[07] Therefore, there is a need for rapid processes and reagents that are useful for crystallizing PHA polymers. Such processes and reagents can be efficient, cost-saving, and suitable to large-scale processing of PHA materials.

SUMMARY

[08] The present disclosure provides a process for crystallizing a polymer having at least 20 mole percent of hydroxyalkanoate repeat units, comprising admixing the polymer and a compound with a crystal structure similar to the PHA crystal structure, such as pentaerythritol, providing heterogeneous nucleation sites.

[09] The present disclosure also provides a composition comprising a polymer having at least 20 mol percent of hydroxyalkanoate repeat units, and a compound that has allotropic character, such as sulfur and selenium.

[09a] In one aspect, the present disclosure provides a polymeric composition comprising:

a polymer including at least 20 mole percent hydroxyalkanoate repeat units, and

a nucleating agent, in an amount from about 0.01% to about 20% by weight of the polymer, wherein the nucleating agent is selected from the group consisting of (1) compounds having an orthorhombic crystal structure, (2) compounds having a hexagonal crystal structure, (3) compounds having a tetragonal crystal structure, (4) allotrophic elements having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, (5) polymorphic compounds having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, and (6) mixtures thereof.

[09b] In another aspect, the present disclosure provides a process for crystallizing a polymer, comprising the steps of:

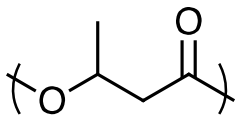
admixing a polymer including at least 20 mole percent of hydroxyalkanoate repeat units with a nucleating agent, in an amount from about about 0.01% to about 20% by weight of the polymer, at a first temperature, which is from about 5°C to about 15°C above the melting point of the polymer; and

cooling the mixture to a second temperature, which is from about the glass transition temperature of the polymer to about the melting point of the nucleating agent,

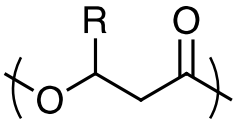
[010] wherein the nucleating agent is selected from the group consisting of (1) compounds having an orthorhombic crystal structure, (2) compounds having a hexagonal crystal structure, (3) compounds having a tetragonal crystal structure, (4) allotrophic elements having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, (5) polymorphic compounds having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, and (6) mixtures thereof.The present disclosure also provides a polymeric composition which includes at least a polymer and a nucleating agent, in an amount from about 0.01% to about 20% by weight of the polymer. The polymer including at least 20 mole percent hydroxyalkanoate repeat units. The nucleating agent is selected from the group consisting of (1) compounds having an orthorhombic crystal structure, (2) compounds having a hexagonal crystal structure, (3) compounds having a tetragonal crystal structure, (4) allotrophic elements having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, (5) polymorphic compounds having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, and (6) mixtures thereof.

[011] The present disclosure further provides a process for crystallizing a polymer. According to one embodiment, the process includes a first step of admixing a

Claim 20. The method of Claim 10, wherein the polymer has a first repeat unit having the structure:



and a second repeat unit having the structure:



wherein each R is independently a C_3 to C_{19} alkyl group, and

wherein the polymer includes from about 75 mole percent to about 99 mole percent of the first repeat unit and from about 1 mole percent to about 25 mole percent of the second repeat unit.

Claim 21. The method of Claim 10, wherein the nucleating agent is selected from the group consisting of (4) allotrophic elements having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, (5) polymorphic compounds having at least one crystalline form which is orthorhombic, hexagonal, or tetragonal, and (6) mixtures thereof; and

wherein the nucleating agent transitions from a crystalline form which is not orthorhombic, hexagonal, or tetragonal to a crystalline form which is orthorhombic, hexagonal, or tetragonal during the cooling step.