and extrusion coating applications. There is a further need for such processes that make optimal use of the coupling and/or branching component, while avoiding and minimizing preheater fouling and gel formation. These needs and others have been met by the following invention.

SUMMARY

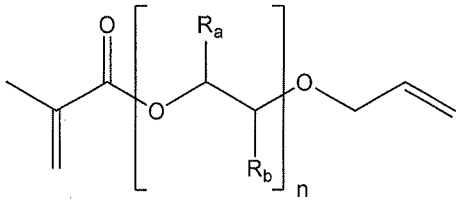
The disclosure provides a process to form an ethylene-based polymer, said process comprising polymerizing ethylene and at least one asymmetrical polyene comprising an "alpha, beta unsaturated – carbonyl end" ("α, β unsaturated – carbonyl end") and a "C-C double bond end," wherein the polymerization takes place in the presence of at least one free-radical initiator; and wherein the polymerization takes place in a reactor configuration comprising at least two reaction zones, reaction zone 1 and reaction zone i ($i \geq 2$), wherein reaction zone i is downstream from reaction zone 1.

In one aspect, there is provided a process to form an ethylene-based polymer, said process comprising polymerizing ethylene and at least one asymmetrical polyene, comprising an "alpha, beta unsaturated – carbonyl end" and a "C-C double bond end," and

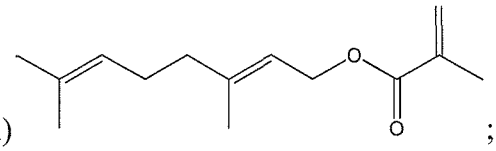
wherein the polymerization takes place in the presence of at least one free-radical initiator; and

wherein the polymerization takes place in a reactor configuration comprising at least two reaction zones, reaction zone 1 and reaction zone i ($i \geq 2$), wherein reaction zone i is downstream from reaction zone 1,

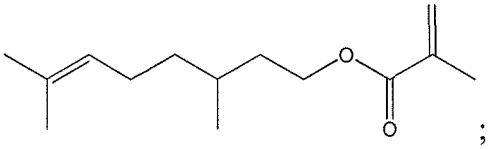
wherein the asymmetrical polyene is selected from the group consisting of the following:

i) 

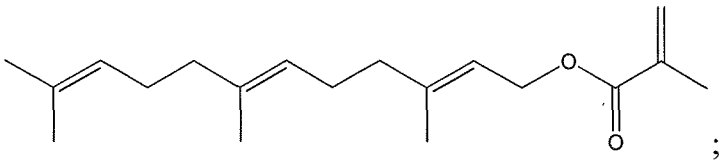
wherein n is from 1 to 50; Ra is selected from H or alkyl; Rb is selected from H or alkyl;

ii) 

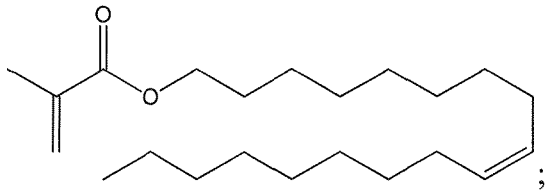
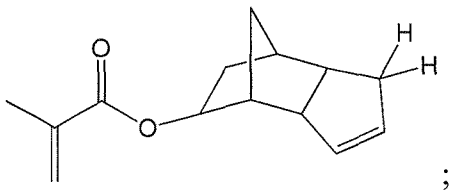
;

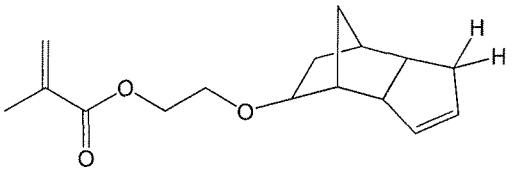
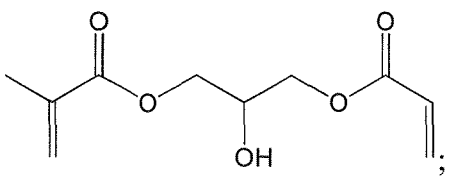
iii) 

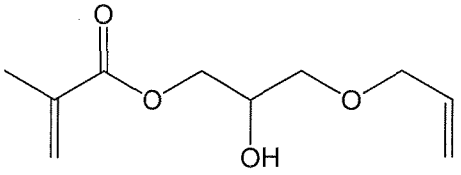
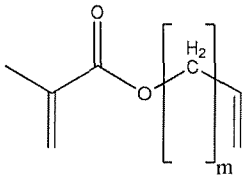
;

iv) 

;

v)  ; vi)  ;

vii)  ; viii)  ;

ix)  ; and x)  wherein m = 1 to 20.

In another aspect, there is provided an ethylene-based polymer formed from the process as defined herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a flow diagram for a LDPE process.

Figure 2 shows the temperature profile for the tubular configuration used in comparative polymerizations 1-2 and inventive polymerizations 1-3;

Figure 3 shows the temperature profile for the tubular configuration used in inventive polymerizations 4-6;

Figure 4 shows the temperature profile for the tubular configuration used in comparative polymerization 3 and inventive polymerizations 7-8;

Figure 5 shows the incorporation frequency of polyene (bifunctional component) into locally-formed polymer versus reactor length for comparative polymerizations 1-2 and inventive polymerizations 1-2;

Figure 6 shows the incorporation frequency of polyene (bifunctional component) into locally-formed polymer versus reactor length for inventive polymerizations 3-5;

Figure 7 shows the incorporation frequency of polyene (bifunctional component) into locally-formed polymer versus reactor length for inventive polymerizations 6-7;

Figure 8 shows the incorporation frequency of polyene (bifunctional component) into locally-formed polymer versus reactor length for comparative polymerization 3 and inventive polymerization 8.

Figure 9 shows the LCB frequency in locally-formed polymer versus reactor length for comparative polymerization 1 and inventive polymerizations 5-6.

Figure 10 shows a flow diagram for the polymerizations used for Inventive Example A' and inventive examples 1', 2' and 4'.

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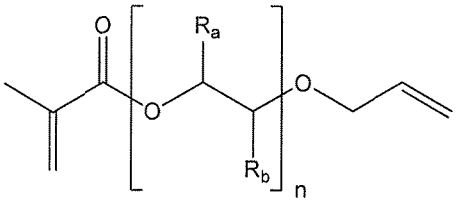
CLAIMS

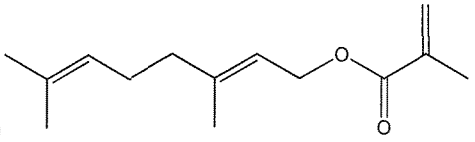
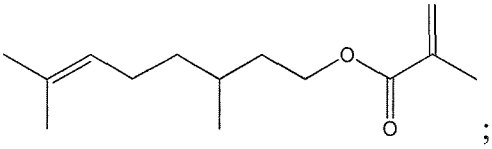
1. A process to form an ethylene-based polymer, said process comprising polymerizing ethylene and at least one asymmetrical polyene, comprising an "alpha, beta unsaturated – carbonyl end" and a "C-C double bond end," and

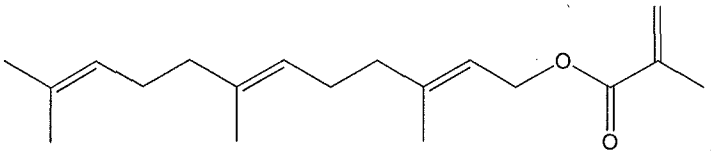
wherein the polymerization takes place in the presence of at least one free-radical initiator; and

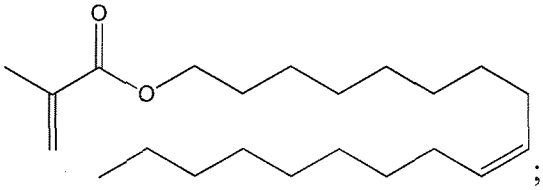
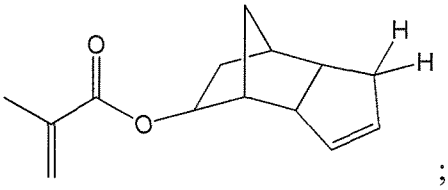
wherein the polymerization takes place in a reactor configuration comprising at least two reaction zones, reaction zone 1 and reaction zone i ($i \geq 2$), wherein reaction zone i is downstream from reaction zone 1,

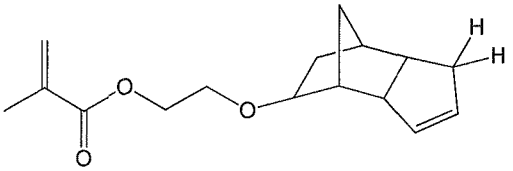
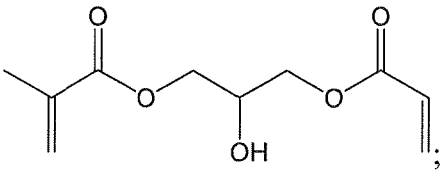
wherein the asymmetrical polyene is selected from the group consisting of the following:

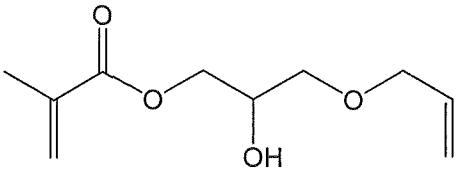
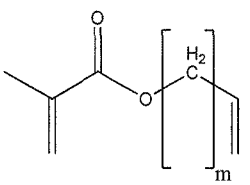
i)  wherein n is from 1 to 50; Ra is selected from H or alkyl; Rb is selected from H or alkyl;

ii)  ; iii)  ;

iv)  ;

v)  ; vi)  ;

vii)  ; viii)  ;

ix)  ; and x)  wherein m = 1 to 20.

2. The process of claim 1, wherein more polyene is added to reaction zone i compared to the amount of polyene added to reaction zone 1.

3. The process of claim 1, wherein more polyene is added to reaction zone 1 as compared to the amount of polyene added to reaction zone i.

4. The process of any one of the previous claims, wherein the polyene is fed through a compression stage of a secondary compressor, prior to being fed to a reaction zone.

5. The process of any one of claims 1, 2, 4 or 5, wherein ratio of "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone 1" to "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone 2 (i=2)" is less than or equal to 1.

6. The process of claim 5, wherein the ratio of "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone 1" to "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone i + 1" is less than 1; and wherein i is from 2 to n-1, and n = total number of reaction zones.

7. The process of any one of the previous claims, wherein the ratio of "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone i +1" to "the concentration of the polyene incorporated into the locally-formed polymer of reaction zone 2" is less than or equal to 1, wherein i is from 2 to n-1, and n = the total number of reaction zones.

8. The process of any one of the previous claims, wherein the ethylene fed to the first reaction zone is from 10 to 100 percent of the total ethylene fed to the polymerization.

9. The process of any one of the previous claims, wherein the maximum temperature of the first reaction zone is greater than the maximum temperature of each consecutive reaction zone downstream from the first reaction zone.

10. The process of any one of the previous claims, wherein at least one CTA is added to the polymerization.

11. The process of claim 10, wherein the CTA comprises at least one of the following groups: alkanes, aldehydes, ketones, alcohol, ether, ester, mercaptan or phosphine.

12. The process of any one of the previous claims, wherein the process takes place in a reactor configuration that comprises at least one tubular reactor.

13. The process of any one of the previous claims, wherein CTA is added to the polymerization in at least zones 1 and zone i, wherein $i \geq 1$, and wherein reaction zone i is downstream from reaction zone 1, and wherein the ratio of "the concentration of the CTA in the feed to reaction zone i" to "the concentration of the CTA in the feed to reaction zone 1" is greater than or equal to than 1.0.

14. An ethylene-based polymer formed from the process of any one of the previous claims.