WHAT IS CLAIMED IS:

1. An ionic liquid catalyst system, comprising:
    a. a regenerated quaternary ammonium haloaluminate ionic liquid having the general formula Q^+A^-, wherein Q^+ is an ammonium cation and A^- is a negatively charged ion;
    b. a hydrogen chloride; and
    c. 1 to 24 wt% of a conjunct polymer;
    wherein the ionic liquid catalyst system has both a molar ratio of Al to N greater than 2.0 and less than 0.1 wt% $AlCl_3$ precipitate, when the ionic liquid catalyst system is held at a temperature at or below 25°C for at least two hours.
2. The ionic liquid catalyst system of claim 1, wherein the hydrogen chloride is at least partially produced from an alkyl chloride.
3. The ionic liquid catalyst system of claim 1, wherein the ionic liquid system is not significantly deactivated by the conjunct polymer.
4. The ionic liquid catalyst system of claim 1, wherein the solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst system is 3 wt% or higher at 50°C or below.
5. The ionic liquid catalyst system of claim 1, wherein the ionic liquid catalyst system produces an alkylate product with a RON of 86 or higher.
6. The ionic liquid catalyst system of claim 1, wherein the quaternary ammonium haloaluminate ionic liquid is regenerated by mixing the quaternary ammonium haloaluminate ionic liquid with aluminum metal.
7. The ionic liquid catalyst system of claim 1, wherein the quaternary ammonium haloaluminate ionic liquid is an N-alkyl-pyridinium chloroaluminate, a N-alkyl-alkyl-pyridinium chloroaluminate, a pyridinium hydrogen chloroaluminate, an alkyl pyridinium hydrogen chloroaluminate, a di-alkyl-imidazolium chloroaluminate, a tetra-alkyl-ammonium chloroaluminate, a tri-alkyl-ammonium hydrogen chloroaluminate, or a mixture thereof.
8. The ionic liquid catalyst system of claim 1, wherein the molar ratio of Al to N greater than 2.0 extends the life of the ionic liquid catalyst before it requires additional regeneration.
9. The ionic liquid catalyst system of claim 1, wherein the molar ratio of Al to N is from 2.1 to 8.0.
10. The ionic liquid catalyst system of claim 1, wherein a solubility of incremental $AlCl_3$ above the 2.0 Al to N molar ratio in the ionic liquid catalyst system is from 3 to 100 wt% at 100°C or below.

11. The ionic liquid catalyst system of claim 1, wherein the regenerated quaternary ammonium haloaluminate ionic liquid is an alkyl-pyridinium haloaluminate and the alkyl- is methyl, ethyl, propyl, butyl, pentyl, or hexyl.
12. The ionic liquid catalyst system of claim 1, comprising from 11 to 24 wt% of the conjunct polymer.
13. The ionic liquid catalyst system of claim 1, wherein the negatively charged ion is $Al_2Cl_7^-$ or $Al_3Cl_{10}^-$.
14. The ionic liquid catalyst system of claim 13, wherein the negatively charged ion is $Al_3Cl_{10}^-$.
15. An ionic liquid catalyst system, comprising:
    a. a quaternary ammonium haloaluminate ionic liquid having the general formula Q^+A^-, wherein Q^+ is an ammonium cation and A^- is $Al_2Cl_7^-$ or $Al_3Cl_{10}^-$; and
    b. 11 to 24 wt% of a conjunct polymer;
    wherein the ionic liquid catalyst system has both a molar ratio of Al to N greater than 2.0 and less than 0.1 wt% $AlCl_3$ precipitate, when the ionic liquid catalyst system is held at a temperature at or below 25°C for at least two hours; and
    wherein the ionic liquid system is effective for performing an isoparaffin/olefin alkylation.
16. The ionic liquid catalyst system of claim 15, wherein the molar ratio of Al to N is from 2.1 to 8.0.
17. The ionic liquid catalyst system of claim 15, wherein a solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst system is from 3 to 100 wt% at 100°C or below.
18. The ionic liquid catalyst system of claim 15, wherein the quaternary ammonium haloaluminate ionic liquid is an alkyl-pyridinium haloaluminate and the alkyl- is methyl, ethyl, propyl, butyl, pentyl, or hexyl.
19. The ionic liquid catalyst system of claim 15, additionally comprising a hydrogen chloride.
20. The ionic liquid catalyst system of claim 18, wherein the hydrogen chloride is at least partially produced from an alkyl chloride.
21. The ionic liquid catalyst system of claim 14, wherein the ionic liquid catalyst system is not significantly deactivated by the conjunct polymer.
22. The ionic liquid catalyst system of claim 14, wherein a solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst system is 3 wt% or higher at 50°C or below.
23. The ionic liquid catalyst system of claim 14, wherein the ionic liquid system produces an alkylate product with a RON of 86 or higher.

24. The ionic liquid catalyst system of claim 14, wherein the quaternary ammonium haloaluminate ionic liquid is regenerated.
25. The ionic liquid catalyst system of claim 23, wherein the quaternary ammonium haloaluminate ionic liquid is regenerated by mixing the quaternary ammonium haloaluminate ionic liquid with aluminum metal.
26. The ionic liquid catalyst system of claim 14, wherein the quaternary ammonium haloaluminate ionic liquid is an N-alkyl-pyridinium chloroaluminate, a N-alkyl-alkyl-pyridinium chloroaluminate, a pyridinium hydrogen chloroaluminate, an alkyl pyridinium hydrogen chloroaluminate, a di-alkyl-imidazolium chloroaluminate, a tetra-alkyl-ammonium chloroaluminate, a tri-alkyl-ammonium hydrogen chloroaluminate, or a mixture thereof.
27. The ionic liquid catalyst system of claim 14, wherein the molar ratio of Al to N greater than 2.0 extends the life of the ionic liquid catalyst before it requires additional regeneration.

WHAT IS CLAIMED IS:

1. An ionic liquid catalyst, comprising an ammonium chloroaluminate salt and 12 to 24 wt% of a conjunct polymer, wherein the ionic liquid catalyst has a molar ratio of Al to N greater than 2.0, when the ionic liquid catalyst is held at a temperature at or below 25°C for at least two hours, and wherein the ionic liquid catalyst remains effective to perform its catalytic function.

2. The ionic liquid catalyst of claim 1, wherein the Al is in the form of $AlCl_3$ and the N is in the form of $R_4N^+X^-$ or $R_3NH^+X^-$, where R is an alkyl group and X is a halide.

3. The ionic liquid catalyst of claim 1, wherein the molar ratio of Al to N is greater than 2.1.

4. The ionic liquid catalyst of claim 1, wherein the solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst is 3 wt% or higher at 50°C or below.

5. The ionic liquid catalyst of claim 1, wherein the solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst is at least 10 wt% higher at 100°C than at 50°C.

6. The ionic liquid catalyst of claim 1, wherein less than 0.1 wt% $AlCl_3$ precipitates out of the ionic liquid catalyst when it is held for three hours or longer at 25°C.

7. The ionic liquid catalyst of claim 1, wherein the ionic liquid catalyst is used for a hydrocarbon conversion reaction selected from the group of alkylation, isomerization, hydrocracking, polymerization, dimerization, oligomerization, acylation, acetylation, metathesis, copolymerization, hydroformylation, dehalogenation, dehydration, olefin hydrogenation, and combinations thereof.

8. The ionic liquid catalyst of claim 1, wherein the ammonium chloroaluminate salt is an N-alkyl-pyridinium chloroaluminate, N-alkyl- alkylpyridinium chloroaluminate, a pyridinium hydrogen chloroaluminate, an alkyl pyridinium hydrogen chloroaluminate, a di-alkyl- imidazolium chloroaluminate, a tetra-alkyl-ammonium chloroaluminate, a trialkyl-

ammonium hydrogen chloroaluminate, or a mixture thereof.

9. An ionic liquid catalyst, comprising an alkyl-pyridinium haloaluminate and 12 to 24 wt% of an impurity, wherein the ionic liquid catalyst has a molar ratio of Al to N greater than 2.0 when the ionic liquid catalyst is held at a temperature at or below 25°C for at least two hours, and wherein the ionic liquid catalyst remains effective to perform its catalytic function.

10. The ionic liquid catalyst of claim 9, wherein the alkyl-pyridinium haloaluminate comprises a haloaluminate selected from the group consisting of chloroaluminate, fluoroaluminate, bromoaluminate, iodoaluminate, and mixtures thereof.

11. The ionic liquid catalyst of claim 1 or claim 9, wherein the molar ratio of Al to N is from 2.1 to 8.0.

12. The ionic liquid catalyst of claim 9, wherein the solubility of incremental $AlCl_3$ above the 2.0 Al/N molar ratio in the ionic liquid catalyst is from 3 to 100 wt% at 100°C or below.

13. An ionic liquid system for an isoparaffin/olefin alkylation, comprising: a quaternary ammonium chloroaluminate, 12 to 24 wt% of a conjunct polymer, and a hydrogen chloride; wherein the ionic liquid system has a molar ratio of Al to N from 2.1 to 8.0, wherein less than 0.1 wt% AlCl3 precipitates from the ionic liquid system when the ionic liquid system is held for three hours or longer at or below 25°C, and wherein the ionic liquid catalyst system extends the life of the ionic liquid catalyst.

14. An alkylation reactor comprising the ionic liquid catalyst of claim 1 or claim 9.