Upcycling of Polyolefins in Single-Use Plastics to Carbonyl-Functionalized Waxes

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BACKGROUND

Polyolefins are indispensable in everyday life. Because of their excellent chemical stability and their flexible physical properties, they are found in everything from automobiles to construction materials to packaging for many household products. Their inexpensive manufacturing costs have led to widespread use. However, consumer use of single-use plastics leads to relatively nonbiodegradable plastic waste. To reduce the environmental impact of this waste, the plastic can be recovered for mechanical recycling, but this process results in reduced thermal and mechanical robustness of the recycled plastic and only delays the waste's trip to the landfill. This limits the applications for recycled plastics, reducing the incentive for nonbiodegradable plastic recycling. There is a need for plastic upcycling technology that converts discarded plastics into value-added products that decompose relatively rapidly under natural conditions.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a solvent and catalyst free method of producing a variety of waxes by depolymerization of polypropylene (PP), polystyrene (PS), or polyethylene (PE), creating an opportunity to reduce the volume of non-biodegradable single-use polyolefin waste. Conventional wax materials are produced in a manner similar to polyolefins, using ethylene/propene as monomer units. However, this new process converts plastic waste to useful waxes at a mild reaction temperature (150 °C), using a peroxide solution in a closed reactor filled with either air or inert gas. The process only uses hydroperoxide sources without costly solvents or catalysts, which makes it more affordable in industrial applications. The oxidized waxes can be used in a multitude of applications such as lubricants, adhesives, paint additives, and more.

ADVANTAGES

- Upcycles widely available polyolefin waste into higher-value products
- Reduces downcycling or landfilling
- No solvents or catalysts are required thereby simplifying processing and lowering production costs
- Mild reaction temperature (~150 °C) reduces energy consumption versus harsher chemical recycling routes
- Operable in air or inert gas, providing flexibility for different processing environments
- The upcycled materials are useful in existing markets for waxes, lubricants, adhesives, and additives

APPLICATIONS

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OTHER INFORMATION

KEYWORDS

polyolefins, wax, waxes, carbonyl, plastic, plastic waste, lubricants, adhesives, paint, coatings, cosmetics, feedstock, chemicals, surfactants, biodegradable

CATEGORIZED AS

- **Materials & Chemicals**
  - Chemicals
  - Other

RELATED CASES

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- Industrial and automotive lubricants
- Hot-melt and pressure-sensitive adhesive formulations
- Paints, coatings, and ink additives to modify flow, gloss, or film properties
- Cosmetic and personal care wax components
- Packaging and release-agent applications
- Feedstock for further chemical modification to produce specialty chemicals, surfactants, or biodegradable materials

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Efficient and Selective Upcycling of Polyethylene to Alkylbenzenes under Moderate Hydrogen Pressure
- Catalytic Upcycling Of Hydrocarbon Polymers To High Value Unsaturated Compounds

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