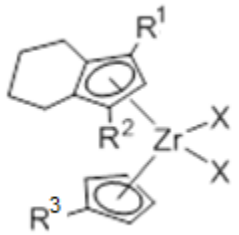
[0013a] In one aspect, the present disclosure refers to a polymerization catalyst having improved selectivity for ethylene enchainment, the polymerization catalyst comprising a zirconocene catalyst of Formula I:



(Formula I)

wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl group or hydrogen, and wherein R_3 is a C_1 alkyl or a linear C_3 alkyl.

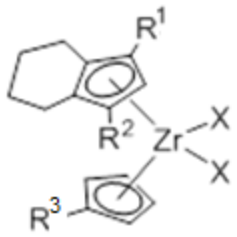
[0013b] In another aspect, the present disclosure refers to a bimodal polymerization catalyst system including the polymerization catalyst as disclosed herein and a non-metallocene olefin polymerization catalyst.

[0014] Further, the present disclosure provides bimodal polyethylene compositions including a high molecular weight polyethylene component and a low molecular weight polyethylene component having improved ethylene enchainment formed in a single reactor via a bimodal polymerization catalyst comprising a non-metallocene catalyst and a zirconocene catalyst of the Formula I, as described above.

[0014a] In another aspect, the present disclosure refers to a bimodal polyethylene composition having improved ethylene enchainment comprising a high molecular weight polyethylene component and a low molecular weight polyethylene component formed together in a single reactor via a bimodal polymerization catalyst system comprising:

a non-metallocene olefin polymerization catalyst; and

a zirconocene catalyst of the Formula I:



(Formula I)

wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl group or hydrogen, wherein R_3 is a C_1 alkyl or a linear C_3 alkyl, and wherein the low molecular weight polyethylene has a butyl branching frequency of from 0.43 to 0.72.

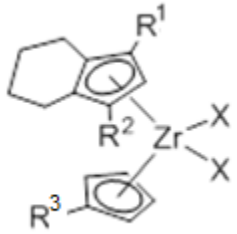
[0015] Furthermore, the present disclosure provides methods of producing polyethylene, the methods including polymerizing ethylene in a reactor in presence of a bimodal polymerization catalyst system to form the polyethylene, where the bimodal polymerization catalyst system includes a non-metallocene catalyst and a zirconocene catalyst of Formula I, as described above.

[0015a] In another aspect, the present disclosure refers to a method of producing a bimodal polyethylene having improved ethylene enchainment, the method comprising:

polymerizing ethylene in a reactor in presence of a bimodal polymerization catalyst system to form the bimodal polyethylene, wherein the bimodal polymerization catalyst comprises:

a non-metallocene catalyst; and

a zirconocene catalyst of Formula I:



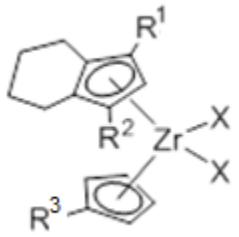
(Formula I)

wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl or hydrogen, and wherein R_3 is a C_1 alkyl or a linear C_3 alkyl.

Claims

What is claimed:

1. A polymerization catalyst having improved selectivity for ethylene enchainment, the polymerization catalyst comprising a zirconocene catalyst of Formula I:



(Formula I)

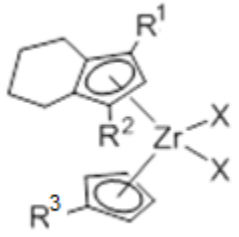
wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl group or hydrogen, and wherein R_3 is a C_1 alkyl or a linear C_3 alkyl.

2. A bimodal polymerization catalyst system including the polymerization catalyst of claim 1 and a non-metallocene olefin polymerization catalyst.

3. A bimodal polyethylene composition having improved ethylene enchainment comprising a high molecular weight polyethylene component and a low molecular weight polyethylene component formed together in a single reactor via a bimodal polymerization catalyst system comprising:

a non-metallocene olefin polymerization catalyst; and

a zirconocene catalyst of the Formula I:



(Formula I)

wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl group or hydrogen, wherein R_3 is a C_1 alkyl or a linear C_3 alkyl, and

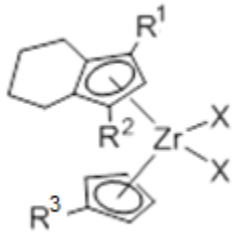
wherein the low molecular weight polyethylene has a butyl branching frequency of from 0.43 to 0.72.

4. A method of producing a bimodal polyethylene having improved ethylene enchainment, the method comprising:

polymerizing ethylene in a reactor in presence of a bimodal polymerization catalyst system to form the bimodal polyethylene, wherein the bimodal polymerization catalyst comprises:

a non-metallocene catalyst; and

a zirconocene catalyst of Formula I:



(Formula I)

wherein R_1 is a C_1 alkyl, wherein R_2 is a C_1 alkyl, wherein each X is independently a halide, C_1 to C_{20} alkyl, aralkyl or hydrogen, and wherein R_3 is a C_1 alkyl or a linear C_3 alkyl.