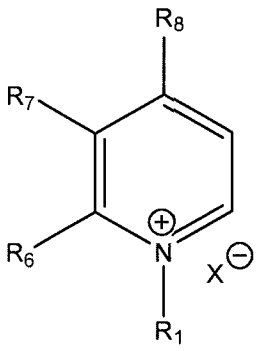


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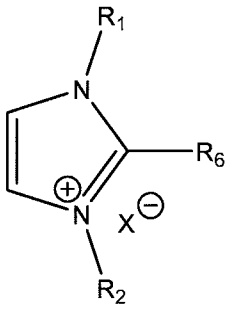


VI

wherein

$X^-$ is $Br^-$ or $Cl^-$ or a mixture thereof, and

$R_1$, $R_2$, $R_3$ are, independently, hydrogen or alkyl substituents having about 12 or fewer carbon atoms; and

$R_4$ is an alkyl chain having in the range from about 1 to about 10 carbon atoms.

13. An electrolyte solution as in claim 1, wherein $R_1$, $R_2$, $R_3$ and $R_4$ are, independently, ethyl or methyl.

14. A bromine-containing flow cell battery comprising an electrolyte as in claim 1.

15. A Zinc bromide-type flow cell battery, Vanadium bromide flow-type cell battery, Polysulfide bromine-type flow cell battery or Hydrogen bromine-type flow cell battery comprising an electrolyte as in claim 1.