Fast Evaporating Polymers and Copolymers Cross-linking

Materials and processes for the creation of catalyzed de-polymerization of polymers

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Georgia Tech inventors have invented materials and processes for the creation of catalyzed de-polymerization of polymers, including the amplification of the catalyst. In catalyst amplification, small molecules within the polymer body of a device will create additional catalyst molecules upon contact with an initial photo-catalyst at a single trigger source. This allows for generation and amplification of acid catalysts in non-photosensitive regions, and thus increasing the rate of polymer decomposition while substantially reducing residue. Low ceiling temperature polymers are used so that they readily depolymerize when catalyzed. Cross-linking copolymers of phthalaldehyde (PHA) with other aldehydes improves the mechanical properties of the material. The cross-linking can be achieved by a number of mechanisms including free radical reactions of unsaturated carbon bonds. The researchers incorporated unsaturated aldehyde monomers into the polymer along with a free-radical generator additive. This crosslinking leads to increase in molecular weight of the polymer and opens up the possibility of addition of other polymers and other functional groups to obtain desired chemical properties. For packaging methods, potential options include a trigger, such as light or heat, to perform slow evaporation (over a few days or weeks) or fast evaporation over a few minutes.

Summary Bullets

- Incorporation of small molecules that are capable of amplification
- Residue reduction
- Waste elimination

Solution Advantages

- Incorporation of small molecules that are capable of amplification
- Residue reduction
- Waste elimination

Potential Commercial Applications

- Transient devices
- Electronic devices
- Sensors
- Polymer applications- plastics, coverings, structural elements, adhesives

Background and More Information

Rapid de-polymerization and evaporation of polymers is useful for fabricating systems that have a fixed lifetime or targeted end-of-life. De-polymerization can prevent device detection and capture or reduce disposal in landfills, making it desired in a wide array of polymer-based components, ranging from electronic sensors to parachutes. The de-polymerization reaction can be triggered by thermal, chemical, photo, or acoustic events at ambient conditions. Polymer disposal rate can be controlled via specific trigger sites that instigate catalyst diffusion and amplification. The modulus and toughness of the polymer can be modified by use of a series of additives and through cross-linking of one or more co-polymers.

Inventors

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IP Status

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Publications

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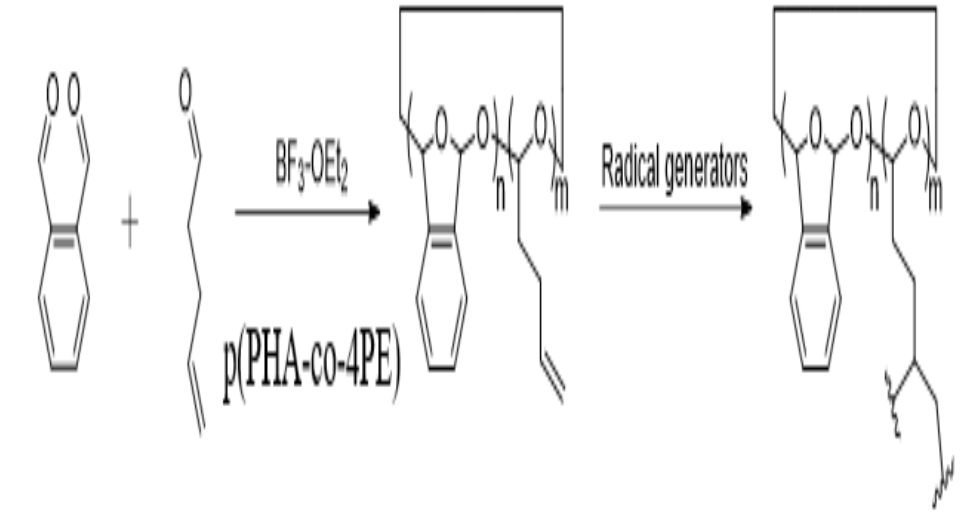
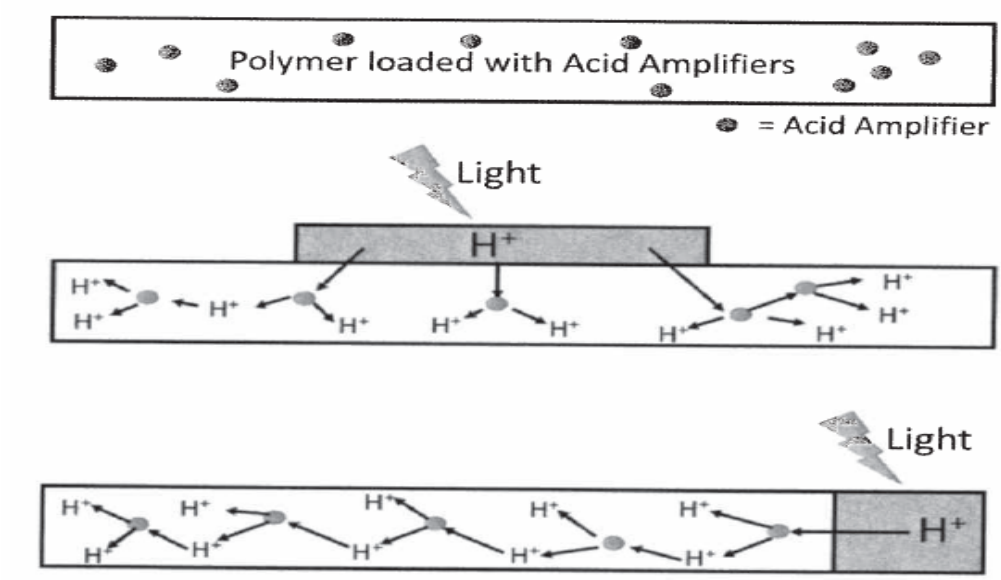
Images





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