Recyclable and Self-Healing Highly Branched Polymers

We are looking for partners for a joint development of this invention and its potential applications

This polymer enables material design based on the interactions of terminal groups in highly branched polymers, offering both recyclability and self-healing properties

◆Background

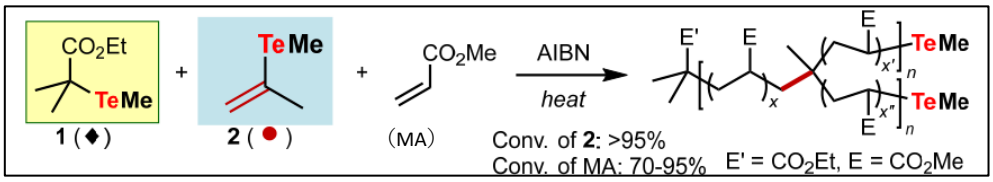
Plastics (synthetic polymers) are widely used as indispensable materials in modern society due to their high functionality and low cost. However, the large volume of used plastics has caused severe environmental issues. Traditional plastic recycling methods can be categorized into two types: physical recycling, which involves mechanical breakdown and separation of materials, and chemical recycling, which decomposes plastics into monomers. In general, the former leads to a decline in the physical properties and functionality of the recycled material, while the latter involves high environmental impact processes.

◆Description

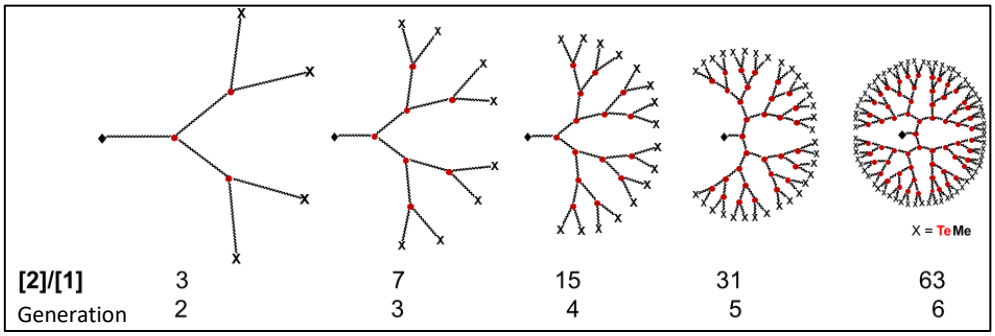
The inventors have developed a novel polymer synthesis method that replaces the conventional "polymer chain entanglement" in linear polymers with "interactions among the terminal groups of highly branched polymers." This approach allows for the simultaneous achievement of "elastomeric properties" and "degradability into monomers," or the ability to control the balance between the two. As a result, it enables the development of recyclable polymer materials. Furthermore, self-healing properties have also been observed, making this technology a promising solution to the global plastic waste problem.

[Key Features]

- **Hyperbranched Polymers**
  - Hyperbranched polymers with a controlled 3D dendritic structure can be synthesized via the living radical polymerization of monomer molecules (2)*, an organic tellurium polymerization control agent (1), and acrylic acid ester (MA) [Figure 1] (*JP6754124).
  - The synthesis process is simple, and the branching structure (branch number and branch density) can be easily controlled [Figrure 2].
- **Formation of “Polymer Aggregated States” via Terminal Group Interactions**
  By introducing interactive terminal groups at the ends of the multibranched polymer, a “polymer aggregated state” can be formed through terminal group interactions, which leads to plastic or elastomer physical properties appear.
- **Recyclability**
  The polymer can be easily decomposed into monomers through a low-energy process using a solvent.
- **Self-Healing Properties**



[Figure 1] Synthesis Method of Highly Branched Polymers



[Figure 2] Controlled Synthesis of Highly Branched Polymers Using a Novel Monomer. The reaction progresses to form a branched structure.

◆Development Stage

- Verification of elastomeric properties, self-healing ability, and recyclability.

◆Application Fields

- Adhesive,Viscosity modifiers
- Environmental materials (battery components etc.)
- Catalyst supports
- Additives for aviation fuels

◆Publications

- Hyperbranched Poly（octadecyl Acrylate）s as Lubricant Additive Studied by Resonance Shear Measurement
- OneStep_Synthesis_of_Dendritic_Highly_Branched_Polystyrenes..

◆Intellectual Properties

- Patent application filed
  Current
  Assignee: Kyoto University

◆Offers

- Joint research
- Licensing agreements
- Option contracts

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IAC Institutional Advancement and Communications

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