Claims

1. (Currently Amended) A catalyst that reduces polymeric fouling, the catalyst comprising:

at least one titanate compound;

at least one aluminum compound; and

an antifouling agent chosen from one or more of a sulfonate or a sulfonate salt; or a sulfonium or sulfonium salt.

2. The catalyst of claim 1, where the antifouling agent comprises a sulfonate or a sulfonate salt.

3. The catalyst of claim 2, where the antifouling agent comprises one or more of sodium dodecylbenzenesulfonate, sodium dioctylsulfonsuccinate, tetrabutylphosphonium methanesulfonate, tetrabutylphosphonium p-toluenesulfonate, hexadecyltrimethylammonium p-toluene sulfonate, 3-(dimethyl(octadecyl)ammonio)propane-1-sulfonate, 3,3'-(1,4-didodecylpiperazine-1,4-diium-1,4-diyl)bis(propane-1-sulfonate), and 3-(4-(tert-butyl)pyridinio)-1-propanesulfonate.

4. The catalyst of claim 1, where the antifouling agent comprises a sulfonium or sulfonium salt.

5. The catalyst of claim 1, further comprising a non-polymeric ether compound.

6. The catalyst of claim 5, where the non-polymeric ether compound is tetrahydrofuran, a dioxane, or tetrahydropyran.

7. The catalyst of claim 1, where at least one of the titanate compounds is an alkyl titanate.

8. The catalyst of claim 7, where the alkyl titanate has the structure $Ti(OR)_4$, where R is a branched or straight chain alkyl radical comprising from 2 to 8 carbon atoms.

9. The catalyst of claim 7, where the alkyl titanate is chosen from tetraethyl titanate, tetraisopropyl titanate, tetra-n-butyl titanate, or 2-tetraethylhexyl titanate.

10. (Currently Amended) A method for selectively producing 1-butene, the method comprising:

contacting ethylene with a catalyst to oligomerize the ethylene to selectively form 1-butene, where the catalyst comprises:

at least one titanate compound;

at least one aluminum compound; and

an antifouling agent chosen from one or more of a phosphonium or phosphonium salt; or a sulfonate or a sulfonate salt.