CLAIMS

1. An alkylation process comprising:
passing an isobutane feed and an ethylene feed to an alkylation reactor, wherein the alkylation reactor contains an ionic liquid catalyst, the ionic liquid comprising an organic cation and a halometallate anion, for reacting the isobutane and ethylene to generate an alkylate having a research octane number (RON) of 93 or more;
wherein the alkylation reactor is operated at reaction conditions including a temperature of from 30°C to 100°C, a pressure of from 300 psig to 700 psig (2068 kPa to 4826 kPa), an overall paraffin to olefin molar ratio from 2 to 20, and a residence time of from 5 minutes to 1 hour.

2. The process of claim 1, wherein the ethylene feed is a dilute ethylene feed stream, a polymer-grade ethylene feed stream, or a combination thereof.

3. The process of claim 2, wherein the dilute ethylene feed stream comprises 5 wt. % to 50 wt. % ethylene.

4. The process of claim 2, wherein the polymer-grade ethylene feed stream comprises at least 98 wt. % ethylene.

5. The process of claim 1, wherein the organic cation of the ionic liquid comprises an ammonium cation, a pyrrolidinium cation, a pyridinium cation, an imidazolium, a phosphonium cation, or a combination thereof.

6. The process of claim 1, wherein the halometallate anion comprises a metal selected from Al, Ga, In, Mn, Fe, Co, Ni, Cu, Zn, or a combination thereof, and a halide selected from F, Cl, Br, I, or a combination thereof.

7. The process of claim 1, wherein the halometellate anion is a haloaluminate anion.

8. The process of claim 1, wherein the ionic liquid is present in an amount of from 1 vol. % to 70 vol. % of a total volume of material in the alkylation reactor.

9. The process of claim 1, wherein the process has a selectivity for C6 of at least 70%, and the alkylate has a mole ratio of dimethylbutane to methylpentane of greater of at least 10.

10. The process of claim 1, wherein the alkylation reactor further comprises a co-catalyst.

11. The process of claim 10, wherein the co-catalyst comprises a Brønsted acid selected from the group consisting of HCl, HBr, HI, and mixtures thereof, or a Brønsted acid precursor.

12. The process of claim 1, wherein a conversion of the ethylene is at least 95%.

13. The process of claim 1, wherein the alkylate has a RON of 94 or more, or 95 or more, or 96 or more, or 97 or more, or 98 or more, or 99 or more, or 100 or more.

14. The process of claim 1, wherein the temperature is in a range of from 35°C to 70°C.

15. The process of claim 1, wherein the pressure is in a range of from 350 psig to 500 psig (2413 kPa to 3447 kPa).

16. The alkylation process of claim 1 further comprising:
separating the alkylate and unreacted isobutane feed from the ionic liquid to form a hydrocarbon stream comprising the alkylate and the unreacted isobutane feed and an ionic liquid stream comprising the ionic liquid;
separating the hydrocarbon stream into an alkylate stream and an unreacted isobutane stream; and
recycling at least one of the unreacted isobutane stream and the ionic liquid stream.

17. The process of claim 16, further comprising:
regenerating at least a portion of the ionic liquid in the ionic liquid stream; and
recycling the regenerated ionic liquid catalyst to the alkylation reactor.