CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Are you an AICIS registrant? You must provide information about any introduction of 522 listed PFAS

2025-10-29

On 13 October 2025, our Executive Director initiated an evaluation on 522 per- and poly-fluoroalkyl substances (PFAS) in Australia under section 74 of the Industrial Chemicals Act 2019. As part of the evaluation, we require information on any introduction and use of these 522 listed PFAS between 1 September 2023 and 31 August 2025.

If you were registered with us during the 2023–24 and 2024–25 registration years, you should have received our email notice on 21 October 2025. You can use your unique link to the online electronic form in your email notice to give us the required information. Responses are due by 16 December 2025.

You must still respond to the notice even if you did not introduce any of the 522 listed PFAS, or if you don't know.

Thank you to the more than 20% of registrants that have responded so far. Your information will be valuable in our evaluation of these chemicals.

For more details, read the:

- website notice about the PFAS information requirement
- announcement on the evaluation of PFAS.

Commonly asked questions

We've published answers to your questions about how to respond to the email notice.

Read More

AICIS, 29-10-25

https://www.industrialchemicals.gov.au/consumers-and-community/per-and-polyfluoroalkyl-substances-pfas

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AMERICA

California Announces Development of Public Health Goal for PFHxS

2025-10-30

By developing a public health goal, California is advancing regulation of PFHxS in drinking water. Our Environment, Land Use & Natural Resources Group explains how this move signals continued state-level action despite shifts in federal oversight.

- The state claims 130 public water systems serving 9.7 million Californians are affected by PFHxS contamination
- Creating a public health goal for PFHxS is required before setting enforceable maximum contaminant levels (MCL) for state drinking water
- Public water systems could use a new MCL to sue companies allegedly responsible for groundwater contamination

On October 3, 2025, California's Office of Environmental Health Hazard Assessment (OEHHA) announced the development of a public health goal (PHG) for perfluorohexane sulfonic acid (PFHxS) contamination in drinking water. PFHxS is a manmade chemical used in commercial products for its water- and stain-repellent properties and in firefighting foam.

Read More

JD Supra, 30-10-25

https://www.jdsupra.com/legalnews/california-announces-development-of-3851683/

Even low PFAS in drinking water raise blood levels, California study shows

2025-11-02

A new California study reveals that "safe" levels of PFAS in tap water may still lead to elevated toxic chemicals in the bloodstream, raising new concerns about everyday exposure and regulatory limits.

In a recent article in the Journal of Exposure Science & Environmental Epidemiology, researchers examined blood chemical levels in adults exposed to per- and polyfluoroalkyl substances (PFAS) through public drinking water systems.

Their findings suggest that even in areas without industrial PFAS manufacturing, people can be significantly exposed to these "forever chemicals" through contaminated drinking water, requiring ongoing monitoring.

PFAS Persistence and Environmental Impact

PFAS are man-made chemicals used for resistance to heat, stains, and water. They persist in the environment and human body, accumulating in water and living organisms due to their long half-lives.

Major Human Exposure Pathways

Humans are mainly exposed through contaminated water and food. There is also exposure via skin contact, dust, or consumer products. Certain PFAS have been linked to health problems such as cancer, hormone disruption, reduced birth weight, and immune system effects.

Read More

News Medical, 02-11-25

https://www.news-medical.net/news/20251102/Even-low-PFAS-in-drinking-water-raise-blood-levels-California-study-shows.aspx

Whistleblower sounds alarm about radioactive spill at US facility: 'This never should have happened'

2025-11-03

Journalists are calling attention to a spill of radioactive wastewater from a treatment facility along the Susquehanna River in Pennsylvania. And whistleblowers say the problem has been years in the making.

What's happening?

On Aug. 17, the state's Department of Environmental Protection confirmed that around 16,000 gallons of wastewater leaked from a 26,000-gallon storage tank at a Eureka Resources treatment plant. The "oily" fluid ended up in the river, leaving a sheen on the water. This prompted the DEP to take action to limit the spread.

The DEP later confirmed to the Public Herald that the discharge had stopped. However, the company was already under scrutiny. In 2024, whistleblowers accused Eureka Resources of environmental crimes involving radioactive fracking wastewater, leading to an investigation from the Public Herald.

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Eureka entered into a consent order and agreement with the DEP in early 2025, allowing it to continue operating. Eureka continued storing radioactive fluids even after it had stopped treatment operations. But records show the company violated parts of that agreement not long after signing it.

Read More

TCD, 03-11-25

https://www.thecooldown.com/green-business/eureka-resources-radioactive-wastewater-facility-leak/

EUROPE

EU Ecolabel hits record numbers as green opportunities for businesses and consumers grow

2025-10-09

Italy tops the rankings in terms of products certified under the scheme, followed closely by Spain, France and Germany.

EU Ecolabel hits record numbers as green opportunities for businesses and consumers grow

Italy tops the rankings in terms of products certified under the scheme, followed closely by Spain, France and Germany.

The EU Ecolabel has reached a historic milestone: more than 109,096 products now covered by 3,384 licences across Europe carry its trusted logo – the widest range of eco-friendly choices ever available under the scheme.

The EU Ecolabel is gaining momentum, offering new opportunities for businesses and greener choices for consumers. Since March 2025, certified products have increased by 7% (+6,723), while licences have grown by 4% (+136).

SMEs & European leadership

Small and medium-sized enterprises (SMEs) play a central role in the success of the EU Ecolabel. They make up 57% of all licence holders, showing that Europe's green transition is being driven from the ground up.

With 97% of licences based in the European Economic Area, local businesses are turning sustainable ideas into tangible solutions that benefit both markets and the environment.

Some countries are emerging as clear leaders in EU Ecolabel certification. Italy tops the rankings with 17% of all certified products, followed by Spain (15%), France (12%) and Germany (9%).

Together, these four countries account for more than half of the EU Ecolabel's presence across Europe, underlining their strong commitment to sustainable production and consumption.

At the same time, Denmark, Czechia, Portugal and Sweden are steadily expanding their eco-labelled offerings, confirming that demand for sustainable products is spreading across Europe.

Read More

EC Environment, 09-10-25

https://environment.ec.europa.eu/news/eu-ecolabel-hits-record-numbers-green-opportunities-grow-2025-10-09_en

Call for evidence for the Advanced Materials Act

2025-10-23

Advanced materials are designed to have new or enhanced properties and/or targeted or enhanced structural features intended to achieve specific or improved functional performance. Examples include bio-based materials with enhanced insulation and circularity capacity, and recyclable carbon reinforced plastics for windmill blades or aerospace applications.

These materials provide innovative solutions for a more efficient, sustainable and competitive industry, playing a key role in achieving the EU objectives of strengthening competitiveness and achieving climate neutrality by 2050, as outlined in the Clean Industrial Deal.

The Advanced Materials Act will make production smarter by supporting investments in critical production capacities in the EU. It will also tackle shortcomings in the development, production and uptake of advanced materials.

The consultation will collect evidence, experience and views from stakeholders about the EU's R&I ecosystem for advanced materials and how it could be improved to boost EU competitiveness. The results of the consultation will help the Commission to solve the problems identified on

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the basis of the evidence obtained and to take due consideration of the potential solutions when developing the initiative.

Read about the call for evidence here and give your feedback. Open from 21 October 2025 to 13 January 2026.

Read More

European Union, 23-10-25

https://circulareconomy.europa.eu/platform/en/news-and-events/all-news/call-evidence-advanced-materials-act

Commission proposes targeted measures to ensure the timely implementation of EU Deforestation Regulation

2025-10-21

The Commission is today proposing targeted solutions to support companies, global stakeholders, third countries and Member States to ensure a smooth implementation of the EU Deforestation Regulation (EUDR).

With today's proposal, the Commission wants to make sure that the IT system is fully operational to address the EU's contribution to the global challenge of deforestation. At the same time, the proposal will simplify reporting obligations, notably for micro and small primary operators from low risk countries worldwide, while maintaining a robust tracking mechanism.

The EUDR is a key initiative to fight deforestation. The Commission is committed to pursuing its objectives.

Key measures

Taking into account feedback from stakeholders in the context of the Commission's simplification efforts throughout the year, the Commission proposal introduces targeted simplifications to reduce obligations for:

- Operators and traders that commercialise the relevant EUDR products once they have been placed on the EU market. These can be, for example, retailers or large EU manufacturing companies. These

companies are in the downstream part of the relevant value chains. The upstream operator will continue to exercise due diligence.

Read More

European Commission, 21-10-25

https://ec.europa.eu/commission/presscorner/detail/en/ip_25_2464

Calculating the environmental impact of the Dutch healthcare sector

2025-11-01

Method report

The healthcare sector in the Netherlands emits greenhouse gases, for example, through energy use required to heat hospitals, the use of anaesthetic gases, and the production of medicines. Healthcare-related emissions account for approximately 7% of the total emission of greenhouse gases, both in the Netherlands and abroad. Reducing emissions in the healthcare sector contributes to achieving Dutch climate goals. To lower these emissions it is essential to identify which healthcare sectors have the greatest environmental impact.

For a more precise understanding the RIVM has enhanced its method for calculating the environmental footprint of healthcare. In addition to climate impact this method looks at wider environmental effects, relevant to the circular economy and biodiversity. The previous method (2022) provided useful insights but lacked details or granularity per healthcare sector and product group. Additionally, it could not be used for repeated calculations of environmental impact. The improved method addresses these limitations, offering policy makers and healthcare professionals better insights into the environmental burden of different healthcare sectors. The new method consists of two models. The basic model can be used immediately and provides an overview of how different healthcare sectors contribute to the environmental impact. The specific model offers more detailed insights into the contributions of specific product groups and services. The data required for this model is highly fragmented and found across multiple organisations.

Close collaboration between healthcare organisations is crucial for obtaining and centralising the required data. Additionally, standardized data collection is essential to ensure comparability across different

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sources. The RIVM will work with healthcare professionals to discuss these challenges and will conduct pilot projects to refine data collection.

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RIVM, 01-11-25

https://www.rivm.nl/bibliotheek/rapporten/2025-0096.pdf

Plastic pellet regulation: the Rethink Plastic alliance welcomes the EU Parliament's green light

2025-10-21

After 2 years of negotiations, the Regulation on preventing pellet losses to reduce microplastic pollution has finally been formally approved by the European Parliament, paving the way for its publication in the Official Journal and entry into force in the coming weeks.

As pellet pollution is a daily reality for citizens – such as in Tarragona (Spain) or Ecaussinnes (Belgium) – Rethink Plastic alliance (RPa) welcomes this long-awaited Regulation which we have advocated for over a decade (see the note to the editor below).

The final regulation marks a significant step towards a concrete "Zero Pellet Loss" objective and follows a comprehensive supply chain approach, introducing measures on prevention, adapted packaging, staff training, mandatory certification of conformity issued by an accredited certifier for medium and large operators.

By mandating annual reporting on pellet losses for both EU and non-EU carriers, the European Union sends a strong global message that compliance and accountability are essential to tackling this major source of microplastic pollution.

Still, RPa is disappointed that Small and Medium Enterprises (SMEs) managing fewer than 1,500 tonnes per year per installation will fall outside the regulation's ambition, facing only reduced obligations, such as a one-off certification five years after the regulation comes into effect. This represents a major loophole that risks undermining ambition in the new Regulation.

Read More

Rethink Plastic alliance, 21-10-25

https://rethinkplasticalliance.eu/news/plastic-pellet-regulation-the-rethink-plastic-alliance-welcomes-the-eu-parliaments-green-light/

INTERNATIONAL

Breaking down PFAS: Why forever chemicals are so hard to remove

2025-10-23

Forever chemicals have been around for decades, but they don't owe their longevity to chemistry alone. Is their time running out?

The discovery of forever chemicals' adverse health risks is almost as old as the invention of PFAS chemistry. Considering the decades of research detailing the toxicity of these artificial substances to lab animals and humans, it would be safe to presume that they would've gone the way of asbestos by now – except they haven't.

Forever chemicals continue to permeate the planet, leaving everyone's lives unchecked. These synthetic compounds may be durable by design, but their chemical makeup no longer has anything to do with their persistence.

Suppliers continue to lie about them

PFASs are hard to remove from society because they generally fly under the radar. While the authorities have done an excellent job of informing the public of their dangers, their usual exclusion from ingredient labels and material safety sheets diminishes the effectiveness of awareness drives.

Read More

Innovation News Network, 23-10-25

https://www.innovationnewsnetwork.com/breaking-down-pfas-why-forever-chemicals-are-so-hard-to-remove/62782/

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BIR Bangkok 2025 – Stainless Steel & Special Alloys Committee: More restrictive trade likely for the stainless sector

2025-10-29

"Challenging" and "uncertain" were words used to describe the state of the global stainless steel markets at the BIR World Recycling Convention in Bangkok, Thailand.

During the Stainless Steel & Special Alloys Committee meeting on 28 October, chaired by Joost van Kleef of Oryx Stainless BV (NLD), topics included the shift from globalisation to regionalisation, restrictions, tariffs and changing trade flows.

The opening 'BIR World Mirror' summary report, given by Vegas Yang, CEO, HSKU Raw Material Ltd (TWN), revealed that the market in China continues to be weak following the tariff war, while US tariffs are one of the challenges facing the growing market in India.

But in the US, the stainless market was described as "healthy", supported by the 50% import tariff, with information showing domestic melt rates above 80% capacity. Local mills in the US are reported to be profitable due to stable consumption and less competition from imports. The special alloys sector, meanwhile, has a 10-year future order book from the aerospace and industrial sectors.

US perspective

Asked whether trade would become more, or less, restrictive, Emily Sanchez, Chief Economist, ReMA (USA) and General Delegate on the Stainless Steel & Special Alloys board, said: "In the medium term, at least, I don't see how it can't be an environment that becomes more restrictive, before we have a situation where we can return to rationalisation."

Read More

BIR, 29-10-25

https://www.bir.org/en/news-press/news/1000042504-bir-bangkok-2025-stainless-steel-special-alloys-committee-more-restrictive-trade-likely-for-the-stainless-sector

REACH Update

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ECHA adds one hazardous chemical to the Candidate List

2025-11-05

The Candidate List of substances of very high concern (SVHC) now contains 251 entries for chemicals that can harm people or the environment. Companies are responsible for managing the risks of these chemicals and giving customers and consumers information on their safe use.

Helsinki, 5 November 2025 – ECHA's Member State Committee confirmed the addition of 1,1'-(ethane-1,2-diyl)bis[pentabromobenzene] (DBDPE) to the list in its October meeting. The substance has very persistent and very bioaccumulative properties and is used as a flame retardant in various industries. This identification will support the potential restriction work on brominated flame retardants.

Entry added to the Candidate List on 5 November 2025:

Substance name	EC number	CAS number	Reason for inclusion	Examples of uses
1,1'-(ethane-1,2-diyl)	284-366-9	84852-53-9	Very persistent	Flame retardant

The list now contains 251 entries – some are groups of chemicals, so the overall number of impacted chemicals is higher.

This substance may be placed on the Authorisation List in the future. If a substance is on this list, companies cannot use it unless they apply for authorisation and the European Commission authorises its continued use.

Read More

ECHA,25-11-05

https://echa.europa.eu/nl/-/echa-adds-one-hazardous-chemical-to-the-candidate-list-2

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Janet's Corner

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Who am I?

2025-11-07

I am a heavy, bluish-white metal once used in paint and plumbing, now primarily in batteries and radiation shielding. My symbol is Pb.

(Send in your answers and get a surprise Chemwatch merch from us for free)

I am a heavy, bluish-white metal once used in paint and plumbing, now primarily in batteries and radiation shielding.

1,4 Dioxane

2025-11-07

1,4-Dioxane is a chemical with the chemical formula $C_4H_8O_2$, and molecular weight of 88.10 g/mol. It occurs as a colourless flammable liquid that is miscible in water and has a faint pleasant odour, with an odour threshold of 24 parts per million (ppm). [1] 1,4-Dioxane is found as a trace contaminant of some chemicals used in cosmetics, detergents, and shampoos. However, manufacturers now reduce 1,4-dioxane from these chemicals to low levels before these chemicals are made into products used in the home. [1,2]

USES [2,3]

1,4-Dioxane (dioxane), a cyclic ether, is used as a degreasing agent, as a component of paint and varnish removers, and as a wetting and dispersion agent in the textile industry. Dioxane is used as a solvent in chemical synthesis, as a fluid for scintillation counting, and as a dehydrating agent in the preparation of tissue sections for histology.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- The manufacture and transportation of 1,4-dioxane;
- Use as a solvent for fats, oils, ethyl cellulose, benzyl cellulose, cellulose acetate, and other cellulose esters and ethers, dyes, paints, polyvinyl polymers, varnishes, waxes, greases, natural and synthetic resins, and in the pulping of wood;
- Use in paint and varnish strippers and as a degreaser;
- Use as a wetting and dispersing agent in textile processing, dye baths, and stain and printing compositions;
- Use in manufacture of detergents, adhesives, fumigants, emulsions, and cleaning preparations, and in manufacture of polishing compounds;
- Use as a stabiliser for chlorinated solvents; in preparation of cosmetics and deodorants; and in purification of drugs;
- Use as a working fluid for scintillation counter samples; for radioimmunoassay of glucagon; in molecular weight determinations; as a solvent to purify organic compounds; and as a dehydrating agent of histological slides

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Routes of Exposure

- **Inhalation** – Predominant route of exposure for the general population and workers. Inhalation exposure also occurs from 1,4-dioxane released from tap water during bathing and laundering.
- **Oral** – Predominant route of exposure for the general population ingesting contaminated drinking water and from food.
- **Dermal** – Use of contaminated consumer products such as cosmetics or shampoos

HEALTH EFFECTS [4]

Acute Health Effects

Acute inhalation exposure to high levels of 1,4-dioxane has caused vertigo and irritation of the eyes, nose, throat, and lungs in humans. It may also irritate the skin. Some symptoms of poisoning include the irritation of the upper respiratory passages, coughing, irritation of eyes, drowsiness, vertigo, headache, anorexia, stomach pains, nausea, vomiting, coma, and death; these symptoms were observed in workers, but length of exposure was unknown. In a fatal case of acute 1,4-dioxane poisoning by inhalation, hepatic and renal lesions, and demyelination and oedema of the brain were observed in the individual.

Convulsions, collapse, and effects to the kidneys and liver were observed in rabbits injected with 1,4-dioxane. Acute animal tests in rats, mice, rabbits, and guinea pigs, have demonstrated 1,4-dioxane to have moderate acute toxicity by inhalation or dermal exposure, and low to moderate acute toxicity by ingestion.

Carcinogenicity

In three epidemiologic studies on workers exposed to 1,4-dioxane, the observed number of cancer cases did not differ from the expected cancer deaths. A study by the National Cancer Institute (NCI) of rats and mice exposed to 1,4-dioxane in their drinking water reported increased incidences of liver carcinomas and adenomas and nasal cavity squamous cell carcinomas. Liver carcinomas and gallbladder carcinomas were observed in mice and guinea pigs, respectively. No treatment-related lesions resulted from exposure to 1,4-dioxane vapour in rats. EPA has classified 1,4-dioxane as a Group B2, probable human carcinogen.

Other Effects

No information is available on the reproductive and developmental effects of 1,4-dioxane in humans. No evidence of gross, skeletal, or visceral malformations was found in the offspring of rats exposed via gavage (experimentally placing the chemical in the stomach). Embryotoxicity was observed only at the highest dose.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.
- **Skin Contact:** Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops. Cold water may be used.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling 1,4-dioxane:

- Splash goggles;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves (impervious);

Personal Protection in Case of a Large Spill:

- Splash goggles;

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- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

OSHA: The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for dioxane is 100 ppm (360 milligrams per cubic metre (mg/m3) as an 8-hour time-weighted average (TWA) concentration. The OSHA PEL also bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [29 CFR 1910.1000, Table Z-1].

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for dioxane of 1 ppm (3.6 mg/m3) as a 30-minute ceiling. NIOSH also considers dioxane a potential occupational carcinogen [NIOSH 1992].

ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned dioxane a threshold limit value (TLV) of 25 ppm (90 mg/m3) as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also assigns a "Skin" notation to dioxane [ACGIH 1994, p. 20].

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5. http://www.osha.gov/SLTC/healthguidelines/dioxane/recognition.html
6. http://www.sciencelab.com/msds.php?msdsId=9923847
7. http://www.safeworkaustralia.gov.au/sites/swa/search/results?k=1%2C4-dioxane

Outdoor Air Pollution Linked to Higher Incidence of Breast Cancer

2025-10-29

Women living in areas with lots of traffic-related air pollution are more likely to develop breast cancer, according to a new analysis of more than 400,000 women.

Women living in parts of the United States with lower air quality, especially neighborhoods with heavy emissions from motor vehicles, are more likely to develop breast cancer, according to a multiyear analysis involving more than 400,000 women and 28,000 breast cancer cases.

The research, which included Veronica Irvin of the Oregon State University College of Health, was published in the American Journal of Public Health.

The project combined data from five large breast cancer studies conducted over multiple decades that tracked individuals even as they changed addresses and followed them for as long as 10 years prior to their diagnosis. The researchers overlaid outdoor air quality information from more than 2,600 monitors to look for an association between air pollution and breast cancer.

The scientists found that a 10-parts-per-billion increase in nitrogen dioxide concentrations in the air equated to a 3% increase in overall breast cancer incidence; nitrogen dioxide is a proxy for pollution from car traffic, Irvin said, and based on the estimated 316,950 cases of female breast cancer expected to be diagnosed in the United States this year, a 3% reduction would mean 9,500 fewer cases.

Irvin and collaborators also found that a 5-microgram-per-cubic-meter rise in the concentration of fine particulate matter, known as PM2.5, was associated with a higher incidence of hormone receptor-negative breast cancer. Cancer cells lacking receptors for the sex hormones estrogen and progesterone are generally harder to treat and more deadly.

"It's often not realistic for people to leave their homes and relocate in areas with better air quality in search of less health risk, so we need more effective clean air laws to help those who are most in need," said Irvin, noting that the average nitrogen dioxide concentrations observed in the research were below current Environmental Protection Agency guidelines. "We also need policies that help to reduce car traffic and promote alternative forms of transportation."

The incidence of breast cancer in the United States, where air pollution levels are lower than they are in other populous countries, has been

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generally on the rise over the past 40 years, the researchers note. It's the second leading cause of cancer death among women, after lung cancer. About one woman in eight in the U.S. will develop breast cancer during her lifetime, and the nation's population includes more than 4 million breast cancer survivors.

Alexandra White of the National Institutes of Health led the study, which also included scientists from Harvard University; the University of Washington; Indiana University; Stony Brook University, the University of California San Diego, La Jolla; The Ohio State University; and the University of North Carolina, Chapel Hill.

The NIH, the EPA, the National Institute of Environmental Health Sciences, the National Institute of Aging, and the National Heart, Lung, and Blood Institute supported the research.

Irvin is the Celia Strickland Austin and G. Kenneth Austin III Endowed Professor in Public Health in the OSU College of Health, which will host a free online panel discussion, "Our Health & Breast Cancer," at noon Pacific time on Thursday, Oct. 30. Irvin will be one of the panelists for the discussion, which will look at screening and survivorship, early detection, research, and support and mentorship for those affected by breast cancer.

Technology Networks, 29 October 2025

https://technologynetworks.com

Improved iron catalysts achieve near-zero CO_2 emissions in liquid fuel synthesis from syngas

2025-11-05

Scientists cut down over 99% of the CO2 production during the conversion of crude oil products into fuels.

Fischer–Tropsch synthesis (FTS) is a widely used process in the petrochemical industry that converts synthesis gas (syngas), a mixture of carbon monoxide (CO) and hydrogen (H2), into liquid hydrocarbons.

In a study published in Science, a team of researchers from China discovered that adding parts-per-million levels of bromomethane (CH3Br) to syngas over iron-based catalysts completely changed the reaction outcome, making it significantly greener.

The addition of the halogen-containing compound reduced CO2 selectivity from the typical 18–35% to near zero. Simultaneously, olefin

(hydrocarbon containing a carbon–carbon double bond) selectivity increased to 85% among carbon-containing products, with an olefin-to-paraffin ratio of 13:1, a 10-fold improvement from the 1.3:1 ratio with the unmodified catalyst.

The world is developing greener energy technologies, but fossil fuels still account for over 80% of global energy consumption. Building a sustainable future requires not only making renewable sources more efficient but also reducing the environmental impact of fossil fuels.

The researchers therefore focused on improving the efficiency and eco-friendliness of the FTS process, which is an irreplaceable part of the petrochemical industry.

The FTS process, invented by Germans Franz Fischer and Hans Tropsch in the 1920s, rose to popularity after playing a key role in providing essential liquid fuels to the German military during World War II. The primary reaction involves converting carbon monoxide (CO) and hydrogen (H2) in syngas into hydrocarbons in the presence of a catalyst.

More than two-thirds of FTS worldwide is driven by iron-based catalysts, which account for almost 15.70 million tons per year. These catalysts are preferred due to their low cost, natural abundance and better yields over a short period of time. However, iron catalysts are notorious for promoting unwanted reactions that lead to excess CO2 formation.

Previously, chemists tried to reduce CO2 formation by coating iron catalysts with hydrophobic materials or graphene layers, which only lowered selectivity to below 13%. Modifying iron carbide catalysts achieved about 10% CO2 selectivity but suffered from low CO conversion and poor olefin productivity.

The researchers in this study found a very simple yet powerful way to increase olefin yield and reduce CO2 emissions from the FTS process. They added trace amounts of bromomethane directly into the syngas feed gas during the catalytic reaction.

This co-feeding process formed surface-bound bromine entities that reshaped the catalyst surface. These entities blocked two unwanted reactions—the water-gas shift (WGS) and Boudouard reactions—that produce water and CO2 byproducts. Furthermore, the catalyst also made it easier for olefins to leave the catalyst surface instead of being further hydrogenated into less valuable products.

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The modified catalyst also showed remarkable long-term stability, running smoothly for more than 450 hours.

The researchers note that this practical strategy is compatible with a broad range of Fe-based FTS catalysts, including commercial formulations. By enabling carbon-neutral conversion of coal and syngas, this work can bridge the gap between fossil-fuel chemistry and climate sustainability.

Phys Org, 5 November 2025

https://phys.org

Mechanochemical upcycling of Teflon creates valuable fluorinated molecules

2025-11-03

A team of researchers in the UK has developed a new way to upcycle PTFE, using only lumps of sodium metal and mechanical force. This simple method creates a source of fluorine which can be used to synthesise a range of valuable fluorinated small molecules.

Polytetrafluoroethylene (PTFE) – more commonly referred to by its brand name Teflon – is known for its thermal and chemical resistance, owing to it's hard to break carbon–fluorine bonds. Such attributes make it an ideal material for lining reaction vessels, batteries and non-stick frying pans.

'The properties that make [PTFE] so amazing also creates a big problem when it comes to disposing of it,' says Roly Armstrong at Newcastle University in the UK. He adds that traditional disposal methods are limited to either sending it to landfill, or incineration, both of which often create smaller chain per- or polyfluoroalkyl substances (PFAS) that can build up in the environment.

Researchers have now started looking at other ways of disposing of waste PTFE – among other fluorinated polymers – with an increased focus on upcycling such materials into useful fluoro–containing reagents and molecules. Recent advances by Véronique Gouverneur and her group at the University of Oxford, UK earlier this year involved mechanochemically breaking down PTFE into fluorinated phosphate salts.

Armstrong is a part of a collaboration between Newcastle University and the University of Birmingham, UK, that has now developed a method that instead uses cheap and readily available sodium metal as the reagent. 'We take the Teflon and sodium metal [under an inert atmosphere], put them in a stainless steel jar with ball bearings and shake it at a high

speed of 30Hz for one hour,' explains Dominik Kubicki at the University of Birmingham, adding that there is no need for any solvents or further processing.

Ina Vollmer, an expert in chemical upcycling at Utrecht University in the Netherlands, says that 'this method seems much simpler than previous studies, while also achieving a single product'. Spectroscopic analysis revealed that the only products are highly-pure sodium fluoride and elemental carbon.

The UK-based team were able to use the sodium fluoride powder without purification to fluorinate a range of sulfonyl and acyl chlorides, using the same mechanochemical method as used to initially upcycle the PTFE. Armstrong explains that such acyl and sulfonyl fluoride products are 'very important in lots of synthetic transformations'.

'The field is rapidly shifting from fluoropolymer destruction towards true fluorine resource recovery,' says Norio Shibata, a fluorine chemist at the Nagoya Institute of Technology, Japan. 'This [work] provides valuable momentum to that transformation.'

Moving forwards, the team are looking to scale up their current method and better understand the mechanism behind how sodium helps break down PTFE, as well as investigate the upcycling of other fluorochemicals using similar methods.

Chemistry World, 3 November 2025

https://chemistryworld.com

Bamboo Tissue Paper May Not Be As Eco-Friendly As You Think

2025-11-03

In recent years, Chinese tissue paper made from bamboo has emerged as a trendy choice for eco-friendly shoppers. However, new research suggests these bamboo paper products may not offer significant climate benefits over tissue produced in the United States and, in some cases, may be more detrimental to the environment.

The findings are detailed in a new paper from North Carolina State University researchers, which compared the carbon footprint of bamboo tissue paper manufactured in China with that of conventional tissue paper manufactured in the U.S. and Canada. The researchers found that, while using bamboo biomass itself did not produce more greenhouse gases

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than traditional wood, the fossil fuel-heavy power grid in China led to significant increases in emissions compared with cleaner fuel sources used in North America.

"As far as emissions go, the technology used to create hygiene tissue paper is far more important than the type of fiber it's made from," said Naycari Forfora, lead author of the study and Ph.D candidate in the NC State College of Natural Resources. "Because the Chinese power grid is so reliant on coal for power, emissions throughout the entire tissue supply chain are higher than what we saw with the wood-based option."

Ronalds Gonzalez, an associate professor at NC State University and co-author of the paper, said that manufacturing tissue paper from bamboo is not meaningfully different from using other wood sources.

"Bamboo is a crop like any other, and it goes through the same production processes as Brazilian or Canadian wood," Gonzalez said. "Consumers often think of bamboo as a 'tree-free' option, but the trees used to make tissue are planted and harvested the same way that bamboo is. When you then factor in how coal-reliant the Chinese mills are, you start to see how emissions from this product are actually higher than others."

Researchers found that Chinese bamboo tissue was responsible for nearly 2,400 kilograms of carbon dioxide equivalent per ton of tissue produced, compared to 1,824 kgCO2eq/ton for wood-based U.S. tissue. Chinese bamboo also underperformed in several environmental categories, including smog formation, respiratory effects and ecotoxicity. Of note, these differences largely disappeared when bamboo production occurred in areas with clean electrical grids, reinforcing the finding that technological improvements are significantly more impactful than a change in fiber type when developing decarbonization strategies.

The authors are members of the Sustainable & Alternative Fibers Initiative (SAFI) at NC State, the world's largest coalition dedicated to advancing knowledge on the sustainability of both conventional and alternative fibers. SAFI brings together more than 30 local and global partners from industry, academia, and government to collaboratively drive innovation and responsible fiber development.

Technology Networks, 3 November 2025

https://technologynetworks.com

Body preservation technique applied to wood to make it stronger, protect from decay

2025-11-05

A technique used for the long-term preservation of human and animal remains is now being tested on one of Canada's most iconic building materials—the Western red cedar.

Plastination, originally designed to embalm the dead, is now being used to improve the functionality and durability of advanced composite materials.

A team from UBC Okanagan's School of Engineering has been experimenting with the technique and previously published a study that examined the plastination of bamboo to create a strong and durable composite building material.

The researchers have taken that work one step further, and in their latest study demonstrated the technique can also be used on Western red cedar to make it stronger and protect the wood from water damage and decay. The study was published in the journal Materials.

"Western red cedar is prized for its abundance and renewability, though its tendency to absorb moisture is a major drawback," says doctoral student Olivia Margoto, a researcher with UBC's Materials and Manufacturing Research Institute. "By applying plastination, we're preserving the wood's structure from the inside out—maintaining its strength while dramatically improving its resistance to water."

Plastination is a new method for managing moisture in wood by replacing water in the cellular structure with a silicone compound to create a durable, hydrophobic barrier that resists swelling, rotting and cracking.

Unlike conventional wood protection treatments—which typically rely on surface coatings, bulk impregnation or chemical treatments—plastination offers a fundamentally different approach by first dehydrating the wood using acetone and infusing it with a compatible polymer.

This replaces water within the cells and preserves the anatomical architecture previously occupied by moisture, explains study supervisor Dr. Abbas Milani, Professor in the School of Engineering. Most importantly, the treatment does not compromise tensile strength and tends to improve the material's flexibility.

"Plastination offers a powerful alternative to traditional wood preservatives, which often rely on toxic chemicals or short-lived coatings,"

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adds Dr. Milani. "This technique could extend the lifespan of natural wood products significantly, without sacrificing environmental performance."

In their recent work, the researchers used advanced imaging and spectroscopy tools to confirm that the silicone deeply saturated the cedar's microscopic channels, reducing water absorption by nearly 60% and increasing surface hydrophobicity by more than 45%.

They found that Western red cedar performed better than their earlier work on bamboo, likely because of the very different microstructure of these two natural materials. Western red cedar is a softwood composed of long, thin cells with microstructural dimensions up to seven times smaller than those of bamboo.

Other researchers on this project include Netzero Enterprises CEO Grant Bogyo and UBCO students Madisyn Szypula and Victor Yang.

This process shows significant moisture resistance in Western red cedar, which is encouraging for North American construction applications. Future work will explore ways to scale up the method, recover and reuse solvents, and substitute bio-based polymers for silicone to further reduce environmental impact.

"Nature has already given us incredible materials," Margoto adds. "Our job is to make them last longer in a safe, sustainable and economical way."

Phys Org, 5 November 2025

https://phys.org

Turning CO2 into clean fuel faster and cheaper

2025-11-05

The reverse water-gas shift (RWGS) reaction is a chemical process that converts carbon dioxide (CO2) into carbon monoxide (CO) and water (H2O) by reacting it with hydrogen (H2) in a reactor. The resulting carbon monoxide can then be combined with hydrogen to make syngas, a fundamental building block used to produce synthetic fuels such as e-fuels* and methanol. Because of its ability to recycle CO2 into usable fuel components, the RWGS reaction is seen as a promising pathway for advancing sustainable energy production.

Overcoming the Limits of Conventional Catalysts

Traditionally, the RWGS reaction operates best at temperatures above 800 °C. Nickel-based catalysts are often used because they can withstand such

heat, but they lose performance over time as particles clump together, reducing surface area and efficiency. Operating at lower temperatures avoids this problem, but it also leads to the formation of unwanted byproducts such as methane, lowering carbon monoxide output.

To make the process more efficient and affordable, researchers have been searching for catalysts that remain highly active under low-temperature conditions. The KIER team succeeded by developing a new copper-based catalyst that delivers outstanding results at just 400 °C.

A Breakthrough in Copper Catalyst Design

The newly engineered copper-magnesium-iron mixed oxide catalyst outperformed commercial copper catalysts, producing carbon monoxide 1.7 times faster and with a 1.5 times higher yield at 400 °C.

Copper catalysts have a key advantage over nickel: they can selectively produce only carbon monoxide at temperatures below 400 °C without forming methane. However, copper's thermal stability typically weakens near that temperature, leading to particle agglomeration and loss of activity.

To solve this challenge, Dr. Koo's team incorporated a layered double hydroxide (LDH) structure into their design. This layered structure contains thin metal sheets with water molecules and anions between them. By adjusting the ratio and type of metal ions, the researchers fine-tuned the catalyst's physical and chemical characteristics. Adding iron and magnesium helped fill the gaps between copper particles, effectively preventing clumping and improving heat resistance.

Real-time infrared analysis and reaction testing revealed why the new catalyst performs so well. Conventional copper catalysts convert CO2 into carbon monoxide through intermediate compounds called formates. The new material, however, bypasses these intermediates entirely, converting CO2 directly into CO on its surface. Because it avoids side reactions that produce methane or other byproducts, the catalyst maintains high activity even at a relatively low temperature of 400 °C.

Record Performance and Global Significance

At 400 °C, the catalyst achieved a carbon monoxide yield of 33.4% and a formation rate of 223.7 micromoles per gram of catalyst per second ($\mu mol \cdot gcat^{-1} \cdot s^{-1}$), maintaining stability for over 100 continuous hours. These results represent a 1.7-fold higher formation rate and a 1.5-fold higher yield than standard copper catalysts. When compared to platinum-

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based catalysts, which are costly but highly active, the new catalyst still outperformed them with a 2.2-fold faster formation rate and a 1.8-fold higher yield. This places it among the top-performing CO2 conversion catalysts in the world.

"The low-temperature CO2 hydrogenation catalyst technology is a breakthrough achievement that enables the efficient production of carbon monoxide using inexpensive and abundant metals," said Dr. Kee Young Koo, the project's lead researcher. "It can be directly applied to the production of key feedstocks for sustainable synthetic fuels. Moving forward, we will continue our research to expand its application to real industrial settings, thereby contributing to the realization of carbon neutrality and the commercialization of sustainable synthetic fuel production technologies."

Notes

* E-Fuels are synthetic fuels produced by combining green hydrogen, generated with renewable electricity, and captured CO2 from the atmosphere or sustainable biomass. They are emerging as a promising alternative to conventional fossil fuels, especially for hard-to-decarbonize sectors such as aviation and shipping.

The research findings were published online in May 2025 in Applied Catalysis B: Environmental and Energy, a leading journal in the field of energy and environmental catalysis. The study was supported by the KIER's R&D project, 'Development of e-SAF (sustainable aviation fuel) production technology from carbon dioxide and hydrogen.

Science Daily, 5 November 2025

https://sciencedaily.com

Scientists uncover key mechanisms that drive an enzyme linked to aging and cancer

2025-11-04

Sir2, an enzyme belonging to sirtuins, has been shown to be involved in the deacetylation of proteins. Researchers from the Institute of Science Tokyo reveal that a tandem allosteric effect of reactant and product is responsible for the efficient deacetylation cycle of the Sir2 enzyme.

This finding reveals a new target for modulating Sir2, an enzyme that is essential for many biological processes, including aging, metabolic regulation, and cancer suppression. This study, published in the Journal

of Chemical Information and Modeling, could potentially lead to new therapeutic applications, including novel cancer treatments.

Sirtuins like SIRT1 and Sir2 are a family of enzymes that play crucial roles in a wide range of physiological and pathological processes, such as aging, stress resistance, metabolic regulation, and even cancer suppression, across almost all organisms. These enzymes trigger deacetylation, a type of post-translational modification, which is a chemical modification made to proteins after they are produced. Sir2, found in yeast, deacetylates proteins such as histones—which bind to DNA—and the tumor suppressor protein p53.

Acetylation and deacetylation of p53 are important for regulating its function. Previous studies have shown that Sir2 relies on the co-substrate nicotinamide adenine dinucleotide (NAD+) for catalyzing deacetylation reactions. Structural studies have highlighted that a flexible region within Sir2, called the cofactor binding loop (CBL), is important for NAD+ binding. However, the exact role and mechanisms of CBL in NAD+ binding and deacetylation remain unclear.

To shed light on this, a research team led by Professor Akio Kitao, along with doctoral student Zhen Bai and Assistant Professor Tran Phuoc Duy, all from the School of Life Science and Technology at Institute of Science Tokyo, Japan, uncovered the key mechanisms through which Sir2 performs protein deacetylation efficiently.

"A detailed understanding of the Sir2 deacetylation process can advance our understanding of aging suppression, carbohydrate and lipid metabolism, DNA repair, and support rational drug design," explains Kitao. "Using large-scale computational simulations, we investigated the conformational changes in CBL induced by the binding of p53, revealing a 'tandem allosteric effect'—two successive allosteric steps acting in concert."\

To investigate the deacetylation mechanism of Sir2, the researchers employed molecular dynamics (MD) simulations in combination with parallel cascade selection MD (PaCS-MD). They simulated three states of Sir2: a form bound to acetylated p53 (just before NAD+ binding), a form bound to nonacetylated p53 (just after deacetylation), and the apo state (before any substrate binding).

The simulations revealed key mechanisms that enable efficient deacetylation. First, in its apo state, Sir2 exists in a closed form, which allows only weak NAD+ binding. When an acetylated protein substrate like

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p53 binds, an allosteric change in CBL occurs, transforming Sir2 into an open state that promotes NAD+ entry and tighter binding, subsequently leading to deacetylation.

This deacetylation leads to the breakdown of NAD+ into nicotinamide and 2 -O-acetyl-ADP-ribose, both of which are quickly released. After deacetylation, a reverse allosteric effect drives the efficient release of the deacetylated protein, resetting Sir2 for the next reaction cycle. Thus, the tandem allosteric effects of the reactant (acetylated p53) and the product (deacetylated p53) accelerate the entire deacetylation process.

Moreover, the researchers demonstrated that the CBL region involved in the tandem allosteric effect is present among the sirtuins of many species, including humans. "This suggests that the tandem allosteric mechanism is a shared, evolutionarily conserved strategy among sirtuins," notes Kitao.

This study has potential implications for drug development. "Our study introduces a potential new approach for cancer therapy, targeting NAD+ binding mechanisms in sirtuins," adds Kitao. "Moreover, the PaCS-MD technique employed in this study holds promise for studying other biological systems with similar mechanisms."

Overall, this study enhances our understanding of the crucial sirtuin deacetylation mechanism, paving the way for new therapeutic strategies for aging-related and metabolic diseases.

Phys.Org, 4 November 2025

https://phys.org

Researchers Crack Decades-Old Chemistry Challenge

2025-11-02

A computational method accurately predicts the optimal ligand for a photochemical palladium catalyst, enabling new radical reactions of alkyl ketones.

Ketones are common components in many organic molecules, and chemists are continually exploring new ways to use them in forming chemical bonds. One particularly difficult reaction involves the one-electron reduction of ketones to produce ketyl radicals. These radicals are highly reactive intermediates that play a key role in natural product synthesis and pharmaceutical development.

However, most existing techniques work best for aryl ketones, while simple alkyl ketones remain difficult to manipulate. Although alkyl ketones are much more prevalent, their chemical structure makes them significantly harder to reduce.

In response to this challenge, a team of organic and computational chemists from WPI-ICReDD at Hokkaido University has created a new catalytic method that successfully generates alkyl ketyl radicals. Their findings were published on October 20, 2025, in the Journal of the American Chemical Society and are freely available as open-access research.

The WPI-ICReDD group had previously shown that a palladium catalyst paired with phosphine ligands could drive photochemical reactions (activated by shining light) with aryl ketones. However, this system did not work with alkyl ketones. Their experiments indicated that while alkyl ketyl radicals could initially form, they quickly transferred an electron back to the palladium catalyst—a process known as back electron transfer (BET)—before any further reaction could take place. As a result, the starting material remained unchanged.

Computational Chemistry to the Rescue

Just like in conventional palladium catalysis, the reactivity of photoexcited palladium catalysts depends greatly on the type of phosphine ligand used. Therefore, the team hypothesized they could identify an appropriate phosphine ligand capable of engendering reactivity towards alkyl ketones.

However, since thousands of phosphine ligands are known, identifying the optimal one for an unknown reaction through experimentation alone would be difficult, time-consuming, and environmentally burdensome due to chemical waste.

The researchers effectively circumvented these issues utilizing computational chemistry to efficiently search for optimal ligands with minimal experiments. Specifically, they employed the Virtual Ligand-Assisted Screening (VLAS) method developed by Associate Professor Wataru Matsuoka and Professor Satoshi Maeda from WPI-ICReDD. For 38 different phosphine ligands, the VLAS generated a heat map that predicted which ligands could best engender reactivity based on their electronics and sterics.

Based on this heat map, the team selected just three promising ligands for experimental testing and successfully identified L4 as the optimal ligand—

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tris(4-methoxyphenyl)phosphine (P(p-OMe-C_6H_4)$_3$). Using this ligand effectively suppressed BET, enabling the generation of ketyl radicals from alkyl ketones and achieving versatile reactions with high yield.

This work provides chemists with facile access to alkyl ketyl radical reactivity and highlights the effectiveness of VLAS to rapidly develop and optimize new chemical reactions.

Sci Tech Daily, 2 November 2025

https://scitechdaily.com

A new solvent-relay strategy to design better electrolytes for lithium-ion batteries

2025-11-05

Lithium-ion batteries (LiBs) are currently the most widely used rechargeable batteries worldwide, powering countless portable electronics, as well as hybrid and electric vehicles. While they are known to have notable advantages over other rechargeable batteries, particularly high energy densities, engineers have been trying to further improve their stability, safety and durability.

Researchers at the Chinese University of Hong Kong recently introduced a promising strategy to design new electrolytes for LiBs. Using this strategy, which was outlined in a paper published in Nature Energy, they developed a new electrolyte that could boost the durability of high-voltage LiBs, while also reducing the risk of overheating and fires.

"The inspiration for this work came from a simple but often overlooked idea," Yi-Chun Lu, senior author of the paper, told Phys.org.

"Most electrolyte studies focus on electrochemical behavior—how ions move and react—but every chemical reaction also involves heat absorption or release, something we all learn in basic chemistry. This made us wonder: what if we studied battery reactions from a thermal perspective instead? After all, heat generation and accumulation are at the heart of many safety issues in batteries."

When the temperature inside a LiB cell significantly increases, the battery can catch fire or even explode. As part of their recent studies, Lu and his colleagues set out to better understand how electrochemical reactions are linked to the generation of heat in batteries, as this could help them to design safer and intrinsically stable batteries.

"The driving force behind our study was to address thermal safety at its chemical roots," explained Lu. "In battery research, optimizing one parameter often comes at the expense of another. It's a bit like balancing on a seesaw: improving one end often tips the other. When we push for higher performance, safety is often compromised, and vice versa. Our idea was to break this long-standing trade-off."

Using two solvents to create safer LiBs

To improve the performance of batteries, energy engineers typically explore chemical reactions between their underlying components at room temperature. In contrast, to increase their safety, they try to prevent components from reacting in undesirable ways at high temperatures.

The key objective of the recent study by Lu and his colleagues was to design an electrolyte that would exhibit different behaviors at different temperatures, retaining its stability at room temperature and yet preventing a battery from catching fire at high temperatures. To achieve this, they mixed two different solvents, substances that dissolve the lithium salts in LiBs to release ions, which have distinct properties.

"As temperature rises, one solvent effectively 'hands off' the lithium ion to the other—much like a relay race—allowing the electrolyte's structure and reactivity to shift with temperature," said Lu. "We infused this solvent-relay electrolyte into commercial dry cells and compared them with cells using commercial carbonate-based electrolytes."

A new thermally stable electrolyte

Using their proposed strategy, the researchers created a new electrolyte that they then tested in a widely used type of LiB cells, known as pouch cells. Notably, they found that the resulting cells exhibited excellent electrochemical performance and thermal stability.

To further assess the safety of the cells, Lu and his colleagues performed a so-called nail penetration test, which mimics a real-world scenario in which a battery cell might be punctured, potentially prompting an explosion or fire. Remarkably, the temperature of their battery rose by only about 3.5 °C, after it was punctured, while commercial pouch cells exceeded temperatures of 500 °C.

"Our work tackles battery safety from the electrolyte perspective, which we believe holds great practical potential," said Lu.

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"The electrolyte we developed can be directly infused into existing commercial dry cells without redesigning the battery structure, making it highly compatible with current manufacturing processes. We demonstrated its performance in nickel-rich ternary (NCM) lithium-ion batteries, which are known for their high energy density but also their tendency toward thermal runaway, leading to fire or explosion."

Paving the way for safe high-energy LiBs

The strategy introduced by these researchers could soon be used to design other promising electrolytes that could further improve the thermal stability and safety of LiBs. This could in turn help to further increase the energy-density of LiBs, extending the battery life of electronics and electric vehicles, without compromising their safety.

"In reality, every component in a battery—the cathode, separator, and anode—plays a crucial role in determining its overall behavior," added Lu. "By tailoring these components, we aim to achieve comprehensive safety without compromising performance. In addition, we are expanding our approach beyond lithium-ion systems to explore sodium-ion and other emerging chemistries, where the same principles of intrinsic safety can be applied.

"Our long-term goal is to establish a general design framework for safe, high-energy batteries across different energy-storage technologies."

Phys Org, 5 November 2025

https://phys.org

Scientists Discover Simple, Eco-Friendly Way to Break Down Teflon

2025-11-04

Scientists have found a clean, low-energy way to recycle Teflon using only sodium and motion.

New scientific findings reveal a straightforward and environmentally friendly approach for breaking down Teflon, one of the most resilient plastics on Earth, into valuable chemical components.

A team of scientists from Newcastle University and the University of Birmingham has created a clean, energy-efficient process for recycling Teflon (PTFE), a material widely recognized for its role in non-stick

cookware and other uses that require exceptional heat and chemical resistance.

The study shows that discarded Teflon can be transformed into reusable materials using only sodium metal and mechanical motion (movement by shaking) at room temperature, all without the need for harmful solvents.

Detailed in the Journal of the American Chemical Society (JACS) on 22 October, the research introduces a low-energy, waste-free method that provides a new alternative to traditional fluorine recycling techniques.

Dr. Roly Armstrong, Lecturer in Chemistry at Newcastle University and corresponding author said: "The process we have discovered breaks the strong carbon–fluorine bonds in Teflon, converting it into sodium fluoride which is used in fluoride toothpastes and added to drinking water.

Turning Waste Into Resources

"Hundreds of thousands of tonnes of Teflon are produced globally each year – it's used in everything from lubricants to coatings on cookware, and currently there are very few ways to get rid of it. As those products come to the end of their lives, they currently end up in landfill – but this process allows us to extract the fluorine and upcycle it into useful new materials."

Associate Professor Dr. Erli Lu, from the University of Birmingham, commented: "Fluorine is a vital element in modern life – it's found in around one-third of all new medicines and in many advanced materials. Yet fluorine is traditionally obtained through energy-intensive and heavily polluting mining and chemical processes. Our method shows that we can recover it from everyday waste and reuse it directly – turning a disposal problem into a resource opportunity."

Polytetrafluoroethylene (PTFE), best known by the brand name Teflon, is prized for its resistance to heat and chemicals, making it ideal for cookware, electronics, and laboratory equipment, but those same properties make it almost impossible to recycle.

When burned or incinerated, PTFE releases persistent pollutants known as 'forever chemicals' (PFAS), which remain in the environment for decades. Traditional disposal methods, therefore, raise major environmental and health concerns.

Mechanochemistry: A Green Solution

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The research team tackled this challenge using mechanochemistry – a green approach that drives chemical reactions by applying mechanical energy instead of heat.

Inside a sealed steel container known as a ball mill, sodium metal fragments are ground with Teflon, which causes them to react at room temperature. The process breaks the strong carbon–fluorine bonds in Teflon, converting it into harmless carbon and sodium fluoride, a stable inorganic salt which is widely used in fluoride toothpastes.

The researchers then showed that the sodium fluoride recovered in this way can also be used directly, without purification, to create other valuable fluorine-containing molecules. These include compounds used in pharmaceuticals, diagnostics, and other fine chemicals.

Associate Professor Dr. Dominik Kubicki, who leads the University of Birmingham's solid-state Nuclear Magnetic Resonance (NMR) team, commented: "We used advanced solid-state NMR spectroscopy – one of our specialties at Birmingham – to look inside the reaction mixture at the atomic level. This allowed us to prove that the process produces clean sodium fluoride without any by-products. It's a perfect example of how state-of-the-art materials characterization can accelerate progress toward sustainability."

A Blueprint for a Circular Fluorine Economy

The discovery provides a blueprint for a circular economy for fluorine, in which valuable elements are recovered from industrial waste rather than discarded. This could significantly reduce the environmental footprint of fluorine-based chemicals, which are vital in medicine, electronics, and renewable-energy technologies.

"Our approach is simple, fast, and uses inexpensive materials," said Dr. Lu. "We hope it will inspire further work on reusing other kinds of fluorinated waste and help make the production of vital fluorine-containing compounds more sustainable."

The work also highlights the growing importance of mechanochemistry – an emerging branch of green chemistry that replaces high-temperature or solvent-intensive reactions with simple mechanical motion – as a tool for sustainable innovation.

Dr. Kubicki added: "This research shows how interdisciplinary science, combining materials chemistry with advanced spectroscopy, can turn one

of the most persistent plastics into something useful again. It's a small but important step toward sustainable fluorine chemistry."

Sci Tech Daily, 4 November 2025

https://scitechdaily.com

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High Levels of Short-Chain PFAS Found in Wilmington Residents' Blood

2025-10-27

In a new study, researchers found high levels of ultrashort-chain per- and polyfluoroalkyl substances (PFAS) in blood samples taken from Wilmington, N.C. residents between 2010-2016. Two ultrashort-chain PFAS – perfluoromethoxyacetic acid (PFMOAA) and trifluoracetic acid (TFA) – were detected at high levels in almost every sample. In contrast, GenX – the chemical that jumpstarted public concern about PFAS in the Cape Fear River Basin – was detected in 20% of the samples. The work adds to the body of evidence that short-chain PFAS can accumulate in the human body.

Ultrashort-chain PFAS such as PFMOAA and TFA have not been well-studied in people for two reasons: they were not thought to bioaccumulate due to their chemical structure, and until recently there were no analytical methods that allowed scientists to reliably detect them in blood.

"With the development of analytical methods targeting ultrashort-chain PFAS, researchers have found these compounds to be the dominant PFAS in environmental matrices including water and human blood," says Detlef Knappe, professor of civil, construction, and environmental engineering at NC State and co-corresponding author of the study. "Given the long history of PFAS exposure in Wilmington, we wanted to look for these compounds in historical water and blood samples of residents."

In 2016, NC State and U.S. Environmental Protection Agency researchers published findings highlighting high concentrations of several PFAS, including GenX, in Wilmington residents' drinking water. The Fayetteville Works plant, an upstream chemical facility, had been releasing PFAS into the Cape Fear River, the city's primary drinking water source, since 1980. After 2017, the chemical manufacturer was required to control PFAS discharges into the river and air.

For the current study, the researchers looked for 56 different PFAS in water samples from the Cape Fear River taken in 2017 as well as in 119 adult blood serum samples from a UNC biobank that were collected between 2010-2016. The serum samples were anonymized, but all were taken from residents in and around the Wilmington area.

The findings were surprising. In the blood serum, 34 of the 56 PFAS were detected in at least one serum sample. Five PFAS accounted for

85% of the total found in the samples. PFMOAA had the highest median concentration at 42 nanograms per milliliter (ng/mL), comprising 42% of the summed total, followed by TFA (17 ng/mL), PFOS (14 ng/mL), PFOA (6.2 ng/mL), and PFPrA (5.4 ng/mL).

Additionally, they found that TFA comprised 70% of the total PFAS in the 2017 water sample, with a concentration of 110,000 nanograms per liter (ng/L). PFMOAA had a concentration of 38,000 ng/L. While TFA has a variety of sources, including fluorinated refrigerants, the publication highlights that Fayetteville Works was the dominant source of both TFA and PFMOAA in the lower Cape Fear River.

"For reference, one European guideline recommends a drinking water level of 2200 ng/L for TFA," Knappe says. "Our sample contained over 50 times that concentration."

"These data gave us a 'timestamp' of exposure before people knew their drinking water was contaminated," says Jane Hoppin, professor of biological sciences, principal investigator of the GenX Exposure Study, member of NC State's Center for Human Health and the Environment (CHHE), and co-corresponding author of the paper describing the work.

"The conventional wisdom is that short-chain PFAS are of lesser concern because they don't bioaccumulate, but what we're seeing is that they can occur at high levels in people," Hoppin adds. "These results point out the need to start thinking about how to study the human health effects of these PFAS, particularly TFA and PFMOAA.

"The other issue is how limited the human health data are for any of these chemicals. Most chemicals in the PFAS class affect the liver and immune system, but this work is still in its infancy in many cases."

Next steps include analyzing samples from the GenX Exposure Study for TFA and PFMOAA levels.

"The sample set gives us a glimpse into the past," Hoppin says. "Seeing what the levels are now will help us determine how these chemicals accumulate in the body and what their health effects might be."

Technology Networks, 27 October 2025

https://technologynetworks.com

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An innovative tool coating could improve the way products—from aerospace to medical devices—are made

2025-11-05

Have you ever wondered how airplanes, cars, oil and gas pipelines or medical devices are made? It's not just the materials they're composed of that's so important, but also the high-speed machining that shapes them. Improving those processes can improve the industries that use them and the products they make.

Aerospace, automotive, medical devices and oil and gas industries all require materials that resist corrosion and have low thermal conductivity, meaning they don't transfer heat easily. That's why materials like austenitic stainless steels, titanium alloys and Inconel super-alloys are crucial to these industries.

But the same properties that make these materials so useful also make them difficult to machine at high speeds, leading to rapid tool wear and shortening the lifespan of cutting tools. Machining refers to a manufacturing process where material is selectively removed from a workpiece—typically a raw material in the form of a bar, sheet or block—using cutting tools to achieve the desired shape, dimensions and surface finish.

An innovation in tool coating could solve these machining challenges. The development of what's known as a bi-layer AlTiN PVD coating enhances cutting-tool performance, improves wear resistance and extends the life of the tool life during ultra-high-speed machining of hard-to-machine materials.

This breakthrough won't just benefit manufacturers. The development of advanced cutting tool coatings can significantly enhance tool performance under extreme machining conditions and improve the surface quality of the finished workpiece. Let's dive into what makes this discovery so important.

Why it matters?

Traditionally, tools have been coated with an AlTiN layer—a hard ceramic coating composed of aluminum (Al), titanium (Ti), and nitrogen (N)—to enhance wear resistance during machining. The coating is applied as an extremely thin film (typically three to five micrometers) through a process

called physical vapor deposition (PVD), in which the coating material is vaporized in a vacuum chamber and condensed onto the tool surface.

A single AlTiN layer can improve oxidation resistance and make tools more durable, but these coatings often struggle to balance the hardness, toughness and frictional properties required for demanding machining environments.

The bi-layer coating used in this study overcomes these limitations by optimizing the mechanical properties of each layer. This approach enables the coating to withstand the extreme heat and mechanical loads during the machining of stainless steel.

How does the bi-layer coating work?

A novel coating system was designed: a bi-layer consisting of two AlTiN layers with different ratios of aluminum and titanium. The bi-layer AlTiN coating stands out due to its unique combination of properties.

The top layer, with a higher ratio of aluminum to titanium, reduces friction and improves oxidation resistance. The sub-layer, with an equal ratio of aluminum to titanium, enhances hardness and provides better adhesion to the tungsten carbide substrate used in cutting tools. This combination enables the tool to withstand higher temperatures and mechanical stresses, resulting in longer tool life and more efficient machining.

This bi-layer coating was tested against single-layer coatings on tungsten carbide cutting tools under ultra-high-speed turning of austenitic stainless steel 304 (SS304)—a high-performance material commonly used in the automotive and aerospace industries. The bi-layer coating demonstrated remarkable results, increasing tool life by 33%.

The improved wear resistance is due to the combination of the two layers. It reduced the type of wear caused by high temperatures—known as crater wear—as well as the type of wear caused by mechanical stress—known as flank wear. This balance of properties resulted in longer tool life during high-speed machining.

Better cutting conditions between tool and workpiece

One of the standout features of the bi-layer coating was its improvement in friction, wear and lubrication, three key properties studied in the science of tribology. During machining, these effects were evident in the way chips were formed. Chip formation—the process by which small pieces of material are removed from the whole workpiece by the cutting

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tool—serves as an important indicator of friction and cutting conditions at the tool–workpiece interface.

In this study, the bi-layer tool produced chips with a smoother surface and a more regular shape compared to the chips produced by single-layer tools.

The smoother chips indicate better frictional conditions, meaning that the cutting tool experienced less resistance as it machined the stainless steel. This reduced friction not only extended tool life but also contributed to a more efficient cutting process, as less energy was required to perform the machining.

The bi-layer coating's ability to reduce friction was evident in the lower cutting forces recorded during tests. The bi-layer tool consistently showed lower forces, indicating it required less energy to cut through material. This efficiency could lead to energy savings in industrial settings where high-speed machining is frequently used, making the process more cost-effective and sustainable.

Evidence of superior wear resistance

The study used several advanced techniques to analyze the wear mechanisms affecting the tools, which showed how the bi-layer coating effectively reduced both crater and flank wear.

Crater wear occurs on the tool's rake face—the surface of the cutting tool that comes into direct contact with the chip as it is formed—due to the intense heat generated in the cutting zone, while flank wear happens on the tool's side, typically as a result of mechanical abrasion. The combination of properties in the bi-layer coating helped reduce both forms of wear. This allows the tool to last longer even under the harsh conditions of ultra-high-speed turning.

The impact of high-speed machining

The development of this bi-layer AlTiN coating represents a significant advancement in cutting tool technology. By enhancing wear resistance and reducing friction, the coating extends tool life and improves the efficiency of machining difficult materials like SS304. For industries that rely on high-speed, precision machining, this innovation could lead to cost savings, reduced downtime and greater productivity.

SS304 is widely used in products that require high strength, corrosion resistance and a smooth surface finish—such as automotive exhaust

systems, aerospace components, food-processing equipment and medical instruments. For industries that rely on high-speed, precision machining, this innovation could translate into significant cost savings, reduced downtime and greater productivity.

This research highlights the exciting possibilities of advanced coatings in machining and manufacturing technologies. Innovations like this demonstrate how materials science and mechanical engineering can drive progress across industries such as aerospace, automotive, energy, and medical device manufacturing—where precision, durability and efficiency are critical to performance.

Phys Org, 5 November 2025

https://phys.org

Turning CO2 into clean fuel faster and cheaper

2025-11-05

A team of scientists led by Dr. Kee Young Koo from the Hydrogen Research Department at the Korea Institute of Energy Research (President Yi Chang-Keun, hereafter referred to as KIER) has created a world-leading catalyst capable of transforming carbon dioxide, a major greenhouse gas, into an essential ingredient for producing eco-friendly fuels.

The reverse water-gas shift (RWGS) reaction is a chemical process that converts carbon dioxide (CO2) into carbon monoxide (CO) and water (H2O) by reacting it with hydrogen (H2) in a reactor. The resulting carbon monoxide can then be combined with hydrogen to make syngas, a fundamental building block used to produce synthetic fuels such as e-fuels* and methanol. Because of its ability to recycle CO2 into usable fuel components, the RWGS reaction is seen as a promising pathway for advancing sustainable energy production.

Overcoming the Limits of Conventional Catalysts

Traditionally, the RWGS reaction operates best at temperatures above 800 °C. Nickel-based catalysts are often used because they can withstand such heat, but they lose performance over time as particles clump together, reducing surface area and efficiency. Operating at lower temperatures avoids this problem, but it also leads to the formation of unwanted byproducts such as methane, lowering carbon monoxide output.

To make the process more efficient and affordable, researchers have been searching for catalysts that remain highly active under low-temperature

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conditions. The KIER team succeeded by developing a new copper-based catalyst that delivers outstanding results at just 400 °C.

A Breakthrough in Copper Catalyst Design

The newly engineered copper-magnesium-iron mixed oxide catalyst outperformed commercial copper catalysts, producing carbon monoxide 1.7 times faster and with a 1.5 times higher yield at 400 °C.

Copper catalysts have a key advantage over nickel: they can selectively produce only carbon monoxide at temperatures below 400 °C without forming methane. However, copper's thermal stability typically weakens near that temperature, leading to particle agglomeration and loss of activity.

To solve this challenge, Dr. Koo's team incorporated a layered double hydroxide (LDH) structure into their design. This layered structure contains thin metal sheets with water molecules and anions between them. By adjusting the ratio and type of metal ions, the researchers fine-tuned the catalyst's physical and chemical characteristics. Adding iron and magnesium helped fill the gaps between copper particles, effectively preventing clumping and improving heat resistance.

Real-time infrared analysis and reaction testing revealed why the new catalyst performs so well. Conventional copper catalysts convert CO2 into carbon monoxide through intermediate compounds called formates. The new material, however, bypasses these intermediates entirely, converting CO2 directly into CO on its surface. Because it avoids side reactions that produce methane or other byproducts, the catalyst maintains high activity even at a relatively low temperature of 400 °C.

Record Performance and Global Significance

At 400 °C, the catalyst achieved a carbon monoxide yield of 33.4% and a formation rate of 223.7 micromoles per gram of catalyst per second ($\mu mol \cdot g_{cat}^{-1} \cdot s^{-1}$), maintaining stability for over 100 continuous hours. These results represent a 1.7-fold higher formation rate and a 1.5-fold higher yield than standard copper catalysts. When compared to platinum-based catalysts, which are costly but highly active, the new catalyst still outperformed them with a 2.2-fold faster formation rate and a 1.8-fold higher yield. This places it among the top-performing CO2 conversion catalysts in the world.

"The low-temperature CO2 hydrogenation catalyst technology is a breakthrough achievement that enables the efficient production of

carbon monoxide using inexpensive and abundant metals," said Dr. Kee Young Koo, the project's lead researcher. "It can be directly applied to the production of key feedstocks for sustainable synthetic fuels. Moving forward, we will continue our research to expand its application to real industrial settings, thereby contributing to the realization of carbon neutrality and the commercialization of sustainable synthetic fuel production technologies."

Notes

* E-Fuels are synthetic fuels produced by combining green hydrogen, generated with renewable electricity, and captured CO2 from the atmosphere or sustainable biomass. They are emerging as a promising alternative to conventional fossil fuels, especially for hard-to-decarbonize sectors such as aviation and shipping.

The research findings were published online in May 2025 in Applied Catalysis B: Environmental and Energy, a leading journal in the field of energy and environmental catalysis. The study was supported by the KIER's R&D project, 'Development of e-SAF (sustainable aviation fuel) production technology from carbon dioxide and hydrogen.

Science Daily, 5 November 2025

https://sciencedaily.com

Why Do Pumpkins Accumulate Pollutants in Their Edible Flesh?

2025-10-30

The Cucurbitaceae or gourd family of plants includes many popular fruits and vegetables, such as pumpkins, squash, watermelon, cucumbers and zucchini.

While these plants all make for tasty treats, scientists are aware of another commonality – they tend to take up pollutants from the soil they are planted in, which can accumulate in their edible parts and potentially pose a health risk.

Not all edible plants have this type of accumulation issue, which raises the question: why do gourds do this? With a new study published in the journal Plant Physiology and Biochemistry, scientists are one step closer to the answer.

Extracellular protein secretion could explain pollutant accumulation

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Understanding the mechanism behind how these plants accumulate pollutants is crucial if scientists are to help farmers grow safer produce.

"The pollutants don't easily break down and thus pose a health risk to people who eat the fruit. Interestingly, other plants don't do this and so I became interested in why this happens in this group specifically," said study author Hideyuki Inui, an associate professor at Kobe University's Biosignal Research Center.

In previous research, Inui's team found that plants in the gourd family contain a class of major latex-like proteins (MLPs) that exhibit a strong binding affinity to hydrophobic organic pollutants, such as polycyclic aromatic hydrocarbons (PAHs).

"However, these proteins exist in many other plants, and even among the gourds, there are varieties that are more prone to accumulating pollutants than others. We then noticed that in the highly accumulating varieties, there are higher concentrations of the protein in the sap," said Inui.

In the new study, Inui's team took a closer look at the secretion of these pollutant-transporting proteins into the plant sap. They saw that MLPs in the highly accumulating plants are indeed exported into the sap, whereas other variants are retained in the cells.

The team found that this difference is likely due to a small variation in the MLP's amino acid sequence. This variation acts as a tag that tells the cell which proteins it should retain and which should be excreted.

"Only secreted proteins can migrate inside the plant and be transported to the aboveground parts. Therefore, this seems to be the distinguishing factor between low-pollution and high-pollution plant varieties," Inui explained.

To test this further, the researchers introduced two versions of the MLP into unrelated tobacco plants. The plants that were given the highly accumulating version of the MLP promptly began to excrete the protein into the plant sap, while the plants given the other version continued to hold it intercellularly.

From cleaner produce, to cleaner soil

Through understanding the mechanisms behind these pollutant-transporting proteins, scientists hope they will be able to develop new approaches for growing safer crops that do not accumulate pollutants in

their edible flesh, thus reducing human exposure to potentially harmful contaminants.

"By controlling the behavior of contaminant-transporting proteins, through genetic modification of their pollutant-binding ability or its excretion into the plant sap, we believe it will be possible to cultivate safe crops that do not accumulate harmful chemicals in their edible parts," said Inui.

However, the Kobe University team does not want to stop there. If they can create plants that do not accumulate pollutants, they might also be able to create new gourd varieties that will act as super-accumulators. These plant varieties could then intentionally be planted in polluted soils, where they will draw up the contaminants through their roots, leaving cleaner soil behind.

"I started this research because I was looking for plants that can detect and digest pollutants effectively. Therefore, I also envision that we could use the knowledge gained through this work for creating plants that are more effective in absorbing soil pollutants. This could turn into a technology for cleaning contaminated soils," Inui said.

Technology Networks, 30 October 2025

https://technologynetworks.com

Mechanochemical upcycling of Teflon creates valuable fluorinated molecules

2025-11-03

A team of researchers in the UK has developed a new way to upcycle PTFE, using only lumps of sodium metal and mechanical force. This simple method creates a source of fluorine which can be used to synthesise a range of valuable fluorinated small molecules.

Polytetrafluoroethylene (PTFE) – more commonly referred to by its brand name Teflon – is known for its thermal and chemical resistance, owing to it's hard to break carbon–fluorine bonds. Such attributes make it an ideal material for lining reaction vessels, batteries and non-stick frying pans.

'The properties that make [PTFE] so amazing also creates a big problem when it comes to disposing of it,' says Roly Armstrong at Newcastle University in the UK. He adds that traditional disposal methods are limited to either sending it to landfill, or incineration, both of which often create

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smaller chain per- or polyfluoroalkyl substances (PFAS) that can build up in the environment.

Researchers have now started looking at other ways of disposing of waste PTFE – among other fluorinated polymers – with an increased focus on upcycling such materials into useful fluoro–containing reagents and molecules. Recent advances by Véronique Gouverneur and her group at the University of Oxford, UK earlier this year involved mechanochemically breaking down PTFE into fluorinated phosphate salts.

Armstrong is a part of a collaboration between Newcastle University and the University of Birmingham, UK, that has now developed a method that instead uses cheap and readily available sodium metal as the reagent. 'We take the Teflon and sodium metal [under an inert atmosphere], put them in a stainless steel jar with ball bearings and shake it at a high speed of 30Hz for one hour,' explains Dominik Kubicki at the University of Birmingham, adding that there is no need for any solvents or further processing.

Ina Vollmer, an expert in chemical upcycling at Utrecht University in the Netherlands, says that 'this method seems much simpler than previous studies, while also achieving a single product'. Spectroscopic analysis revealed that the only products are highly-pure sodium fluoride and elemental carbon.

The UK-based team were able to use the sodium fluoride powder without purification to fluorinate a range of sulfonyl and acyl chlorides, using the same mechanochemical method as used to initially upcycle the PTFE. Armstrong explains that such acyl and sulfonyl fluoride products are 'very important in lots of synthetic transformations'.

'The field is rapidly shifting from fluoropolymer destruction towards true fluorine resource recovery,' says Norio Shibata, a fluorine chemist at the Nagoya Institute of Technology, Japan. 'This [work] provides valuable momentum to that transformation.'

Moving forwards, the team are looking to scale up their current method and better understand the mechanism behind how sodium helps break down PTFE, as well as investigate the upcycling of other fluorochemicals using similar methods.

Chemistry World, 3 November 2025

https://chemistryworld.com

Calcium bicarbonate crystals synthesised for first time

2025-10-22

Crystals of calcium bicarbonate have finally been synthesised, nearly 200 years after the mineral was first proposed to exist. The researchers say that obtaining and resolving the structure of such crystals (see video) 'addresses a historical gap in both textbooks and contemporary research'.

Calcium bicarbonate ($Ca(HCO_3)_2$) is a well–known, water–soluble mineral. However, previous attempts to isolate crystals of the mineral from solution have failed, owing to the mineral's tendency to decompose into more stable calcium carbonate ($CaCO_3$) upon evaporation of water.

Researchers in China have now prepared the first crystals of solid calcium bicarbonate by using ethanol, a less-polar solvent, that helps stabilise the bicarbonate ions. The team pumped carbon dioxide into an anhydrous ethanol solution that contained dissolved calcium dichloride ($CaCl_2$) and ammonia. This formed the required bicarbonate ions, which subsequently coordinated with calcium to form precipitates of calcium bicarbonate. Using the same strategy, the researchers also made bicarbonate crystals of strontium and barium, which were previously difficult to synthesise.

Diffraction experiments with calcium bicarbonate revealed a similar rhombohedral crystal structure to calcium carbonate. However, the new mineral has an increased porosity owing to the different binding modes of bicarbonate in the crystal, one of which helps bridge denser ionic layers. The uncoordinated hydroxy group may also further increase the distance between layers, with the researchers comparing it with the 'dangling' methyl group found in calcium acetate ($Ca(CH_3COO)_2$).

Computational analysis revealed that the decreased polarity of ethanol increases the stability of the O–H bond in the bicarbonate ions, preventing deprotonation and decomposition to calcium carbonate.

The researchers note that forming calcium bicarbonate crystals expands understanding of how metal–bicarbonate bonds form within ionic compounds. Materials such as these may also offer new ways to remove carbon dioxide from the atmosphere through direct mineralisation, they note.

Chemistry World, 22 October 2025

https://chmeistryworld.com

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Chemists provide new 'atlas' for reliable experiments with polyoxometalates

2025-11-04

Polyoxometalates (POMs) look like tiny, perfectly ordered mandalas—complex molecular cages made of metal and oxygen atoms. Chemists produce these POMs as versatile model systems for catalysis, energy storage and biomedical applications. But their apparent symmetry can be deceptive.

A new study shows when such structures remain intact and when they rearrange themselves unnoticed in liquids. With the new data and practical guidelines from their new study, the researchers provide an important basis for future experiments.

The research, from the University of Vienna by Ingrid Gregorovic, Nadiia I. Gumerova and Annette Rompel, is published in the journal Science Advances.

When perfect order becomes unstable

Polyoxometalates often behave differently than expected in solution. The new study shows that under many common laboratory conditions, they either decompose or rearrange themselves. Measurements could then unknowingly examine decomposition products instead of the intended molecules—a key reason why results in catalysis, energy research and biomedicine can be difficult to reproduce. Chemists at the University of Vienna want to counteract this problem with their new findings.

The study focuses on so-called Keplerates—iconic molecular cages similar to a football pattern, consisting of dozens of metal and oxygen atoms and measuring only a few nanometers in size. They serve as model building blocks for reactions and materials. The team systematically tested their stability across pH values, temperatures and common buffer systems.

The result is clear: in strongly acidic solutions, the cages remain intact, while at near-neutral pH values, they quickly reorganize into smaller units. Tungsten-based Keplerates prove to be more resistant than their molybdenum counterparts—a practical tip for experiments where neutral media are unavoidable.

A roadmap for reliable chemistry

The new publication expands on the "Speciation Atlas," which provided an initial roadmap for 10 widely used POM systems. With their new study,

Gregorovic, Gumerova and Rompel now offer a user-friendly extension to this atlas: open data sets, simple stability tests and clear recommendations on which conditions to use—and which to avoid.

"Our goal was to provide guidance for everyday use," says Annette Rompel. "Knowing when POM cages are stable—and when they are not—saves time and resources and leads to more reliable results. The expanded atlas not only tells you whether something is stable, but also helps you design experiments and turn ideas into solid results faster."

By openly sharing their data and offering concrete recommendations, the authors provide a valuable tool for scientists who want to make chemistry, materials research and biomedical applications more reproducible and efficient.

Phys Org, 4 November 2025

https://phys.org

How do mineral and chemical sunscreens work and what do we know about their health effects?

2025-08-03

Mineral and chemical sunscreens work differently, but both are considered safe when used correctly.

Mineral sunscreens have gained in popularity in recent years, fueled by claims that they're gentler or safer than their chemical counterparts.

But the real differences between the two types of sun protection are more technical than many consumers realise, making it easy to misunderstand what scientists know about their health effects.

The differences between these sunscreens mainly come down to their active ingredients and, to a certain degree, how they protect against ultraviolet (UV) rays.

Both chemical and mineral sunscreens absorb UV radiation, converting it into heat and releasing it from the skin. To a lesser extent, mineral sunscreens, sometimes called physical sunscreens, also create a thin barrier that scatters UV rays away from the skin.

Even the terms "mineral" and "chemical" can be misleading, though, given all sunscreens use chemicals. Many mineral-based formulas also use other substances, called "boosters," to help the active ingredients work better.

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More accurate descriptors could be "soluble" sunscreen filters – those that could permeate the skin – and "insoluble" filters that could not do so, said Christian Surber, a dermatopharmacologist (someone who studies how drugs affect the skin) at the University of Zurich and the University of Basel.

"It's just the mechanism of action [of the filters] that is different," he told Euronews Health. "It can be absorption, and it can be scattering".

Euronews Health has chosen to use the terms that consumers are most likely to see when they shop for sunscreens.

Sunscreen and health

Concerns around how sunscreens affect our health are nothing new, prompting the European Commission Scientific Committee on Consumer Safety (SCCS) to assess the safety of three non-mineral UV filters – oxybenzone, homosalate, and octocrylene – in 2021 over concerns that they may have endocrine-disrupting properties.

The SCCS determined that homosalate and oxybenzone were not safe at the concentrations commonly used at the time, and that octocrylene was safe at a concentration up to 10 per cent – though it cautioned that the data was inconclusive.

One analysis, for example, estimated that a person would have to apply sunscreen daily for 277 years to experience the same hormone-disrupting effects observed in rats that were fed oxybenzone in a lab.

Even so, the European Commission issued new restrictions in 2022 to lower the amount of these filters allowed in sunscreens.

"We pretty much don't see them anymore on the market, because producers know that [they may] cause problems or will not be allowed anymore on the European market in a few years," Laura Clays from Euroconsumers and the Belgian consumer protection group Test-Achats told Euronews Health.

Euro News, 7 August 2025

https://euronews.com

From nail bars to firefighting foams: How chemicals are deemed safe enough or too harmful

2025-11-04

If you've sat in a nail salon recently, you may well have encountered TPO or trimethylbenzoyl diphenylphosphine oxide to give it its full chemical name. You won't have seen the name on the bottle. But if you've had your gelled fingers under a blue-violet lamp, TPO could well have been part of the process.

TPO is what chemists call a photoinitiator—basically, a chemical that reacts when it's hit with UV light. When your nails go under the lamp, TPO breaks apart and helps link tiny liquid molecules together, turning the polish into that solid, shiny, long-lasting gel layer.

It's smart chemistry, and it's one reason gel manicures last so much longer than normal nail polish. But recently, the EU banned TPO because research suggests it might increase the risk of cancer and could be harmful to the reproductive system.

Meanwhile, alternatives such as benzophenone and other common photoinitiators come with concerns of their own.

Benzophenone, for instance, is listed as a possible endocrine disruptor, meaning it may interfere with hormones. Another common substitute for TPO, called TPO-L is harmful to aquatic life and may cause skin allergies. None of this is hidden. The European Chemicals Agency maintains a public database where anyone can look up chemicals and find their hazard classifications and environmental data.

The point is not that nail varnish is dangerous. It is that even everyday products involve chemistry that is more complex than we might assume and that decisions about what is "safe enough" involve weighing risks, benefits and available alternatives.

The same pattern has played out recently with two much wider-reaching chemicals: PFAS, so-called "forever chemicals," and glyphosate, a herbicide used in agriculture.

Recently, the European Commission announced new restrictions on Pfas in firefighting foam. It did this because Pfas don't break down in the environment and can build up in living things over time, which can be harmful. Meanwhile, the use of glyphosate has been under review, with the EU approving its continued use and the UK due to make a decision in the next year or so.

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None of these decisions happen instantly or automatically. Here is how chemical safety is regulated.

What Reach does?

Pharmaceuticals are tightly controlled globally, but chemicals aren't always regulated as strictly. However, in the EU and UK, chemicals are managed under a system called Reach that is often described as one of the most comprehensive chemical regulations in the world.

The basic difference in how we treat medicines versus chemicals comes down to how we think about risk. Chemicals are expected to be safe when used properly. Medicines, on the other hand, are allowed to have some risks if the benefits outweigh the risks.

That's why harsh cancer treatments, which can have serious side effects, are still considered acceptable—because they can save lives. And it's also why very dangerous chemicals can still be made and used, as long as there are strong safety measures in place.

Under Reach, companies must register their chemicals and provide detailed information on a chemical's properties, hazards and safe handling. The principle here is: "no data, no market."

Regulators then evaluate that information—and can request more if needed. Such substances may then be authorized, meaning they can only be used if companies can demonstrate that risks are controlled or that societal benefits outweigh them while safer options are developed.

If a substance poses an unacceptable risk that cannot otherwise be managed, regulators can restrict or ban specific uses of chemicals. Later if evidence emerges that suggests a chemical can cause cancer, harm reproduction, persist in the environment, accumulate in living things, or otherwise be hazardous, it might be added to a list of "substances of very high concern."

Reach is a strict, step-by-step system that requires companies to prove their chemicals can be used safely. But in reality, we often only learn the full effects of a chemical over time, once it is being used outside the lab and in everyday life. That's why decisions about chemicals such as TPO, Pfas and glyphosate can change slowly and sometimes take many years to fully settle.

Safe and sustainable by design

As a result of cases such as these, many feel that despite Reach being one of the most comprehensive chemical regulations in the world, it isn't enough. This has led to a philosophy known as safe and sustainable by design, where, instead of making a chemical and then proving it is safe, a material is designed with safety and disposal or recycling in mind.

In this area, artificial intelligence may well prove to have a major role. AI is increasingly being used to predict toxicity of chemicals and so allow them to be flagged before they are manufactured.

Chemistry has built the modern world, given us durable coatings on the ends of our fingers, high-yield crops, non-stick pans, waterproof jackets and thousands of other unnoticed conveniences. It has also given us chemicals that travel too far, last too long and accumulate where they were never intended.

The challenge is not to stop using chemistry. It is to use it wisely. Whether we are talking about manicures, farmland, or emergency foam, the principle should be the same: use chemistry that does the job, without leaving a legacy. The more we can predict that, the fewer surprises we'll find later.

Phys Org, 4 November 2025

https://phys.org

Zinc-Air Battery Survives Punctures, Fire and Water Submersion

2025-11-06

A research team in Mexico has created a battery that can still function after being punctured and submerged in water – conditions that would likely ignite the lithium-ion batteries currently used in cell phones and electric vehicles.

The ultra-durable prototype was developed by Noé Arjona and colleagues at the Center for Advanced Materials Research in Chihuahua, Mexico.

"We are not using lithium-ion batteries because of the many safety concerns regarding the flammability of the electrolytes that are used in that kind of technology," says Arjona. Instead, the team made a metal-air battery, combining metal and oxygen from the air in place of a flammable liquid.

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"Many metals also create safety concerns when they are used in batteries. Many of the most active materials are in the list of critical materials. So, we wanted to use as little metal as possible," explains Arjona. Instead of bulk metal inside the battery, they set out to create a carbon sheet dotted with individual atoms of nickel.

The scientists used the intensely bright light of the Canadian Light Source (CLS) at the University of Saskatchewan to analyze their prototype at the molecular level. They confirmed their design had single atoms of nickel, which – when combined with novel gel polymer electrolytes and Zinc – eliminated the safety risks associated with a battery containing a larger amount of metal and flammable electrolytes. Their findings were published in the journal ACS Applied Materials & Interfaces.

The team has put their battery to the test by hammering a nail through it, placing it in flames, and submerging it in water. Their prototype continued to work through each of these extreme conditions.

In addition to being safer, their battery design isn't impacted by temperature extremes.

"In Canada, you have a huge problem with recharging batteries in very cold temperatures, such as with electric vehicles," Arjona points out. "Our kind of technology doesn't have the same issues with very low or very high temperatures."

Since his team is focused on using metals such as nickel -- which are more abundant and affordable than lithium and cobalt -- their work could lead to cheaper batteries.

Arjona and his team are also exploring ways to make their battery eco-friendlier, including integrating components that are biodegradable. Once the battery reaches the end of its life, these materials could help to enrich soil and grow plants. In subsequent studies, the researchers plan to incorporate bioplastics in their design and to use iron – commonly found in soil – instead of nickel.

While the team is excited about the promise their new design holds, Arjona says more research is needed before this technology is ready to replace current batteries.

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Technical Notes

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(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Bifunctional SERS-Fenton micro-nano platform: Integrating ultrasensitive sensing with advanced oxidation for the detection and degradation of organic pollutants in water

Ammonium is associated with enhanced haloacetamide formation, cytotoxicity, and aryl hydrocarbon receptor activation during sulfate radical-based oxidation of acetaminophen

Deep neural networks reveal organic pollutants' dominance in global inflammatory bowel disease

ENVIRONMENTAL RESEARCH

Coffee grounds-derived core-shell aerogels: Preparation and application for diesel pollutant degradation in water

Unraveling the threshold and interaction effects of environmental variables on cadmium contamination in rice grains

PHARMACEUTICAL/TOXICOLOGY

A pilot study of nivolumab in combination with neoadjuvant and post-surgical chemotherapy in newly diagnosed ovarian cancer

Real-world data and clinical experience from over 100,000 multi-cancer early detection tests

Determination of perfluoroalkyl sulfonyl fluorides in environmental water and soil around an abandoned manufactory

OCCUPATIONAL

Mortality Risk from Chronic Ischemic Heart Disease Associated with Short-Term Co-Exposure to Summer Heatwave and Ozone

Prenatal exposure to bisphenols, metals, and risk of fetal chromosome numerical abnormalities in high-risk pregnancies: Independent, combined, and interactive effects