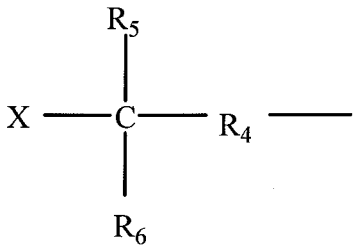
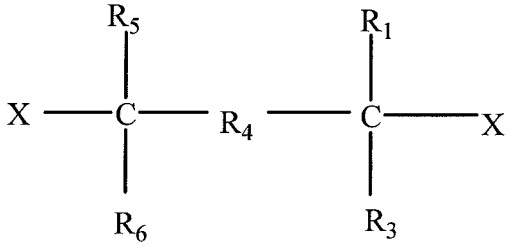
phenylalkyl; and R_2 is selected from the group consisting of C_4 to C_{200} alkyl, C_2 to C_8 alkenyl, phenyl, phenylalkyl, alkylphenyl, C_3 to C_{10} cycloalkyl, and



(B)

wherein X is a halogen; R_5 is selected from the group consisting of C_1 to C_8 alkyl, and C_2 to C_8 alkenyl; R_6 is selected from the group consisting of C_1 to C_8 alkyl, C_2 to C_8 alkenyl and phenylalkyl; and R_4 is selected from the group consisting of phenylene, biphenyl, α,ω-diphenylalkane and ~~$-(CH_2)_n-$~~ $(CH_2)_n$, wherein n is an integer from 1 to 10; and wherein R_1, R_2, and R_3 can also form adamantyl or bornyl ring systems, the X group being in a tertiary carbon position.

[0037] Substitution of the above structural formula radical (B) for R_2 in formula (A) results in the following formula (C):

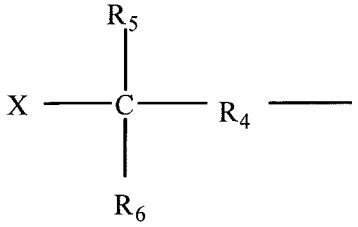


(C)

wherein X, R_1, R_3, R_4, R_5 and R_6 are as defined above. The compounds represented by structural formula (C) contain two dissociable halides and may be considered as merely multiples of those compounds represented by structural formula (A).

[0038] Multifunctional initiators are employed where the production of branched copolymers is desired, while mono-and di-functional initiators are preferred for the production of substantially linear copolymers.

[0039] In one desirable embodiment of structure (A), the initiator is an oligomer of isobutylene as in structure (D):



wherein X is a halogen; R_5 is selected from the group consisting of, C_1 to C_8 alkyl, and C_2 to C_8 alkenyl; R_6 is selected from the group consisting of, C_1 to C_8 alkyl, C_2 to C_8 alkenyl and phenylalkyl; and R_4 is selected from the group consisting of phenylene, biphenyl, α,ω-diphenylalkane and ~~$-(CH_2)_n-$~~ $(CH_2)_n$, wherein n is an integer from 1 to 10; and wherein R_1, R_2, and R_3 can also form adamantyl or bornyl ring systems, the X group being in a tertiary carbon position;

L. The polymerization method of any one of embodiments A to K, or any combination of embodiments A to K, wherein an oxygenate or ion containing species is provided into the reactor;

M. The polymerization method of embodiment L, wherein the oxygenate is an alcohol or an ester;

N. The polymerization method of any one of embodiments A to M, or any combination of embodiments A to M, wherein the isoolefin monomer is isobutylene, isobutene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, 1-butene, 2-butene, methyl vinyl ether, indene, vinyltrimethylsilane, hexene, or 4-methyl-1-pentene;

O. The polymerization method of any one of embodiments A to N, or any combination of embodiments A to N, wherein the alkyl substitution of the alkyl-styrene is a C_1 to C_7 alkyl;

P. The polymerization method of any one of embodiments A to O, or any combination of embodiments A to O, wherein an additional monomer may be present in the feed stream for polymerization with the isoolefin and the alkylstyrene, the additional monomer being a C_4 to C_{14} multiolefin;

CLAIMS

What is claimed is:

1. A polymerization method for preparing polymers derived from C_4 to C_7 isoolefin monomers and alkyl-styrene monomers, the method comprising:

a) providing feed streams into a reactor, the feed streams comprising the isoolefin, alkyl-styrene monomers, a polar diluent or polar diluent mixture, and a catalyst system ~~comprised of a Lewis acid and an initiator~~ wherein the catalyst system is selected from either i) a weak Lewis acid with an HCl initiator or ii) a strong Lewis acid, an initiator and either an oxygenate or an ion containing species; and

b) allowing the feed streams to contact one another within the reactor so that the monomers form a polymer in a slurry, wherein the amount of polymer in the slurry yields a slurry concentration greater than 22 wt%,

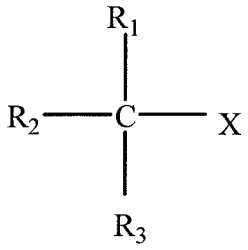
wherein the ratio of moles of polymer formed per mole of initiator is not more than 4 moles of polymer per one mole of initiator.

2. The polymerization method of claim 1, wherein the slurry concentration is in the range of greater than 22 to 40 wt%.

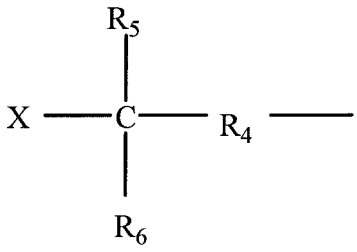
~~3. The polymerization method of either claim 1 or 2, wherein Lewis acid is a Group 13 Lewis acid having the formula R_nMX_{3-n}, wherein M is a Group 13 metal, R is a monovalent hydrocarbon radical selected from the group consisting of C_1 to C_{12} alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals; and n is an integer from 0 to 3; and X is a halogen independently selected from the group consisting of fluorine, chlorine, bromine, and iodine.~~

~~4.~~3. The polymerization method of ~~any one of claims 1 to 3~~ either claim 1 or 2, wherein the weak Lewis acid is ethyl aluminum sesquichloride, aluminum bromide, boron trichloride, ~~diethylaluminum chloride,~~ dimethylaluminum chloride, and diisobutylaluminum chloride, or mixtures thereof, and the strong Lewis acid is ethyl aluminum dichloride.

~~5.~~4. The polymerization method of any one of claims 1 to 4 3, wherein the catalyst system is ii) consisting of a strong Lewis acid, an initiator, and either an oxygenate or an ion containing species, wherein the initiator is HCl, water, or has the formula:



wherein X is a halogen; R_1 is selected from the group consisting of C_1 to C_8 alkyl, and C_2 to C_8 alkenyl; R_3 is selected from the group consisting of, C_1 to C_8 alkyl, C_2 to C_8 alkenyl and phenylalkyl; and R_2 is selected from the group consisting of C_4 to C_{200} alkyl, C_2 to C_8 alkenyl, phenyl, phenylalkyl, alkylphenyl, C_3 to C_{10} cycloalkyl, and



wherein X is a halogen; R_5 is selected from the group consisting of, C_1 to C_8 alkyl, and C_2 to C_8 alkenyl; R_6 is selected from the group consisting of, C_1 to C_8 alkyl, C_2 to C_8 alkenyl and phenylalkyl; and R_4 is selected from the group consisting of phenylene, biphenyl, α,ω-diphenylalkane and ~~$-(CH_2)_n-$~~ $(CH_2)_n$, wherein n is an integer from 1 to 10; and wherein R_1, R_2, and R_3 can also form adamantyl or bornyl ring systems, the X group being in a tertiary carbon position.

~~6. The polymerization method of any one of claims 1 to 5, wherein the ratio of moles of polymer formed per mole of initiator is not more than 4 moles of polymer per one mole of initiator.~~

~~7.~~5. The polymerization method of ~~any one of claims 1 to 6~~ claim 1 or 2, wherein the catalyst system is ii) consisting of a strong Lewis acid, an initiator, and an ion

containing species, wherein ~~an oxygenate or~~ the ion containing species is ~~provided into the reactor~~ an organic salt selected from quaternary ammonium halides, quaternary phosphonium halides, oxonium ions, and tertiary organic halides.

~~8.~~6. The polymerization method of claim ~~7~~ 1, wherein the oxygenate is an alcohol or an ester.

~~9.~~7. The polymerization method of any one of claims 1 to ~~8~~ 6, wherein the isoolefin monomer is isobutylene, ~~isobutene,~~ 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, 1-butene, 2-butene, methyl vinyl ether, indene, vinyltrimethylsilane, hexene, or 4-methyl-1-pentene.

~~10.~~8. The polymerization method of any one of claims 1 to ~~9~~ 7, wherein the alkyl substitution of the alkyl-styrene is a C_1 to C_7 alkyl.

~~11.~~9. The polymerization method of any one of claims 1 to ~~10~~ 8, wherein an additional monomer may be present in the feed stream for polymerization with the isoolefin and the alkylstyrene, the additional monomer being a C_4 to C_{14} multiolefin.

~~12. A polymerization method for preparing polymers derived from C_4 to C_7 isoolefin monomers and alkyl-styrene monomers, the method comprising:~~

~~a) providing feed streams into a reactor, the feed streams comprising the isoolefin, alkyl-styrene monomers, a polar diluent or polar diluent mixture, and a catalyst system comprising a Lewis acid and an initiator and~~

~~b) allowing the feed streams to contact one another within the reactor so that the monomers form a polymer in a slurry,~~

~~wherein the ratio of moles of polymer formed per mole initiator is in the range of 0.25 to 3.0 moles polymer per mole of initiator.~~

10. The polymerization method of any one of claims 1 to 9, wherein the ratio of moles of polymer formed per mole initiator is in the range of 0.25 to 3.0 moles polymer per mole of initiator.

~~13.~~11. An isoolefin-alkylstyrene polymer manufactured by the method of any one of claims 1 to ~~12~~ 10.

~~14.~~12. The polymer of claim ~~13~~ 11, wherein the polymer is blended to form a composition, the composition may further comprise:

a) at least one filler selected from calcium carbonate, clay, mica, silica, silicates, talc, titanium dioxide, starch, wood flour, carbon black, or mixtures thereof;

b) at least one inorganic nanoclay or organic nanoclay;

c) at least one processing oil;

d) at least one processing aid selected from plastomer, polybutene, polyalphaolefin oils, or mixtures thereof;

e) at least one curative;

f) a secondary elastomer;

g) a thermoplastic resin; or

h) any combination of a-g;

wherein the composition may optionally be used in a tire innerliner, a tire bladder, a curing bladder, a hose, a conveyor belt, or a pharmaceutical stopper.