TROY TECHNICAL

# POLYMERS & RESINS
# WEEKLY REPORT

October 31 - November 6, 2026 | Issue 2026-W44

**Qualification evidence across formulation, processing, durability and circularity**

| 12 | 10 |
| --- | --- |
| ANALYZED ARTICLES | PRIORITY THEMES |

Issued 2026-11-06 | English edition | fixed approved cover artwork



# Polymers & Resins: the boundary moved from isolated claims to qualification evidence

12 English articles were reviewed independently from the Japanese edition. Ten themes are retained for management decisions.

SIGNAL 01 | MOLECULE & FORMULATION

## PFAS Destruction: A Holdings' Subcritical Water Treatment Results

A Holdings and Suruga GX Technology achieved over 99.8% reduction of PFOS and PFOA in PFAS concentrates using low-temperature subcritical water treatment.

SIGNAL 02 | MATERIAL PRODUCTION

## Wind Turbine Blade Recycling: Flash Joule Heating for Upcycling

Researchers have developed a flash Joule heating process to convert decommissioned wind turbine blades into high-value silicon carbide and graphene.

SIGNAL 03 | PROCESSING

## PTP-based Plastics: OMU's Laplace Pressure Method for Degradability

Researchers at Osaka Metropolitan University (OMU) have utilized Laplace pressure in aqueous miniemulsions to increase the incorporation of 3-Phenylthionophthalid (PTP) into vinyl copolymers from 37% to 92%.

SIGNAL 04 | COMPONENT ADOPTION

## KRICT Oxide Hybrid Solid Electrolytes: Transfer Printing Specs

Researchers at KRICT have developed a "sticker-like" transfer printing process for garnet-type oxide solid electrolytes (LLZTO) that produces uniform layers of 15 µm over 120 cm2.

DECISION

**Focus this week's management attention on qualification evidence across formulation, processing, durability and circularity. Move only when the linked evidence can be reproduced under your own operating conditions.**

THREE MANAGEMENT MOVES

1. Buyers: select applications where performance data can justify qualification effort and switching cost.
2. Suppliers: provide process windows, reliability data, traceability and recovery economics with the material.
3. Executives: track scale, price, long-term reliability, regulation, recyclability and customer qualification.

EVIDENCE DISCIPLINE

FACT states what the collected English source reports. BUSINESS READ and ACTION are editorial interpretations. UNKNOWN lists information that the source file does not establish. A linked article is not treated as independent confirmation of every claim.

## Five numbers or evidence anchors that require conditions

**99.8%**
A06

SOURCE-BOUND CONDITION
A Holdings and Suruga GX Technology achieved over 99.8% reduction of PFOS and PFOA in PFAS concentrates using low-temperature subcritical water treatment.

**92%**
A02

SOURCE-BOUND CONDITION
This method reduces greenhouse gas emissions by up to 92% compared to current recycling techniques and offers a potential profit of $80 per ton.

**37%**
A07

SOURCE-BOUND CONDITION
Researchers at Osaka Metropolitan University (OMU) have utilized Laplace pressure in aqueous miniemulsions to increase the incorporation of 3-Phenylthionophthalid (PTP) into vinyl copolymers from 37% to 92%.

**120 cm**
A10

SOURCE-BOUND CONDITION
Researchers at KRICT have developed a "sticker-like" transfer printing process for garnet-type oxide solid electrolytes (LLZTO) that produces uniform layers of 15 µm over 120 cm2.

**4 hours**
A05

SOURCE-BOUND CONDITION
Kirin HD and Japan Steel Works have reduced the depolymerization time of polyethylene terephthalate (PET) from 4 hours to under 10 minutes.

HOW TO USE THESE NUMBERS
Each value is shown with the condition stated in the collected English article. Do not compare values across different test methods, device sizes, operating temperatures or commercial stages without normalizing those conditions.

## Where the value chain moved

Each stage combines one leading theme and one supporting theme. The report treats handoffs as evidence transfers, not decorative arrows.

1

### Molecule & formulation

P01/P06

A Holdings and Suruga GX Technology achieved over 99.8% reduction of PFOS and PFOA in PFAS concentrates using low-temperature.

2

### Material production

P02/P07

Researchers have developed a flash Joule heating process to convert decommissi oned wind turbine blades into high-value.

3

### Processing

P03/P08

Researchers at Osaka Metropolitan University (OMU) have utilized Laplace pressure in aqueous miniemulsions to increase the.

4

### Component adoption

P04/P09

Researchers at KRICT have developed a " sticker-like" transfer printing process for garnet-type oxide solid electrolytes.

5

### Recovery & reuse

P05/P10

Kirin HD and Japan Steel Works have reduced the depolymerization time of polyethylene terephthalate (PET) from 4 hours to.

EVIDENCE REQUIRED AT EACH HANDOFF

| | |
|---|---|
| Molecule & formulation to Material production | Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck scale, price, long-term reliability, regulation, recyclability and customer qualification. |
| Material production to Processing | Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck scale, price, long-term reliability, regulation, recyclability and customer qualification. |
| Processing to Component adoption | Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck scale, price, long-term reliability, regulation, recyclability and customer qualification. |
| Component adoption to Recovery & reuse | Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck scale, price, long-term reliability, regulation, recyclability and customer qualification. |

COMMON CONTROL POINT

**No theme moves to a commercial commitment until a named owner has reproduced the relevant evidence and documented scale, price, long-term reliability, regulation, recyclability and customer qualification.**

# Priority map: maturity and next decision locus




| | |
|---|---|
| P01 | PFAS Destruction: A Holdings' Subcritical Water Treatment Results<br>Tech / process \| cue: no system/business cue |
| P02 | Wind Turbine Blade Recycling: Flash Joule Heating for Upcycling<br>Tech / process \| cue: no system/business cue |
| P03 | PTP-based Plastics: OMU's Laplace Pressure Method for Degradability<br>Tech / process \| cue: no system/business cue |
| P04 | KRICT Oxide Hybrid Solid Electrolytes: Transfer Printing Specs<br>Business / rules \| cue: capacity |
| P05 | Kirin HD: PET Chemical Recycling via Mechanochemical Reaction<br>Tech / process \| cue: no system/business cue |
| P06 | Sodium Metal Batteries: PDES Electrolyte and 1,000-Cycle Stability<br>Business / rules \| cue: capacity |
| P07 | FDCA Production: Wood Sawdust-to-Plastic Process Efficiency 2026<br>Tech / process \| cue: no system/business cue |
| P08 | ETH Zurich Plastic Glue: Upcycling Polyolefins via Light-Induced Grafting<br>Tech / process \| cue: no system/business cue |
| P09 | Supramolecular Plastics: Ionic Association Modes and Recyclability<br>Tech / process \| cue: no system/business cue |
| P10 | Ulva lactuca Mulch Films: Soil-Degradable Specs and Growth Impact<br>Tech / process \| cue: no system/business cue |

**REPRODUCIBLE POSITIONING RULE**

Horizontal position uses five discrete stages: Research, Prototype, Joint evaluation, Product adoption and Scale. The vertical bands classify the next decision locus: Tech / process, System / adoption, or Business / rules (including supply systems). Article-title cues take precedence; the overview is used only when the title is silent. These are categories, not impact ranks. Bubble diameter reflects the editorial score.

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

## P01 PFAS Destruction: A Holdings' Subcritical Water Treatment Results

A06 | Molecule & formulation | Research

2026-11-02

FACT

A Holdings and Suruga GX Technology achieved over 99.8% reduction of PFOS and PFOA in PFAS concentrates using low-temperature subcritical water treatment. The process reduced concentrations of PFOS, PFOA, and PFHxS to below the detection limit of 50ng/L at approximately 220°C. This provides a potential non-incineration pathway for treating concentrated PFAS waste recovered from water sources.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P01.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 20/25 | MATURITY 1/5 | DECISION LOCUS: TECH / PROCESS

## P02 Wind Turbine Blade Recycling: Flash Joule Heating for Upcycling

A02 | Material production | Pilot

2026-11-06

FACT

Researchers have developed a flash Joule heating process to convert decommissioned wind turbine blades into high-value silicon carbide and graphene. This method reduces greenhouse gas emissions by up to 92% compared to current recycling techniques and offers a potential profit of $80 per ton.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P02.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

## P03 PTP-based Plastics: OMU's Laplace Pressure Method for Degradability

A07 | Processing | Pilot

2026-11-03

FACT

Researchers at Osaka Metropolitan University (OMU) have utilized Laplace pressure in aqueous miniemulsions to increase the incorporation of 3-Phenylthionophthalid (PTP) into vinyl copolymers from 37% to 92%. This method introduces thioester bonds as "predetermined breaking points," enabling the chemical splitting of plastics that are otherwise highly stable.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P03.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

## P04 KRICT Oxide Hybrid Solid Electrolytes: Transfer Printing Specs

A10 | Component adoption | Product adoption

2026-11-04

FACT

Researchers at KRICT have developed a "sticker-like" transfer printing process for garnet-type oxide solid electrolytes (LLZTO) that produces uniform layers of 15 µm over 120 cm2. This method significantly improves capacity retention and thermal stability compared to direct coating and conventional PE separators.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P04.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

## P05 Kirin HD: PET Chemical Recycling via Mechanochemical Reaction

A05 | Recovery & reuse | Research

2026-11-02

FACT

Kirin HD and Japan Steel Works have reduced the depolymerization time of polyethylene terephthalate (PET) from 4 hours to under 10 minutes. By utilizing a twin-screw kneading extruder to trigger mechanochemical reactions, the process significantly lowers energy consumption and equipment size. This breakthrough enables the semi-permanent recycling of PET into virgin-quality resin.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P05.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 1/5 | DECISION LOCUS: TECH / PROCESS

## P06 Sodium Metal Batteries: PDES Electrolyte and 1,000-Cycle Stability

A12 | Molecule & formulation | Product adoption

2026-10-31

FACT

Researchers at Chonnam National University developed a polymerizable deep eutectic solvent (PDES) electrolyte that enables sodium metal batteries to maintain 90.4% capacity after 1,000 cycles. By combining in-situ polymerization with a specific molecular design, the team achieved high ionic conductivity and enhanced safety against leakage and fire.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P06.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

## P07 FDCA Production: Wood Sawdust-to-Plastic Process Efficiency 2026

A09 | Material production | Product adoption

2026-11-01

FACT

Researchers have developed a three-stage "BMF-AMF-FDCA" process to convert non-edible wood sawdust into bio-plastic raw materials with over 99% purity. The method reduces greenhouse gas emissions by approximately 60% compared to edible sugar-based processes and achieves a total mass yield of 45.5% from wood sawdust.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P07.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 4/5 | DECISION LOCUS: TECH / PROCESS

## P08 ETH Zurich Plastic Glue: Upcycling Polyolefins via Light-Induced Grafting

A04 | Processing | Pilot

2026-11-06

FACT

Researchers at ETH Zurich have developed a method to convert waste polyethylene and polypropylene into a high-performance adhesive capable of lifting 20 kilograms with just 13 milligrams of material. By using visible light to graft polar polymer side chains onto non-polar plastic waste, the team has transformed disposable packaging into a technical material.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P08.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

## P09 Supramolecular Plastics: Ionic Association Modes and Recyclability

A03 | Component adoption | Pilot

2026-11-05

FACT

Researchers from the University of Science and Technology of China have developed high-strength, recyclable supramolecular plastics by controlling ionic association modes. The "fork-shaped" bridging architecture achieved a tensile strength of 96.56±4.73 MPa, providing a molecular design framework for sustainable materials that balance mechanical robustness with water-based recyclability.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P09.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

## P10 Ulva lactuca Mulch Films: Soil-Degradable Specs and Growth Impact

A08 | Recovery & reuse | Pilot

2026-11-06

FACT

Researchers developed soil-degradable mulch films using whole-biomass Ulva lactuca seaweed, which increased Italian red chicory leaf area by 18% compared to polyethylene mulch. The films utilize diglycerol and natural rubber latex to balance flexibility and water resistance, offering a sustainable alternative to synthetic plastics.

WHY IT MATTERS

The decision relevance is qualification evidence across formulation, processing, durability and circularity. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, provide process windows, reliability data, traceability and recovery economics with the material.

ACTION

Within 30 days, select applications where performance data can justify qualification effort and switching cost; record the evidence and owner against P10.

UNKNOWN

Still unproven or incompletely stated: scale, price, long-term reliability, regulation, recyclability and customer qualification.

EDITORIAL SCORE 19/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

# Playbook and 0-5 year roadmap

| STAKEHOLDER | NOW \| 0-30 DAYS | NEXT \| 1-12 MONTHS | LATER \| 1-5 YEARS |
|---|---|---|---|
| **Operating companies** | select applications where performance data can justify qualification effort and switching cost | Run production-like qualification with explicit acceptance and stop criteria. | Build a portfolio and architecture that can absorb technology and supplier changes. |
| **Materials, equipment and technology suppliers** | provide process windows, reliability data, traceability and recovery economics with the material | Create shared reliability, process-window and failure-analysis data with customers. | Standardize interfaces, traceability, lifecycle support and recovery services. |
| **Trading, investment and legal teams** | Map scale, price, long-term reliability, regulation, recyclability and customer qualification. | Contract for capacity, quality, change notice, liability, alternatives and exit. | Diversify regional, technical and customer concentration risk. |

ROADMAP

NOW | 0-30 DAYS
### Evidence ledger
Owner: Strategy + quality
Deliverable: claim, source, condition, owner

NOW | 0-30 DAYS
### Risk screen
Owner: Procurement + legal
Deliverable: unknowns, alternatives, stop

NEXT | 1-12 MONTHS
### Joint qualification
Owner: R&D + supplier
Deliverable: process window and failure data

NEXT | 1-12 MONTHS
### Commercial gate
Owner: Business + finance
Deliverable: unit economics and capacity

LATER | 1-5 YEARS
### Platform strategy
Owner: Executive team
Deliverable: portfolio and interface roadmap

LATER | 1-5 YEARS
### Service layer
Owner: Operations + channel
Deliverable: monitoring, maintenance and recovery

GO / NO-GO GATES

| GATE | OWNER | REQUIRED EVIDENCE | NO-GO CONDITION |
|---|---|---|---|
| **G1 Evidence** | **Quality** | Source, test conditions and reproducibility | No traceable evidence |
| **G2 Integration** | **R&D** | Interface, process window and failure analysis | Cannot meet system conditions |
| **G3 Commercial** | **Business** | Capacity, total cost, contract and alternatives | Economics or supply cannot be supported |
| **G4 Lifecycle** | **Operations** | Monitoring, maintenance, change notice and exit | No accountable operating plan |

## ANALYZED ARTICLES | ITEMS 01-12

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

| ID | FULL ARTICLE TITLE | FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE |
|---|---|---|
| A01 | Toray PPS Recycling: Solvent-Based Recovery Process and 2030 Timeline | https://www.chemengonline.com/solvent-based-technology-recovers-pps-from-waste-materials/ |
| A02 | Wind Turbine Blade Recycling: Flash Joule Heating for Upcycling | https://gizmodo.com/scientists-found-a-clever-second-life-for-dead-wind-turbine-blades-2000835746 |
| A03 | Supramolecular Plastics: Ionic Association Modes and Recyclability | https://news.qq.com/rain/a/20261105A02XH500 |
| A04 | ETH Zurich Plastic Glue: Upcycling Polyolefins via Light-Induced Grafting | https://www.forschung-und-wissen.de/nachrichten/chemie/13-milligramm-plastik-kleber-heben-20-kilogramm-gewicht-133715537 |
| A05 | Kirin HD: PET Chemical Recycling via Mechanochemical Reaction | https://newswitch.jp/p/50688 |
| A06 | PFAS Destruction: A Holdings' Subcritical Water Treatment Results | https://prtimes.jp/main/html/rd/p/000000003.000153264.html |
| A07 | PTP-based Plastics: OMU's Laplace Pressure Method for Degradability | https://www.trendsderzukunft.de/kunststoff-recycling-troepfchendruck-aktiviert-traegen-baustein-fuer-zerlegbare-kunststoffe |
| A08 | Ulva lactuca Mulch Films: Soil-Degradable Specs and Growth Impact | https://bioengineer.org/research-report-whole-biomass-ulva-lactuca-derived-soil-degradable-mulch-films-for-sustainable-agriculture/ |
| A09 | FDCA Production: Wood Sawdust-to-Plastic Process Efficiency 2026 | https://www.fnnews.com/news/202610301642245786 |
| A10 | KRICT Oxide Hybrid Solid Electrolytes: Transfer Printing Specs | https://www.newswise.com/articles/krict-develops-oxide-hybrid-solid-electrolytes-using-sticker-like-transfer-printing |
| A11 | PAN Membranes: Room-Temperature Crude Oil Separation Specs | https://www.sciencedaily.com/releases/2026/11/261103003207.htm |
| A12 | Sodium Metal Batteries: PDES Electrolyte and 1,000-Cycle Stability | https://xenospectrum.com/polymer-electrolyte-sodium-metal-battery-durability/ |

# Polymers_Resins — Selected Articles

Date: 2026-11-08

Articles: 12

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#05 Kirin HD: PET Chemical Recycling via Mechanochemical Reaction

#06 PFAS Destruction: A Holdings' Subcritical Water Treatment Results

#07 PTP-based Plastics: OMU's Laplace Pressure Method for Degradability

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#12 Sodium Metal Batteries: PDES Electrolyte and 1,000-Cycle Stability

# #01 Toray PPS Recycling: Solvent-Based Recovery Process and 2030 Timeline

Published November 01, 2026 Chemical Engineering USA



## OVERVIEW

Toray Industries Inc. has developed the industry's first solvent-based recycling process to recover high-purity polyphenylene sulfide (PPS) from automotive waste. The method maintains polymer structure and molecular weight comparable to virgin material, offering a lower-emission alternative to chemical and mechanical recycling.

## IN DEPTH

### Key Findings

Toray Industries Inc. has developed a solvent-based recycling process capable of recovering polyphenylene sulfide (PPS) from automotive waste while maintaining a molecular weight, melting point, and crystallization temperature similar to virgin PPS. A preliminary lifecycle-analysis study indicates that PPS produced via this technology may reduce cradle-to-gate greenhouse gas emissions compared to virgin material production.

### Technical Details

The process leverages the unique solubility characteristics of PPS to selectively recover the material in its polymer form. The technical workflow consists of the following steps:

- **Dissolution:** A proprietary solvent is used to dissolve PPS-containing waste materials.
- **Separation:** A solid-liquid separation step removes insoluble materials, including metal contaminants and glass fibers found in PPS composites.
- **Recovery:** The PPS is recovered through crystallization.

By avoiding the depolymerization and repolymerization required in chemical recycling, this solvent-based route is expected to provide substantial energy savings. Unlike conventional mechanical recycling, this method removes impurities without degrading the polymer structure.

### Background & Context

PPS is a high-performance thermoplastic used extensively in automotive glass-fiber-reinforced components due to its thermal and mechanical properties. However, recycling is typically difficult due to impurity separation challenges and the risk of polymer degradation during mechanical processing. Toray developed this process to address demand driven by end-of-life vehicle regulations, such as those recently introduced in the E.U.

## Significance & Outlook

Toray is currently verifying the continuous operation of the process and evaluating additional application-relevant properties. The company has identified three primary challenges for commercial-scale production: securing waste feedstock supplies, demonstrating large-scale continuous operation, and establishing customer acceptance for recycled PPS. Toray aims to begin commercial supply of the recycled PPS in 2030 and intends to explore the future reuse of recovered glass fibers.

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Source: https://www.chemengonline.com/solvent-based-technology-recovers-pps-from-waste-materials/

Collected: November 07, 2026 | Automated Research System (AI)

# #02 Wind Turbine Blade Recycling: Flash Joule Heating for Upcycling

Published November 06, 2026 Gizmodo USA



## OVERVIEW

Researchers have developed a flash Joule heating process to convert decommissioned wind turbine blades into high-value silicon carbide and graphene. This method reduces greenhouse gas emissions by up to 92% compared to current recycling techniques and offers a potential profit of $80 per ton.

## IN DEPTH

### Key Findings

A study published in the journal Chem Circularity demonstrates a method to upcycle low-value wind turbine blade waste into high-value manufacturing materials. By utilizing flash Joule heating, researchers converted approximately 56% of a waste mixture into a composite consisting of 66% graphene and 34% silicon carbide. Integrating just 0.3% of these recovered materials by weight into resin improved tension resistance by 27% and bending resistance by 9%, while a 0.1% weight addition increased thermal diffusivity by 41%.

### Technical Details

Wind turbine blades are typically composed of fiberglass (containing silica) and carbon-rich polymer resin. The researchers employed flash Joule heating, which applies a high-current electrical pulse to conductive raw materials, raising temperatures to 2,000 degrees Celsius or higher within milliseconds. At these temperatures, carbon reacts with silica to form silicon carbide—a heat-resistant compound—and reorganizes into graphene. The process was tested using a mixture of pulverized blade waste and nearly pure elemental carbon.

### Background & Context

The extreme durability of turbine blades makes them difficult to break down, often resulting in them being sent to landfills. Current recycling alternatives are costly and carbon-intensive; pyrolysis costs roughly $460 per ton, and chemical dissolution costs about $1,800 per ton. In contrast, the flash Joule heating approach cuts greenhouse gas emissions by 92% and 83% compared to chemical dissolution and heat recovery, respectively.

## Significance & Outlook

The process presents a potential shift toward a closed-loop manufacturing system where retired blades enhance the durability of new ones. While the recovered materials could generate a profit of $80 per ton, scaling remains a primary challenge. Experiments have progressed from 10-gram batches to a 200-gram reactor, though lead author Hao Bi of Tsinghua University notes that further optimization is required to ensure uniform heating and consistent product quality before the technology can be deployed at real wind farms.

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Source: https://gizmodo.com/scientists-found-a-clever-second-life-for-dead-wind-turbine-blades-2000835746

Collected: November 07, 2026 | Automated Research System (AI)

# #03 Supramolecular Plastics: Ionic Association Modes and Recyclability

Published November 05, 2026 腾讯新闻（高分子科学前沿） China



## OVERVIEW

Researchers from the University of Science and Technology of China have developed high-strength, recyclable supramolecular plastics by controlling ionic association modes. The "fork-shaped" bridging architecture achieved a tensile strength of 96.56±4.73 MPa, providing a molecular design framework for sustainable materials that balance mechanical robustness with water-based recyclability.

## IN DEPTH

### Key Findings

The study demonstrates that the mechanical properties of supramolecular plastics are directly governed by the relationship between ionic association modes, network organization, and macro-performance. Specifically, a "fork-shaped" bridging association mode significantly enhances strength and modulus compared to "ribbon-like" single-point pairing. The material with the fork-shaped architecture (IA-3) reached a tensile strength of 96.56±4.73 MPa and a lap shear strength on ceramics of 31.6±3.9 MPa, capable of supporting a 60 kg volunteer with a 2.5 $cm^2$ adhesion area.

### Technical Details

The researchers designed two primary ionic association units using poly(diallyldimethylammonium chloride) (PDAD) combined with carboxylate, sulfonate, or phosphonate groups. These were processed via liquid-liquid phase separation in an aqueous phase to create wet precursors, which were then dried into transparent plastics with light transmittance of approximately 92–93%.

- **Ribbon-like Mode (IA-1, IA-2):** Characterized by 1:1 molar ratios of PDAD to anionic components. Molecular dynamics simulations show a relatively parallel, side-by-side chain arrangement with larger radii of gyration. Tensile strengths were measured at 64.20±4.78 MPa and 60.39±2.30 MPa.
- **Fork-shaped Mode (IA-3):** Characterized by a 2:1 PDAD to PVPS ratio. This creates a more compact, constrained network where PDAD chains wrap around PVPS chains.

The materials exhibit hysteresis loops during cyclic loading-unloading, with structural rearrangement and recovery observed after a 5-minute rest period.

### Background & Context

Beyond mechanical strength, the study evaluated thermal stability via in-situ variable-temperature FTIR (30–200 °C) and 3D TG-IR (up to 800 °C). The researchers also tested biocompatibility through CCK-8 and hemolysis experiments. Functional applications include a flexible humidity sensor based on IA/LiCl for detecting oral and nasal expiration.

## Significance & Outlook

Because the ionic associations are reversible, these plastics can be processed, reshaped, and chemically recycled in mild aqueous conditions without irreversible chain degradation. The extension of this system to natural polymers like sodium hyaluronate demonstrates a closed-loop cycle of rehydration and dilution-induced regeneration.

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Source: https://news.qq.com/rain/a/20261105A02XH500

Collected: November 07, 2026 | Automated Research System (AI)

# #04 ETH Zurich Plastic Glue: Upcycling Polyolefins via Light-Induced Grafting

Published November 06, 2026 Forschung und Wissen Germany



## OVERVIEW

Researchers at ETH Zurich have developed a method to convert waste polyethylene and polypropylene into a high-performance adhesive capable of lifting 20 kilograms with just 13 milligrams of material. By using visible light to graft polar polymer side chains onto non-polar plastic waste, the team has transformed disposable packaging into a technical material.

## IN DEPTH

### Key Findings

A research team led by polymer chemist Tae-Lim Choi at ETH Zurich has successfully produced a high-performance adhesive from used polyolefins, specifically polyethylene and polypropylene. In load tests, 13 milligrams of this adhesive were sufficient to lift a weight of 20 kilograms. The material demonstrates strong adhesion to metal, glass, and wood, with shear tests on aluminum showing strength significantly exceeding that of commercial hot-melt adhesives. In some cases involving glass samples, the glass broke before the adhesive bond failed.

### Technical Details

The process, developed significantly by Hongsik Kim, utilizes chlorinated aromatic solvents and 390 nanometer violet light to initiate a chemical restructuring. The light reaction creates short-lived chlorine radicals that remove hydrogen atoms from the carbon chains of the plastic, creating active centers. Vinyl monomers then attach to these centers and grow into long polymer side chains. Specifically, a variant using poly(N-ethylacrylamid) side chains provided superior adhesion by introducing polar groups to the naturally non-polar surface of the polyolefins.

To ensure stability, the team balanced the radical concentration via solvent choice and wavelength; excessive radical formation would damage or cross-link the main chains, while insufficient activation would prevent side chain growth. The resulting adhesive achieved a strength of 13.4 Megapascal.

### Background & Context

Unlike traditional pyrolysis, which uses heat to break plastics down into smaller hydrocarbons for raw material reprocessing, this method preserves the existing polymer as a supporting structure. This "targeted functionalization" differs from other recycling methods that convert plastic waste into hydrogen. While some existing research focuses only on surface treatment, the ETH Zurich process allows polymer chains to grow throughout the entire dissolved starting material.

## Significance & Outlook

The process has been scaled beyond tiny samples to a double-digit gram range, proving that light can penetrate the reaction mixture due to the optical properties of the solvent. The method requires no metal catalysts or specialized radical starters. However, the industrial application depends on the safe management and recovery of chlorinated solvents. Initial tests show the adhesive is robust, retaining 88 percent of its adhesive strength after water exposure.

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Source: https://www.forschung-und-wissen.de/nachrichten/chemie/13-milligramm-plastik-kleber-heben-20-kilogramm-gewicht-133715537

Collected: November 07, 2026 | Automated Research System (AI)

# #05 Kirin HD: PET Chemical Recycling via Mechanochemical Reaction

Published November 02, 2026　ニュースイッチ（日刊工業新聞）　Japan



## OVERVIEW

Kirin HD and Japan Steel Works have reduced the depolymerization time of polyethylene terephthalate (PET) from 4 hours to under 10 minutes. By utilizing a twin-screw kneading extruder to trigger mechanochemical reactions, the process significantly lowers energy consumption and equipment size. This breakthrough enables the semi-permanent recycling of PET into virgin-quality resin.

## IN DEPTH

### Key Findings

Kirin HD has successfully accelerated the depolymerization of polyethylene terephthalate (PET), reducing the processing time from 4 hours to less than 10 minutes. This was achieved by employing a twin-screw kneading extruder developed by Japan Steel Works. The process enables chemical recycling (CR), which breaks plastic down to the molecular level to produce recycled resins equivalent in quality to virgin raw materials.

### Technical Details

The system utilizes "alkaline depolymerization" using a sodium hydroxide aqueous solution as a solvent. While traditional methods rely on high temperature and high pressure over long durations, Kirin HD applied "mechanochemical reactions." By using the extruder's twin screws to rub, crush, and mix the PET with the sodium hydroxide solution, the chemical reaction is triggered mechanically.

- **Energy Efficiency:** The heat generated by the mechanochemical reaction is utilized for the depolymerization process, reducing the external thermal energy required.
- **Capacity:** A single unit, measuring several meters in length, can process 10,000 tons of PET products per year.
- **Footprint:** The equipment allows for significant downsizing compared to existing chemical recycling facilities.

### Background and Context

Chemical recycling of PET has existed since the 2000s, but high energy consumption and associated costs have hindered widespread adoption. Kirin HD's R&D Package Innovation Institute sought to overcome these cost barriers by pursuing a "high-speed, short-time" concept to minimize energy expenditure.

### Significance and Outlook

The current output of the process consists of disodium terephthalate and ethylene glycol. The next research phase focuses on refining these materials by removing sodium and impurities to return them to PET raw materials, as existing purification technologies remain cost-prohibitive.

Once commercialized, the technology will not be limited to beverage bottles; it is intended to process all PET products, including films and fibers, creating a large-scale resource circulation loop.

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Source: https://newswitch.jp/p/50688

Collected: November 07, 2026 | Automated Research System (AI)

# #06 PFAS Destruction: A Holdings' Subcritical Water Treatment Results

Published November 02, 2026 PR TIMES（株式会社Aホールディングス） Japan



## OVERVIEW

A Holdings and Suruga GX Technology achieved over 99.8% reduction of PFOS and PFOA in PFAS concentrates using low-temperature subcritical water treatment. The process reduced concentrations of PFOS, PFOA, and PFHxS to below the detection limit of 50ng/L at approximately 220°C. This provides a potential non-incineration pathway for treating concentrated PFAS waste recovered from water sources.

## IN DEPTH

### Key Findings

In a treatment test using actual samples, A Holdings and its group company, Suruga GX Technology, demonstrated the ability to decompose PFAS concentrates. Under specific conditions involving additives, the concentrations of PFOS, PFOA, and PFHxS were reduced to below the analytical detection limit of 50ng/L. Quantitatively, this represents a reduction of 99.89% or more for PFOS and 99.999% or more for PFOA.

### Technical Details

The samples used in the test were "floss" (foam-like concentrates) recovered from a demonstration plant at the Miho Rainwater Pumping Station in Shizuoka City. The initial concentrations in the floss were 46,000ng/L for PFOS and 66,000,000ng/L for PFOA. The treatment utilized a 2-liter subcritical water apparatus, which maintains water in a liquid state under pressure below its critical point (374°C and 22.1MPa). While PFAS decomposition typically requires temperatures above 300°C, this method achieved results at approximately 220°C with a processing time of 60 minutes by utilizing additives to facilitate the reaction.

### Background and Context

PFAS are synthetic organofluorine compounds known as "forever chemicals" due to their resistance to natural degradation. In Japan, PFOS and PFOA became subject to water quality standards for drinking water starting April 2026. While Suruga GX has already demonstrated a 99% reduction in raw water (from 3,400ng/L to 5ng/L) using dissolved air flotation, the subsequent disposal of the resulting concentrates remains a challenge. Subcritical water treatment was selected as an alternative to incineration for the decomposition of these concentrates.

## Significance and Outlook

The group intends to optimize processing conditions and scale up the system to integrate the removal and decomposition stages at the demonstration plant. Future goals include "fluorine recycling" to recover and reuse fluorine from the treated residue. Additionally, A Holdings is developing mobile, small-scale subcritical water units and researching the decomposition of organic waste into fertilizers at a laboratory within Osaka University.

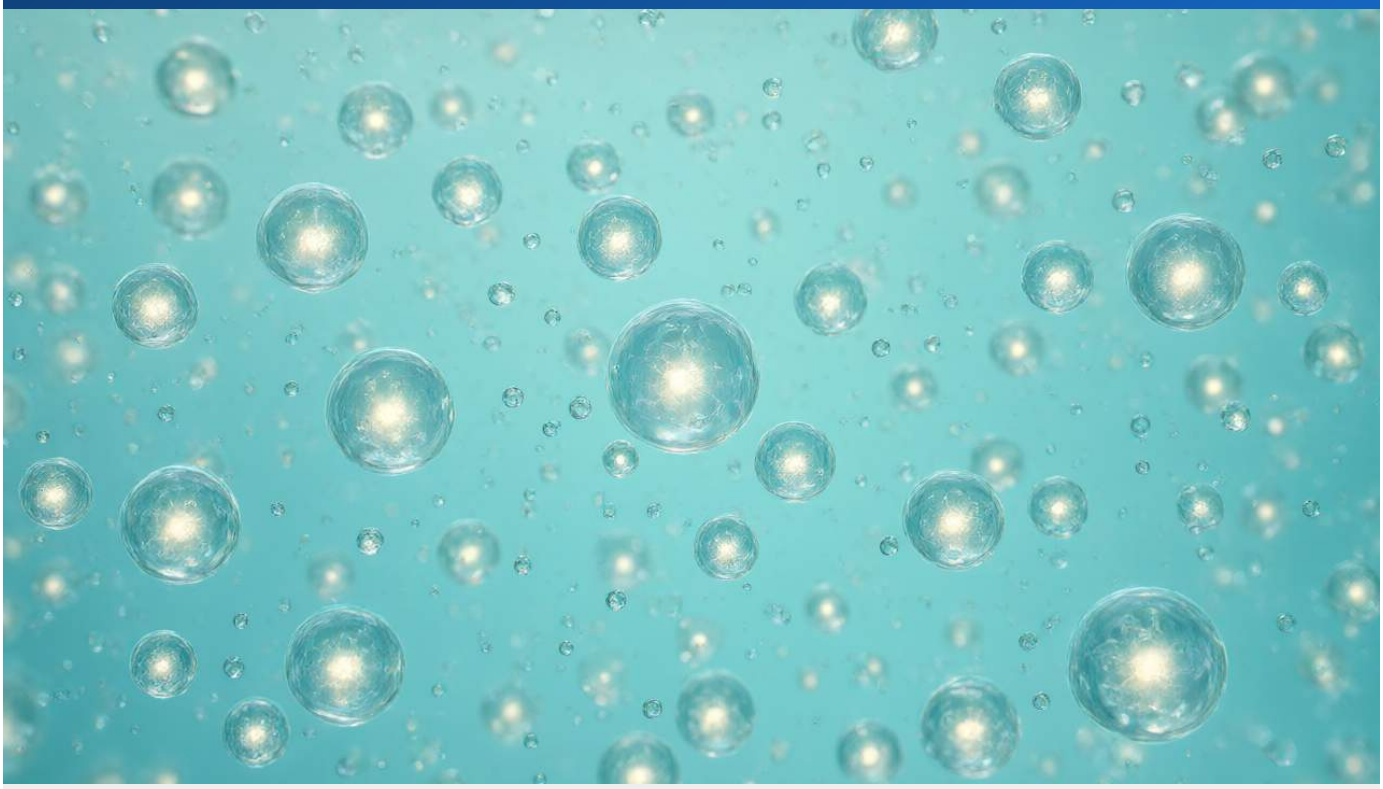
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Source: https://prtimes.jp/main/html/rd/p/000000003.000153264.html

Collected: November 07, 2026 | Automated Research System (AI)

# #07 PTP-based Plastics: OMU's Laplace Pressure Method for Degradability

Published November 03, 2026 Trends der Zukunft Germany



## OVERVIEW

Researchers at Osaka Metropolitan University (OMU) have utilized Laplace pressure in aqueous miniemulsions to increase the incorporation of 3-Phenylthionophthalid (PTP) into vinyl copolymers from 37% to 92%. This method introduces thioester bonds as "predetermined breaking points," enabling the chemical splitting of plastics that are otherwise highly stable.

## IN DEPTH

### Key Findings

A research team led by Yukiya Kitayama at Osaka Metropolitan University (OMU) has developed a method to incorporate 3-Phenylthionophthalid (PTP) into polymer chains to create degradable plastics. By conducting the reaction within an aqueous miniemulsion, the team increased the conversion rate of PTP from 37% in standard solutions to 92%. This process results in vinyl copolymer particles containing thioester bonds that act as chemical breaking points.

### Technical Details

The increase in PTP incorporation is driven by Laplace pressure, where surface tension compresses the contents of a droplet. The effect is inversely proportional to the droplet radius:

- Droplets with a diameter of approximately 130 nanometers generated an additional pressure of about 77 kilopascal, favoring the opening of the PTP ring.
- Droplets with a diameter of five micrometers generated only about 7.3 kilopascal.

Control tests in a pressure reactor showed that while additional pressure above 40 kilopascal increased PTP conversion to over 60%, it simultaneously hindered the reaction of n-butylacrylate. The miniemulsion approach overcomes this by providing a second effect: the spatial separation of reactive chain ends within droplets, which reduces the frequency of chain termination. The combination of Laplace pressure and spatial separation enables the efficient incorporation of both monomers.

### Background & Context

Conventional plastics are durable due to carbon-carbon backbone bonds that resist heat, moisture, and mechanical stress, leading to the persistence of microplastics in the environment. To counter this, chemists use ring-shaped molecules to create splittable bonds. PTP is a candidate for providing these thioester bonds, but it is typically inert under standard conditions.

## Significance & Outlook

Laboratory tests confirmed that particles containing PTP showed a decrease in average molecular mass when treated with amines or a base, whereas particles without PTP remained largely unchanged. However, the study did not demonstrate complete degradation, nor were tests conducted in soil, seawater, or with microorganisms. Kitayama notes that the method avoids complex special procedures, potentially easing industrial adoption, provided further tests on material performance and large-scale production are successful.

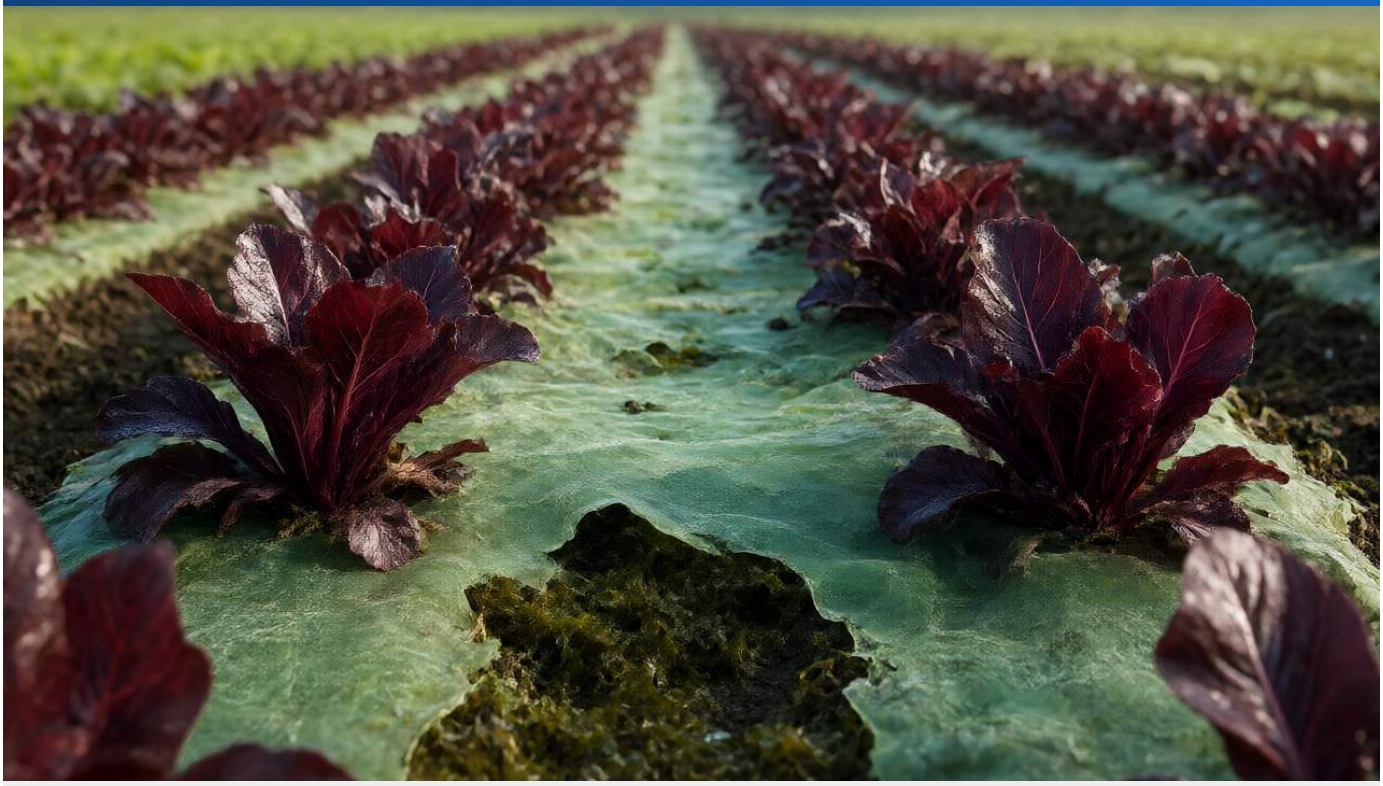
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Source: https://www.trendsderzukunft.de/kunststoff-recycling-troepfchendruck-aktiviert-traegen-baustein-fuer-zerlegbare-kunststoffe

Collected: November 07, 2026 | Automated Research System (AI)

# #08 Ulva lactuca Mulch Films: Soil-Degradable Specs and Growth Impact

Published November 06, 2026 BIOENGINEER.ORG



## OVERVIEW

Researchers developed soil-degradable mulch films using whole-biomass Ulva lactuca seaweed, which increased Italian red chicory leaf area by 18% compared to polyethylene mulch. The films utilize diglycerol and natural rubber latex to balance flexibility and water resistance, offering a sustainable alternative to synthetic plastics.

## IN DEPTH

### Key Findings

Plants grown under Ulva lactuca-derived seaweed mulch exhibited superior growth compared to those under black polyethylene mulch or no mulch. Specifically, Italian red chicory plants showed an 18% larger leaf area than those under polyethylene and a 16% larger area than unmulched controls. Fresh weight was 32% higher than the bare-soil control and 14% higher than the polyethylene treatment.

### Technical Details

The films were produced by subjecting ground seaweed powder (finer than 50 micrometers) to mild alkaline hydrolysis using 1 M ammonium hydroxide at 40 °C for 24 hours. To reduce brittleness, diglycerol was added as a plasticizer; a 20% formulation (HU_20DG) provided the optimal balance of strength and flexibility. To improve water resistance, natural rubber latex from Hevea brasiliensis was blended into the base at 10, 20, and 30 weight percent.

- **Water Solubility:** Films with 20% and 30% latex showed solubility values 10% and 32% lower, respectively, than those with little or no latex.
- **Optical Properties:** Films without latex or with 10% latex transmitted less than 5% of incident light (400–700 nm). Transmittance rose to below 15% with 20% latex and approximately 30% with 30% latex.
- **Mechanicals:** At 30% latex, Young’s modulus dropped to 19.6 megapascals and tensile strength fell to 2.64 megapascals, while elongation at break reached 28%.

### Degradability and Performance

Soil burial tests of 20DG20LX films in potting soil (60% moisture, 21 ± 2 °C) showed a mass loss of 16% after seven days, 62% after 15 days, and 65.18% after one month. By 60 days, the films exhibited rupture and fragmentation. While mechanically inferior to low-density polyethylene, PLA, and PHA, the researchers judged the performance sufficient for greenhouse applications.

## Significance and Outlook

The seaweed mulch's ability to promote growth over synthetic alternatives remains unresolved, though researchers suggest the gradual release of natural compounds from the U. lactuca biomass may be a contributing factor.

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Source: https://bioengineer.org/research-report-whole-biomass-ulva-lactuca-derived-soil-degradable-mulch-films-for-sustainable-agriculture/

Collected: November 07, 2026 | Automated Research System (AI)

# #09 FDCA Production: Wood Sawdust-to-Plastic Process Efficiency 2026

Published November 01, 2026 파이낸셜뉴스 South Korea



## OVERVIEW

Researchers have developed a three-stage "BMF-AMF-FDCA" process to convert non-edible wood sawdust into bio-plastic raw materials with over 99% purity. The method reduces greenhouse gas emissions by approximately 60% compared to edible sugar-based processes and achieves a total mass yield of 45.5% from wood sawdust.

## IN DEPTH

### Key Findings

A research team led by Dr. Hwang Dong-won of the Korea Research Institute of Chemical Technology and Professor Han Ji-hoon of Pohang University of Science and Technology has successfully optimized the production of 2,5-furandicarboxylic acid (FDCA), a bio-based alternative to petroleum-derived terephthalic acid used in PET bottles. The process achieves a final FDCA purity of over 99% while significantly reducing high-pressure reactions and purification steps.

### Technical Details

The developed "BMF-AMF-FDCA linked process" consists of three stages:

- **Stage 1 (Cellulose to BMF):** Using sulfuric acid and bromide salts, cellulose is converted to BMF at atmospheric pressure. This biphasic system moves unstable intermediate substances into an oil layer to prevent byproduct formation. BMF yield reached a maximum of 82%, with productivity over three times higher than reported CMF/BMF processes. Halogen-based substance usage was reduced by more than 30 times compared to hydrochloric acid-based CMF processes.
- **Stage 2 (BMF to AMF):** BMF is converted to AMF at 25°C. In a 1L reactor, a single pass yielded over 95%. Using regenerated ion-exchange resin, the process maintained a 97% AMF yield over 15 repeated operations.
- **Stage 3 (AMF to FDCA):** AMF is oxidized directly without additional purification to produce FDCA.

The total mass yield of FDCA was 56.8% (molar yield 59%) based on cellulose and 45.5% (molar yield 47.2%) based on wood sawdust, surpassing the 32.7% cellulose-based yield reported by the University of Groningen in 2022.

### Background & Context

While FDCA is typically produced from fructose or sugar derived from corn, wood-based research faces challenges due to the rigid structure of wood and the instability of intermediate substances. This new process eliminates the need for high-pressure reactions and minimizes solvent replacement or separate purification of intermediates.

## Significance & Outlook

Life cycle assessment (LCA) simulations indicate that producing 1kg of FDCA via this method emits 2.77kg of CO2 equivalent, roughly 60% lower than the 6.91kg emitted by edible sugar processes. Fossil resource use was reduced by 47.9%. Future research will focus on verifying manufacturing costs and large-scale continuous operation.

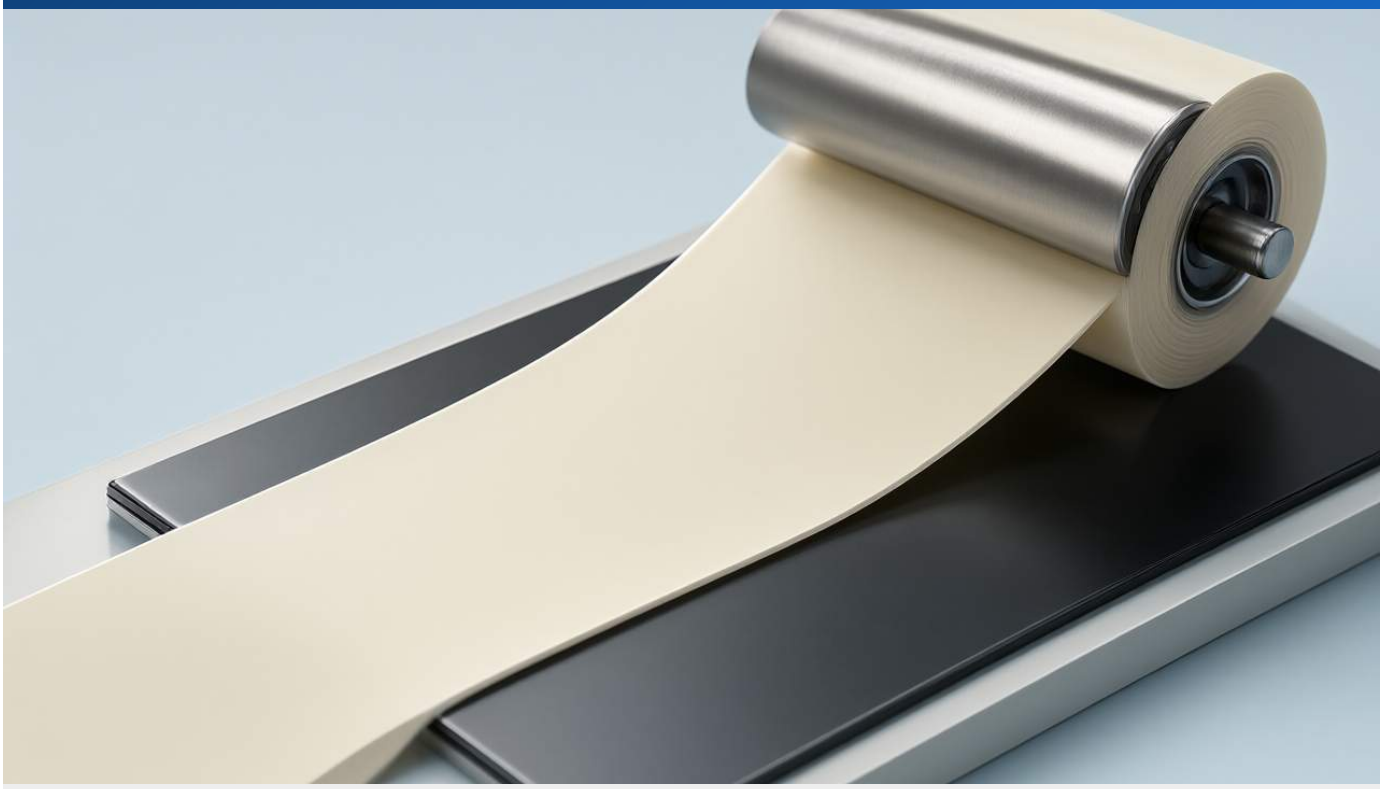
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Source: https://www.fnnews.com/news/202610301642245786

Collected: November 07, 2026 | Automated Research System (AI)

# #10 KRICT Oxide Hybrid Solid Electrolytes: Transfer Printing Specs

Published November 04, 2026 Newswise South Korea



## OVERVIEW

Researchers at KRICT have developed a "sticker-like" transfer printing process for garnet-type oxide solid electrolytes (LLZTO) that produces uniform layers of 15 μm over 120 cm². This method significantly improves capacity retention and thermal stability compared to direct coating and conventional PE separators.

## IN DEPTH

### Key Findings

The transfer printing method achieved a uniform solid electrolyte layer over an area of 6 × 20 cm (120 $cm^2$) with an average thickness of 15 μm and a deviation of approximately 1 μm. In contrast, direct coating produced nonuniform thicknesses ranging from 10 to 25 μm over a smaller 6 × 11 cm area. Performance metrics showed that cells fabricated via transfer printing retained 83.6% of their capacity after 100 charge-discharge cycles, while directly coated cells retained only 36.1%.

### Technical Details

The process involves coating and drying a solid electrolyte slurry on a PET-PDMS substrate, then using a roller to pressure-laminate and transfer the thin layer onto an electrode. To optimize this without trial-and-error, the team utilized Hansen solubility parameters (HSPs) to quantify material affinity:

- **Coating step:** High-affinity combinations were selected to ensure uniform spreading.
- **Transfer step:** Low-adhesion combinations were selected to allow clean detachment from the substrate.

The resulting hybrid solid electrolyte reached an ionic conductivity of $2.83 \times 10^{-4}$ S/cm at 25°C and a $Li^+$ transference number of 0.69, nearly double the 0.36 measured in the PE separator control.

### Background & Context

High-energy-density solid-state batteries require electrolyte layers thinner than 20 μm. However, freestanding films typically require 70–120 μm to prevent tearing, and direct slurry coating often leads to electrode deformation and nonuniformity as the liquid infiltrates the porous electrode.

## Significance & Outlook

The technology enhances safety; in pouch-cell tests at 150°C for 2 hours and 30 minutes, the transfer-printed cell remained stable, whereas the PE separator-based cell suffered an internal short circuit and voltage drop after approximately 10 minutes. The research team suggests that combining HSP data with actual results could enable AI-based prescreening of candidate materials. The study was published in *Advanced Functional Materials* in September 2026.

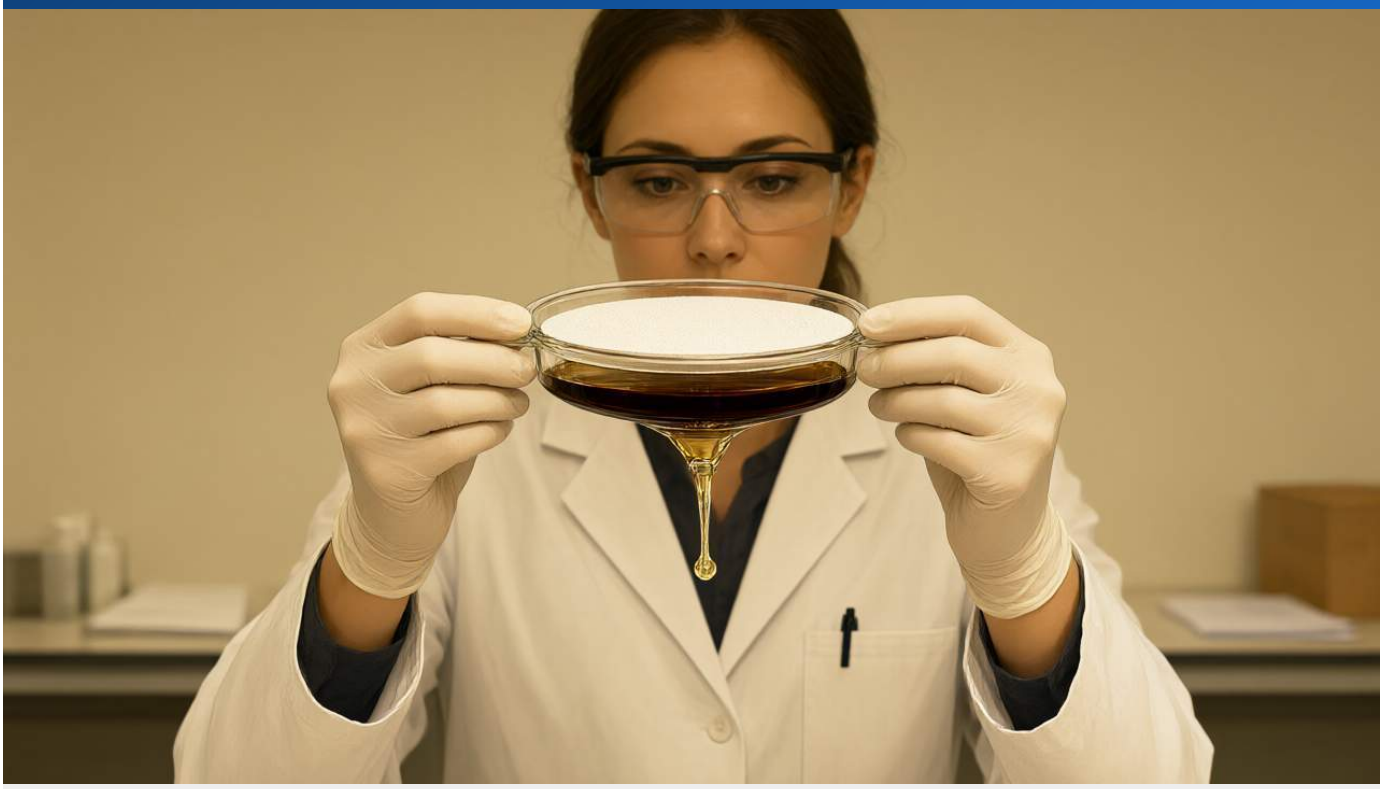
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Source: https://www.newswise.com/articles/krict-develops-oxide-hybrid-solid-electrolytes-using-sticker-like-transfer-printing

Collected: November 07, 2026 | Automated Research System (AI)

# #11 PAN Membranes: Room-Temperature Crude Oil Separation Specs

Published November 05, 2026 ScienceDaily USA



## OVERVIEW

Researchers from KAIST and Georgia Tech have developed a porous polyacrylonitrile (PAN) membrane that separates crude oil at room temperature. The technology could reduce oil refining energy consumption by 31.6% and carbon dioxide emissions by 37.6%.

## IN DEPTH

### Key Findings

A research team led by Professor Dong-Yeun Koh (KAIST) and Professor Ryan Lively (Georgia Tech) has demonstrated a membrane capable of separating crude oil without the need for heating. The uncoated PAN membrane achieved crude oil permeation rates approximately 23 times higher than previous leading separation membranes and maintained stable performance for 28 consecutive days.

### Technical Details

Unlike traditional membranes that require expensive, thin specialized coatings, this system uses a bare membrane made from porous polyacrylonitrile (PAN), a chemically stable polymer. The separation mechanism relies on a phenomenon typically viewed as a failure: fouling. As crude oil passes through the membrane, heavier hydrocarbon molecules accumulate on the inner walls of the pores. This buildup creates narrow channels measuring less than 2 nanometers across, which allow lighter fractions—such as naphtha, gasoline, and kerosene—to pass through while blocking heavier substances.

### Background and Context

Conventional oil refining relies on distillation, which requires heating oil to temperatures above 350 °C. This process is extremely energy-intensive, consuming approximately 1,100 terawatt-hours (TWh) annually worldwide—an amount comparable to the output of roughly 130 nuclear power plants with one-gigawatt capacities. While membranes have been explored as alternatives to avoid extreme temperatures, previous designs were hindered by the high cost and fragility of the required precision coatings.

## Significance and Outlook

The PAN membrane can be implemented as a modular filtration system installed before conventional distillation equipment, meaning refineries would not need to replace existing infrastructure. Computer simulations indicate that this integration could lead to a 36% decrease in operating costs and a 20.7% reduction in cooling water consumption. If adopted across Korea's refining and petrochemical industries, researchers estimate the system could prevent approximately 10 million tonnes of greenhouse gas emissions annually.

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Source: https://www.sciencedaily.com/releases/2026/11/261103003207.htm

Collected: November 07, 2026 | Automated Research System (AI)

# #12 Sodium Metal Batteries: PDES Electrolyte and 1,000-Cycle Stability

Published October 31, 2026 XenoSpectrum South Korea



## OVERVIEW

Researchers at Chonnam National University developed a polymerizable deep eutectic solvent (PDES) electrolyte that enables sodium metal batteries to maintain 90.4% capacity after 1,000 cycles. By combining in-situ polymerization with a specific molecular design, the team achieved high ionic conductivity and enhanced safety against leakage and fire.

## IN DEPTH

### Key Findings

A research team led by Professor Chan-Jin Park at Chonnam National University has developed a PDES-1 electrolyte that allows a sodium metal battery full cell to maintain 90.4% of its initial capacity after 1,000 cycles at a 2C rate. In a sodium symmetric cell, the electrolyte demonstrated stable plating and stripping for over 1,000 hours. Additionally, the PDES-1 electrolyte exhibited an ionic conductivity of 1.39 mS/cm at 30°C and a sodium-ion transference number of 0.58, which is higher than the 0.2–0.4 typically found in liquid electrolytes.

### Technical Details

The PDES-1 electrolyte consists of three components: sodium perchlorate (NaClO4), N-isopropylacrylamide (NIPAM) as a polymerizable monomer, and succinonitrile (SN) as a plasticizer. The team utilized "in-situ polymerization," where the liquid deep eutectic solvent is injected into the cell and then thermally polymerized into a flexible polymer matrix. This approach ensures better contact with the electrode surface compared to pre-solidified electrolytes.

- **Electrochemical Stability:** The electrolyte demonstrated a wide potential window of 5.0 V.
- **Rate Performance:** In a full cell using a sodium vanadium phosphate (Na3V2(PO4)3) cathode, the discharge capacity was 110.2 mAh/g at 0.1C and remained at 90 mAh/g even at a 5C rate.
- **Safety:** The polymer matrix is non-flammable and resists leakage. In pouch cell demonstrations, the battery continued to power an LED even after being folded or cut with scissors.

### Background and Significance

Sodium metal batteries are targeted for higher energy density than standard sodium-ion batteries by replacing hard carbon anodes with metallic sodium. However, metallic sodium is highly reactive and prone to dendrite growth, which can cause short circuits. The PDES-1 design mitigates these issues by forming a stable interface layer that suppresses non-uniform sodium deposition.

## Outlook and Challenges

While promising for energy storage systems (ESS) and backup power, the study was limited to laboratory-scale coin and pouch cells. Future validation is required for large-scale cells, specifically regarding the uniformity of electrolyte penetration in thick electrodes, the minimum required electrolyte volume, and safety evaluations based on international industrial standards.

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Source: https://xenospectrum.com/polymer-electrolyte-sodium-metal-battery-durability/

Collected: November 07, 2026 | Automated Research System (AI)