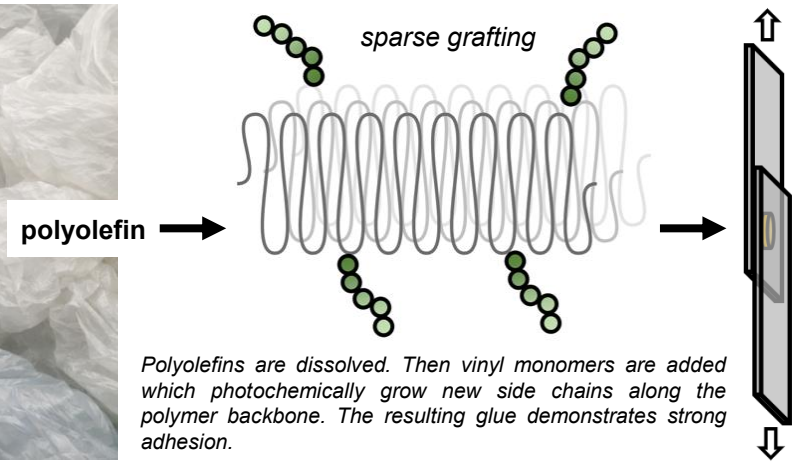
ETH zürich

Licensing Opportunity

Upcyling plastic bags into super glue



Polyolefins are dissolved. Then vinyl monomers are added which photochemically grow new side chains along the polymer backbone. The resulting glue demonstrates strong adhesion.

Application

This technology upgrades low-value polyolefin waste into high-value functional material. It enables manufacturers to add surface polarity and adhesion to commodity plastics without sacrificing the durability that makes polyolefins attractive in the first place. The scalable process applies to adhesives, packaging, composite manufacturing, and specialty plastics.

Features & Benefits

- Process preserves crystallinity and mechanical strength while adding functionality
- One-pot, photochemical process
- Works with major commodity polyolefins, no designer chain-transfer agents required

Publication

- "Direct Polymer-on-Polymer Grafting of Polyolefins under Visible Light", *J. Am. Chem. Soc.* **2026** https://doi.org/10.1021/jacs.5c21265
- Patent pending

Background

Polyolefins demonstrate high chemical resistance and mechanical robustness. These same characteristics make polyolefins difficult to recycle or chemically modify. Furthermore, their highly non-polar nature hinders the fabrication of composite materials. An effective upcycling strategy is sought that preserves the crystallinity and stiffness of the original polymer while enhancing the performance towards higher-value products such as adhesives.

Invention

The presented method upcycles PE, PP, LDPE, LLDPE, HDPE, iPP, PS and PMMA. Long polar side chains are introduced without disrupting the parent semicrystalline framework. As a result, the material exhibits increased surface polarity, adhesion, and interfacial compatibility.

In a first step a chlorinated aromatic solvent solubilizes the polyolefin creating a homogeneous reaction medium. This procedure overcomes the phase and mass-transfer limitations that often restrict conventional polyolefin modification to surfaces or heterogeneous interfaces.

The next step is the photochemical cleavage of C-Cl bonds from the chlorinated solvent. The chlorine radicals generate reactive sites along the polyolefin backbone. Long polymer chains grow outwards from the radical sites on the backbone. The process works with a range of vinyl monomers and is active throughout the bulk phase.

The method was successfully tested in the lab on upcyling LDPE into a high performing adhesive with 13.4 MPa lap-shear strength.

transfer

Invented by D-MATL

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Technology Readiness Level

1 2 3 **4** 5 6 7 8 9