CHEMWATCH

Bulletin Board

Contents

NOV. 28, 2025

(click on page numbers for links)

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

CHEMWATCH
Bulletin Board
Contents
NOV. 28, 2025

ASIA PACIFIC

PFAS inquiry hands down 47 recommendations to better regulate 'forever chemicals' in Australia

2025-11-19

A federal inquiry into the extent, regulation and management of PFAS in Australia has handed down its final report, which includes 47 recommendations.

The report recommends establishing a national PFAS watchdog and standardised guidelines for drinking water across all states and territories.

In June, 2024 it was revealed unsafe levels of the chemicals were found in the drinking water of more than 40,000 people in the upper Blue Mountains.

A federal inquiry into the extent, regulation and management of PFAS has found Australia's public health advice is at odds with the growing international consensus on the health risks of "forever chemicals".

The Senate Select Committee has handed down its final report, containing a total of 47 recommendations.

It referenced recent findings by the International Agency for Research on Cancer, the National Academies of Sciences, Engineering and Medicine and the US Environmental Protection Agency that at least two PFAS chemicals — PFOA and PFOS — are "carcinogens".

Read More

ABC News, 19-11-25

https://www.abc.net.au/news/2025-11-19/pfas-inquiry-hopes-to-strengthen-regulation-human-health/106026416

The workplace exposure standard (WES) for Aluminium (welding fumes) has been reduced from 5 mg/m^3 to 1 mg/m^3 (measured over an 8-hour time weighted average).

2025-11-17

Following WHS ministers' agreement, Safe Work Australia has now published an updated WES list to include the reduced workplace exposure standard.

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 28, 2025

Aluminium welding is widely used in boat building and repair. Like other welding processes, it produces hazardous fumes that can harm workers' health.

This reduction brings the WES for aluminium welding fumes in line with the existing WES for welding fumes (not otherwise classified) to better protect workers from harmful effects of welding fumes.

Next steps for employers

- Review and update your welding fume controls to make sure exposure stays below the 1 mg/m^3 limit. Take all reasonably practicable steps to eliminate and minimise risks.
- Use the model Code of Practice: Welding Processes for guidance. It provides advice and control measures for welding hazards, such as ventilation and personal protective equipment, and outlines other WHS duties.
- Properly worn respiratory protective equipment can be taken into account when determining compliance with the new limit, if all other reasonably practicable higher control measures in the hierarchy of controls have been implemented.
- Get expert advice (such as from an occupational hygienist) if you are not sure you are meeting the new limit and to find out if your control measures are appropriate.
- Stay informed of updates from the WHS regulator in your jurisdiction to know when the new limit becomes legally enforceable in your jurisdiction.

Read More

Safe Work Australia, 17-11-25

https://www.safeworkaustralia.gov.au/media-centre/news/aluminium-welding-fumes-wes-reduction-updated

'So far behind': Lidia Thorpe demands Labor act on addressing PFAS risks

2025-11-20

Independent senator Lidia Thorpe has blasted Labor for not taking action on regulating PFAS, claiming the government is prioritising company profits over public health.

PFAS is a class of chemicals known as perfluorinated chemicals, perfluorochemicals or perfluoroalkyls. They are often referred to as forever chemicals because they can take thousands of years to break down in the environment.

Senator Thorpe, who chaired a Senate inquiry into the usage and regulation of the chemicals, told the ABC that she was calling for national guidelines, describing PFAS as the "asbestos of the 21st century".

"So this country is so far behind, and they're using that excuse over and over again, and they're putting company profits ahead of public health in this country," she said.

"So Australia needs to take it more seriously and stop using excuses.

Read More

News.com.au, 20-11-25

https://www.news.com.au/technology/environment/senate-inquiry-delivers-47-recommendations-to-strengthen-pfas-risks/news-story/6b6c172e04e32e3dda6e1c2470454c3b

AMERICA

California farmland doused with 2.5 million pounds of PFAS pesticides each year, analysis finds

2025-11-18

Farm fields in California, the largest US agricultural state, are sprayed each year with an average of 2.5 million pounds of pesticides containing toxic PFAS, potentially exposing millions of people to the chemicals through contaminated food, soil and drinking water, according to a new analysis of state regulatory data.

The findings in California show "how widely the potentially toxic PFAS pesticides are used on agricultural land," Jared Hayes, a senior policy analyst for the Environmental Working Group (EWG) and co-author of the report, said in a statement. "It doesn't make sense when plenty of non-PFAS pesticides are readily available."

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 28, 2025

EWG's analysis, published November 18, found that pesticides containing PFAS as active ingredients are most heavily used on land where farmers grow almonds, pistachios, wine grapes, alfalfa and tomatoes, among others.

The group developed a map showing that 52 PFAS-containing pesticides approved by the US Environmental Protection Agency (EPA) were sprayed in 58 counties across California from 2018 to 2023, with Fresno, Kern and San Joaquin counties most heavily doused with PFAS pesticides. The analysis cites data collected by the California Department of Pesticide Regulation.

Sixty-seven per- and polyfluoroalkyl substances (PFAS) are federally approved as active ingredients in pesticides even though the class of humanmade chemicals don't easily break down in the environment and have been linked to various health problems.

Read More

TNL, 18-11-25

https://www.thenewlede.org/2025/11/california-farmland-doused-with-2-5-million-pounds-of-pfas-pesticides-each-year-analysis-finds/

Some California landfills are on fire and leaking methane: Newly proposed rules could make them safer

2025-11-20

A vast canyon of buried garbage has been smoldering inside a landfill in the Santa Clarita Valley, inducing geysers of liquid waste onto the surface and noxious fumes into the air.

In the Inland Empire, several fires have broken out on the surface of another landfill. In the San Fernando Valley, an elementary school has occasionally canceled recess due to toxic gases emanating from rain-soaked, rotting garbage from a nearby landfill. And, in the San Francisco Bay Area, burrowing rodents may be digging into entombed trash at a landfill-turned-park, unloosing explosive levels of methane.

These are just a few of the treacherous episodes that have recently transpired at landfills in California, subjecting the state's waste management industry to growing scrutiny by residents and regulators.

Read More

Phys.org, 20-11-25

https://phys.org/news/2025-11-california-landfills-leaking-methane-newly.html

Researchers uncover the source of widespread 'forever chemical' contamination in North Carolina

2025-11-20

An environmental chemistry laboratory at Duke University has solved a longstanding mystery of the origin of high levels of PFAS—so-called "forever chemicals"—contaminating water sources in the Piedmont region of North Carolina.

By sampling and analyzing sewage in and around Burlington, NC, the researchers traced the chemicals to a local textile manufacturing plant. The source remained hidden for years because the facility was not releasing chemical forms of PFAS that are regulated and monitored. The culprit was instead solid nanoparticle PFAS "precursors" that degrade into the chemicals that current tests are designed to detect.

Incredibly, these precursors were being released into the sewer system at concentrations up to 12 million parts-per-trillion—approximately 3 million times greater than the Environmental Protection Agency's recently-enacted drinking water regulatory limit for certain types of PFAS.

Read More

20-11-25

https://phys.org/news/2025-11-uncover-source-widespread-chemical-contamination.html

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 28, 2025

EUROPE

EU postpones chemical labelling rules until 2028 to ease business burden

2025-22-19

The European Council has formally approved a delay to the application of several core requirements under the EU's revised Classification, Labelling and Packaging (CLP) regulation, pushing their start date to 1 January 2028.

These provisions had previously been scheduled to take effect from 1 July 2026 for some elements and 1 January 2027 for others.

The decision, forming Part One of the VI Omnibus package, shifts back transitional deadlines covering relabelling, mandatory formats, advertising, online and distance sales, and fuel pump labelling.

The VI Omnibus package, unveiled in July 2025, targets administrative simplification for businesses, notably in chemicals regulation.

It simplifies labelling obligations, streamlines compliance procedures and defers certain deadlines.

The Danish presidency prioritised the file considering its immediate implications for industry, and the act was adopted without amendments by the co-legislators.

Read More

Yahoo News, 19-11-25

https://www.yahoo.com/news/articles/eu-postpones-chemical-labelling-rules-142519280.html

Scientists call on better regulation for chemical cocktails in Europe

2025-11-19

In a policy brief published in Science, scientists call on European Union for a new approach to protect people and nature from the hidden risks of chemical cocktails.

Every day, people and all other living organisms are potentially exposed to dozens or even hundreds of chemicals - from plastics and pesticides

to cosmetics and cleaning agents. While each chemical may individually meet safety standards, their combined effects can quietly add up.

A new policy brief published in Science argues that current chemical regulations fail to reflect this reality and systematically underestimate the risks from these "chemical cocktails."

The authors, led by Professor Thomas Backhaus from the University of Gothenburg and RWTH Aachen University, call on European policymakers to take a decisive step to regulate mixtures. They suggest that EU integrate a Mixture Allocation Factor (MAF) into the upcoming revision of the EU's REACH Regulation, which governs the registration, evaluation, and authorization of chemicals. "Chemical safety cannot be guaranteed by assessing substances one by one," Backhaus explains. "We urgently need a system that acknowledges that we live in the presence of complex mixtures."

Why mixtures matter

Research shows that mixtures of chemicals, even when each is present below its regulatory limit, can still harm health and ecosystems. The combined exposure can exceed what scientists call the "safe space." Studies on reproductive disorders, for example, reveal that real-world mixtures of pesticides and plasticizers can cause developmental damage in animals at levels far below official thresholds. Similar evidence has been accumulating in environmental research, where shown to interact in complex but predictable ways.

The team of authors point out that the concentration addition principle, long used for dioxin-like pollutants, is a scientifically proven way to estimate the combined effects of multiple chemicals. Ignoring mixture toxicity, they argue, contradicts both empirical evidence and basic biology. Cells and organs do not act in isolation, and neither do chemicals.

Read More

Analytik News, 19-11-25

https://analytik.news/en/press/2025/227.html

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 28, 2025

Including persistence and mobility into the hazard assessment of chemicals in the urban wastewater and for the derivation of environmental quality standards for surface waters

2025-11-18

This paper discusses the need for regulatory measures to include persistence and mobility of chemicals as hazard criteria to better protect freshwater, groundwater and drinking water. In the EU, the hazard criteria persistence and mobility are, regulatorily speaking, still new. These criteria have been included in environmental hazard classes in Regulation 1272/2008 on classification, labelling and packaging of substances and mixtures in 2023 (Commission Delegated Regulation 2023/707). Even though these substances may not be classified as toxic under existing criteria, their persistence and mobility pose potential hazards to the environment and human health. We show the perspective of the German stakeholder dialogue on trace substances and how chemicals are assessed in this national framework. Persistence and mobility criteria should also be integrated into regulatory approaches, namely the derivation of environmental quality standards for surface water and in the hazardousness definition of the Urban Wastewater Treatment Directive 2024/3019. To ensure regulatory consistency, we support harmonized criteria as laid down in Regulation 2023/707 for persistent and mobile substances across different legislative frameworks.

Read More

Environmental Sciences Europe, 18-11-25

https://enveurope.springeropen.com/articles/10.1186/s12302-025-01269-5

EBA Discussed the Implementation of REACH and CLP at International Conferences

2025-11-18

On 12–14 November, the Coordinator of the Chemical Safety Subcommittee of the European Business Association took part in the session "REACH UA and CLP UA: Implementation Stages and Challenges", held within the international conferences "Paint Forum UA 2025" and "DryMix Forum UA 2025", organized by the information and analytics agency Chem-Courier.

In her presentation, the EBA's representative expressed support for the initiative of the Ministry of Economy, Environment and Agriculture of Ukraine to postpone the implementation of the requirements of the Technical Regulation on Chemical Product Safety (REACH) and the Technical Regulation on the Classification, Labelling and Packaging of Chemical Products (CLP).

The implementation of European chemical safety standards must take into account the challenges businesses are currently facing. Moreover, in this context, it is essential to secure the support of, and closely cooperate with, the main regulator during the further harmonisation of technical regulations with EU norms.

The business community understands that postponement is only the first step toward further improvement and updating of regulatory requirements, as well as toward developing effective implementation mechanisms and practical simplifications. Given this, it is crucial to establish joint working groups involving business representatives, the relevant ministry and chemical safety experts.

Read More

EBA, 18-11-25

https://eba.com.ua/en/eba-obgovoryla-vprovadzhennya-reach-ta-clp-na-mizhnarodnyh-konferentsiyah/

Air pollution: effects on adverse birth outcomes

2025-11-20

Given growing interest from the public and the government about the effects of air pollution on pregnancy and early life, the Department of Health and Social Care (DHSC) requested that the Committee on the Medical Effects of Air Pollutants (COMEAP) undertake work on this topic. To support COMEAP's work, DHSC approached the National Institute of Health Research (NIHR) Health Protection Research Unit (HPRU) on Health Impact of Environmental Hazards at King's College London to undertake an evidence-based scoping review on air pollution and adverse birth outcomes.

Using the scoping review as a starting point, a Sub-group of the Committee undertook a programme of work to address the following questions:

Four substances recommended for REACH authorisation

2025-11-20

The European Chemicals Agency (ECHA), to protect health and the environment, recommends that the European Commission adds four substances, including melamine, to the REACH Authorisation List. Once added to the list, companies must apply for authorisation if they wish to continue using the substances.

The recommendation includes the following substances:

- Barium diboron tetraoxide;
- S-(tricyclo[5.2.1.0 2,6]deca-3-en-8(or 9)-yl) O-(isopropyl or isobutyl or 2-ethylhexyl) O-(isopropyl or isobutyl or 2-ethylhexyl) phosphorodithioate;
- Diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide; and
- Melamine.

ECHA has selected these substances from the Candidate List of substances of very high concern (SVHC) for this recommendation because, following the agreed approach, they are of the highest priority.

The inclusion of melamine in the draft recommendation was comprehensively commented on by sectors using the substance during the 2024 consultation period but the decision to include it was made after careful consideration of all the issues.

Ofelia Bercaru, Director for Prioritisation and Integration, said:

"When assessing the consequences of including a substance in the Authorisation List, it is important to consider the scope of the legal requirement. In most of its applications, melamine appears to be used as an intermediate, which does not require authorisation under REACH.

"However, applications for authorisation for the remaining uses may potentially create a significant workload for companies and authorities. ECHA is aware of the challenges and considered that balancing the risks posed by melamine with its continued use, requires a policy decision by the Commission and EU Member States."

REACH Update

NOV. 28, 2025

More information about the reasons for recommending these substances for authorisation and about their uses is available in ECHA's recommendation and related documents.

Read More

ECHA, 20-11-25

https://echa.europa.eu/-/four-substances-recommended-for-reach-authorisation

CHEMWATCH
Bulletin Board

Janet's Corner

NOV. 28, 2025

Who am I?

2025-11-28

I am a pale blue, radioactive noble gas produced from the decay of radium.

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

I am a pale blue, radioactive noble gas produced from the decay of radium.

.

Heptachlor

2025-11-28

Heptachlor, chemical formula C10H5Cl7, is an organochlorine compound that was used as an insecticide. It is one of the cyclodiene insecticides. [1] Heptachlor is a white to light tan waxy solid with a camphor-like odour. It is insoluble in water and soluble in xylene, hexane, and alcohol. [2] Heptachlor was used extensively in the past for killing insects in homes, buildings, and on food crops. These uses stopped in 1988. [3] Due to its highly stable structure, heptachlor can persist in the environment for decades. [1] It is readily converted to more potent heptachlor epoxide once it enters the environment or the body. [1,2]

USES [2,3]

- Heptachlor is a constituent of technical grade chlordane, approximately 10 percent by weight.
- Heptachlor was used as an insecticide in the United States from 1953 to 1974. In 1974, nearly all registered uses of heptachlor were cancelled.
- Heptachlor was used from 1953 to 1974 as a soil and seed treatment to protect corn, small grains, and sorghum from pests. It was also used to control ants, cutworms, maggots, termites, and other pests in agriculture and in the home.
- Its sole U.S. manufacturer voluntarily cancelled the sale of heptachlor in 1987.
- In 1988, the sale, distribution, and shipment of existing stocks of all cancelled heptachlor and chlordane products were prohibited in the United States.
- The only commercial use of heptachlor products still permitted is fire ant control in power transformers. In addition, homeowner's use of existing stocks of heptachlor-containing termite control products is also allowed.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- People whose homes were treated for termites with heptachlor may be exposed to heptachlor in the indoor air for many years after treatment.
- Workers who use heptachlor to kill fire ants or who manufacture the chemical may be exposed to it in the air or through the skin.

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 28, 2025

- Heptachlor has been detected in food, including fish, shellfish, dairy products, meat, and poultry.
- Another possible source of exposure is drinking water; heptachlor has been detected at low concentrations in drinking water wells in several states.

Routes of Exposure

- Inhalation – Minor route of exposure for the general population;
- Oral – Primary route of exposure is through the diet;
- Dermal – Minor route of exposure

HEALTH EFFECTS [4]

Acute Health Effects

Acute inhalation exposure to heptachlor in humans has been associated with nervous system effects in a few case studies, while gastrointestinal effects, such as nausea and vomiting, have been reported to occur following accidental ingestion of heptachlor. Effects on the liver and central nervous system have been noted in animals acutely exposed to heptachlor via the oral route. Heptachlor is considered to have high to extreme acute toxicity based on short-term oral tests in rats.

Carcinogenicity

Human studies on heptachlor exposure and cancer are inconclusive. There are several case reports describing a possible link between heptachlor exposure and leukaemia and neuroblastoma; however, insufficient information is available to confirm a causal effect. Several studies on workers exposed via inhalation to heptachlor are available; however, these are limited due to confounding factors and small sample size. Animal studies have reported liver tumours in mice exposed to heptachlor via ingestion. EPA considers heptachlor to be a probable human carcinogen (cancer-causing agent) and has classified it as a Group B2 carcinogen.

Other Effects

Heptachlor has been shown to cross the placenta to the developing foetus in humans. However, inadequate information is available to determine whether heptachlor may cause developmental or reproductive effects in humans. Animal studies have reported developmental effects, including foetal resorptions, and decreased postnatal survival, as well as

reproductive effects such as failure of animals to reproduce, following oral exposure to heptachlor.

SAFETY

First Aid Measures [5]

- **Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- **Ingestion:** If swallowed, give large quantities of water to drink and get medical attention immediately. Never give anything by mouth to an unconscious person.
- Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
- **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Personal Protective Equipment [5]

The following is a list of recommended personal protective equipment when handling heptachlor:
Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN(EU).

- Hand protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Eye protection: Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 28, 2025

- Skin and body protection: Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

REGULATION

United States

OSHA PEL: The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for heptachlor is 0.5 milligrams per cubic metre (mg/m3) of air 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 REL: The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for heptachlor of 0.5 mg/m3 as a TWA for up to a 10-hour workday and a 40-hour workweek. NIOSH also assigns a "Skin" notation to heptachlor. NIOSH considers heptachlor a potential occupational carcinogen [NIOSH 1992].

ACGIH TLV: The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned heptachlor a threshold limit value (TLV) of 0.5 mg/m3 as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also assigns a "Skin" notation to heptachlor. The ACGIH lists heptachlor as an animal carcinogen [ACGIH 1994, p. 22].

REFERENCES

1. http://en.wikipedia.org/wiki/Heptachlor
2. http://scorecard.goodguide.com/chemical-profiles/html/heptachlor.html
3. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=744&tid=135
4. http://toxipedia.org/display/toxipedia/Heptachlor
5. http://www.epa.gov/ttn/atw/hlthef/heptachl.html
6. http://www.atsdr.cdc.gov/toxguides/toxguide-12.pdf
7. http://www.chembase.com/pdf/readme.php?cbid=Heptachlor
8. http://www.osha.gov/SLTC/healthguidelines/heptachlor/recognition.html
9. http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=PS78&brand=SUPELCO&Pag

eToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Fsupelco%2Fps78%3Flang%3Den

10. http://www.safeworkaustralia.gov.au/sites/swa/search/results?k=heptachlor

Non-toxic solvent enables near-perfect recycling of mixed-fiber textiles

2025-11-26

We are producing more textiles than ever before: worldwide, well over one hundred million tons of textiles are manufactured every year—more than twice as much as in the year 2000. This makes it increasingly important not to simply throw away old textiles, but to recover them in an environmentally friendly way.

That is often not easy—especially when it comes to blended fabrics, such as mixtures of cotton and polyester. At TU Wien, a new method has now been developed to separate and recycle such mixed textiles efficiently—in a remarkably simple way, using menthol and benzoic acid, two nontoxic substances.

The research is published in the journal Waste Management.

Five minutes is all it takes

"What may be surprising at first: both menthol and benzoic acid are solid at room temperature. But together they form a liquid—a so-called deep eutectic solvent. This novel liquid is a powerful, nontoxic and easy-to-produce solvent with a wide range of possible applications," explains Andreas Bartl from the Institute of Chemical, Environmental and Bioscience Engineering.

When this new solvent is heated to 216 °C, a fascinating process begins: within just five minutes, the components of the mixed textiles separate from each other. The polyester dissolves completely, while the cotton remains unchanged. It can then be washed, dried and reused, and the polyester portion precipitates upon cooling, is separated, and can also be recycled.

With recovery rates of 100% for cotton and 97% for polyester, the process achieves an almost complete recycling—a result that conventional methods have not been able to reach so far.

Separating, not breaking down

"The truly remarkable thing about this new process is that neither the cotton nor the polyester is damaged or chemically altered," says Bartl.

"Our analyses show that the cotton fibers remain stable and retain their typical properties—they can even be spun into new yarns again. And the polyester also remains unchanged: its structure and melting temperature

are the same as before. This demonstrates how gentle and efficient this recycling process is."

Until now, polyester has usually been chemically broken down during recycling and split into smaller molecular building blocks. The new method, by contrast, preserves the polymer chains intact—which means that the material quality is maintained.

A promising approach

So far, the process has only been tested in the laboratory, but the research team led by Nika Depope and Bartl sees great industrial potential in it. Both the recovered cotton and the recycled polyester can be used for a wide range of applications—for example, for new yarns, fibers, nonwovens or technical textiles.

The team is currently working on making the process even more energy-efficient, since the required temperature of 216 °C is a drawback in terms of energy consumption. However, the researchers are confident that further optimizations are possible—and that the method could in future be used on an industrial scale.

Phys Org, 26 November 2025

https://phys.org

"Sticky Molecule" Offers New Vaccine Strategy Against COVID

2025-11-20

In a surprising discovery, a "sticky molecule" that occurs naturally in our blood vessels could be both a culprit behind blood clots and organ failure during COVID and long COVID and the key to new treatments to counter COVID-related viruses.

Researchers say the molecule, called P-selectin, could turn the tide to develop a new generation of mRNA therapies to combat not just COVID variants, but also other viruses in the same family.

The study, co-led by the Charles Perkins Centre at the University of Sydney, was published in the Journal of Clinical Investigation.

P-selectin is a molecule that already plays a major role in inflammation in our body, acting like a homing signal to immune cells during infection.

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

The study found that P-selectin was especially 'sticky' and attached itself readily to protein 'spikes' on the surface of coronaviruses, SARS-CoV-1, MERS-CoV, and both Wuhan and Delta strains of SARS-CoV-2 (the virus responsible for causing COVID).

"P-selectin is expressed on platelets – the cells that cause blood clots – and it promotes virus and platelet complexes that can cause dangerous blood clots, a major driver of death in severe COVID infection, and also a likely cause of long COVID," said lead researcher Dr Cesar Moreno from the University of Sydney's Charles Perkins Centre and Faculty of Science.

But P-selectin also normally controls white blood cell migration through our body., and our study found that during COVID infection, P-selectin also captures SARS-CoV-2 virus in the blood, holding the virus in blood vessels and blocking its ability to infect our cells."

Importantly, when the researchers created an mRNA-based therapy that could drive P-selectin expression in the absence of inflammation, it provided broad protection against coronavirus infection.

"Since P-selectin can catch the virus and block its ability to infect our cells, we took advantage of this to create a broad-acting mRNA therapy that can protect against known and most likely emerging coronavirus pandemic strains," said Dr Moreno.

The researchers used CRISPR genetic screening to test the entire human genome, looking for any human genes that can block SARS-CoV-2 infection. Beyond P-selectin, they found 33 other new genes that can protect us from SARS- CoV-2, and these genes can likely also be used as protective therapies against coronavirus and probably also other major viral infections.

"Vaccines have significantly reduced disease severity and deaths, but whether it's coronavirus or other strains, at some stage new pandemics will pose a threat to us. Having broad, easily manufactured mRNA therapies ready can help mitigate these risks," said senior author Professor Greg Neely, Head of the Dr. John and Anne Chong Lab for Functional Genomics at the University of Sydney.

"In some cases people can't get vaccinated, and for these people our strategy can provide another source of protection from current or emerging viral threats,"

"We now have a realistic strategy to future-proof against the next pandemic."

Technology Networks, 20 November 2025

https://technologynetworks.com

Chemical computer can recognise patterns and perform multiple tasks

2025-11-12

A chemical computer made from a network of enzymes can perform a variety of tasks, like measuring temperatures or identifying substances, without needing to be rebuilt each time. This makes it more like an adaptive biological system than a digital circuit, and offers the promise of linking computers with biology.

Living organisms contain molecular networks that constantly integrate chemical and physical signals, such as when cells sense nutrients, hormones or temperature changes and adjust to stay alive. For decades, researchers have tried to mimic this in a variety of ways, such as building logic gates from DNA, but most of these artificial systems have been either too simple, too rigid or too difficult to scale.

Now, Wilhelm Huck at Radboud University in the Netherlands and his colleagues have taken a different approach. Instead of programming each chemical step, they built a system in which enzymes interact freely, creating complex behaviours that can learn to recognise patterns in chemical inputs.

The team's computer uses seven different types of enzymes loaded onto tiny hydrogel beads packed inside a small tube. A liquid flows through this tube and can be injected with short chains of amino acids called peptides, which serve as the "input" for the computer. As the peptides pass the enzymes, each enzyme naturally tries to cut them at specific sites along the peptide chain. But once one enzyme makes a cut, the peptide's shape and available cutting sites change, which can either open or block opportunities for the other enzymes.

Because one reaction can feed into the next, the enzymes create a constantly changing chemical network, producing distinctive patterns that the system can interpret. "We can think of the enzymes as … hardware and the peptides as software [that] solves new problems depending on

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

the inputs," says Dongyang Li at the California Institute of Technology, who wasn't involved in the work.

For example, temperature affects how fast each enzyme works; at higher temperatures, some enzymes speed up more than others, shifting the mix of peptide fragments in the system's output. By analysing these peptide fragments using a machine learning algorithm, the researchers could link these fragment patterns to specific temperatures.

Because different chemical reactions happen on various timescales, the system naturally retains a kind of "memory" of past signals, letting it recognise patterns that unfold over time. For example, it could tell the difference between fast and slow light pulses, meaning it isn't just reacting to inputs, but also tracking how they change.

The result isn't a static chemical circuit, but rather a dynamic, multitasking chemical computer that processes signals like a living system. "The same network handled multiple tasks – chemical classification, temperature sensing with ~1.3°C average error from 25°C-55°C, pH classification and even responding to light-pulse periodicity – without redesigning the chemistry," says Li.

The researchers were surprised by how well the computer performed, given its small size, and Huck says he hopes a more advanced system could one day be used to translate optical or electrical signals directly into chemical ones, allowing it to respond in the way that living cells do. "We only used six or seven enzymes and six peptides," he says. "Imagine what you can do with a hundred enzymes."

New Scientist, 12 November 2025

https://newsacientist.com

'Plumbyne' compound featuring multiple carbon–lead bonds synthesised

2025-11-28

A compound which features multiple bonds between lead and carbon has been isolated and characterised. This heteronuclear 'plumbyne' fills a gap among group 14 alkyne analogues and could offer a starting point to create rarer main group species.

Bonding in organo-lead compounds is typically limited to single lead–carbon bonds, owing to lead's large atomic size and poor orbital energy match to other atoms. Relativistic effects also suppress lead's ability to

form higher-order π bonds. Compounds where lead forms multiple bonds to other lead, transition metal or non-metal atoms exist, but are rare.

By balancing electronic and steric factors, researchers in China have now created a compound that features multiple bonds between lead and carbon.1 An aryl group with bulky substituents and an N-heterocyclic carbene containing phosphorus are connected to the ends of a central lead–carbon bond. The team previously used a similar structure to create the lighter tin 'stannyne' equivalent.2

X-ray diffraction showed that the lead–based compound adopted a trans bonding arrangement, with a central carbon–lead bond length of 2.172Å. The substituents were shown to be nearly orthogonal to each other, which is thought to improve orbital overlap and increase stability of the P–C–Pb linkage. Computational analysis of a simplified structure revealed that the most prevalent resonance form features a P=C=Pb bonding pattern.

Reactions using the compound were possible, where addition of ammonium hydrochloride easily saturated the multiple carbon–lead bond, which the researchers attribute to the bond's relatively weak nature. Using a tin-based reagent saw bond–metathesis occur, creating a new tin compound and lead byproduct, though the exact reaction mechanism remains unclear. The researchers hope that this plumbyne compound will act as platform to access other rare main group species.

Chemistry World, 28 November 2025

https://chemistryworld.com

Unstable protein linked to cancer reveals dynamic behavior

2025-11-27

Around 80% of proteins involved in diseases like cancer and neurodegenerative illnesses do not have a stable structure. These proteins, known as intrinsically disordered proteins (IDPs) can quickly adapt to the conditions in our cells. A better understanding could aid in developing new therapeutic methods.

A research team working under Puja Shrestha and Professor Simon Ebbinghaus (Ruhr University Bochum and Research Center Chemical Sciences and Sustainability, Germany) has examined one of these proteins more closely and described its dynamic behavior. Their work was published in Advanced Science on October 27, 2025.

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

Multifunctional protein

The study focused on a folded segment known as the cold-shock domain (CSD/CSDex) within the YB1 protein, an IDP with multiple functions in the cell. The researchers wanted to know how this segment maintains its structural stability. The protein is involved in many of the cell's most important activities, including the reading of genes, production of proteins, and processing of RNA.

"Because of its close link to cancer growth and drug resistance, understanding how the YB1 protein folds and functions could help in developing new treatment methods," hopes doctoral student Shrestha.

The team found that the CSDex protein exhibits moderate stability under physiological conditions. Half of the molecule is in its folded structure while the other half remains unfolded. If the protein binds to nucleic acids, it entirely transitions into its folded state.

"This indicates that these interactions stabilize the protein in a way that helps fix it in its functional form," says Ebbinghaus.

Knowledge for treating diseases

The team also shows that the protein can take on many different structures, thereby facilitating quick and efficient interaction with a range of nucleic acids. The moderate stability of CSDex could present a natural compromise that gives it the flexibility to efficiently interact with many different molecules while performing numerous functions.

"CSDex-nucleic acid interactions result in an overproduction of different proteins or the repair of nucleic acids, for example, which makes cancer cells more resistant to chemotherapy," explains Shrestha.

Future research could develop molecules that target CSDex-nucleic complexes and specifically block disease-related interactions.

Phys Org, 27 November 2025

https://phys.org

How Close Is MDMA to Becoming a Psychiatric Treatment?

2025-11-05

MDMA (3,4-methylenedioxymethamphetamine), once widely known as the recreational drug "ecstasy," is steadily emerging as a promising addition

in psychiatric therapy, particularly for treatment-resistant posttraumatic stress disorder (PTSD). Following decades of research, a growing body of clinical evidence suggests that, when combined with structured psychotherapy, MDMA can produce profound and lasting improvements in patients who have not responded to conventional treatments.

Yet, despite its potential, regulatory hurdles and safety considerations mean that its path to mainstream psychiatric use remains carefully guarded.

In a recent invited review, Dr. Kenji Hashimoto and colleagues investigated MDMA's evolving role in psychiatry, spanning over 100 primary studies, the neurobiological mechanisms underlying its therapeutic effects and emerging insights into gut–brain and vagus nerve–mediated resilience. The review also addresses regulatory challenges, safety concerns and the prospects of MDMA-assisted therapy in conditions beyond PTSD, including autism spectrum disorder (ASD), eating disorders and existential distress.

To explore these themes further, Technology Networks spoke with Hashimoto about the current state of MDMA research and the questions that must be addressed before this treatment can be integrated into mainstream clinical practice.

Rhianna-lily Smith (RLS): Following the Food and Drug Administration's (FDA) recent request for further Phase 3 trials, the field is at a critical juncture. How do you interpret the current regulatory climate for MDMA?

Kenji Hashimoto, PhD (KH): The current regulatory climate reflects both caution and progress. Although the FDA's request for additional Phase 3 data delays approval, it underscores the agency's commitment to robust evidence of safety and efficacy.

In the long term, this should strengthen the scientific foundation and public trust in MDMA-assisted therapy.

RLS: PTSD has shown the most robust clinical outcomes with MDMA-assisted therapy. What makes PTSD particularly responsive compared with other psychiatric conditions?

KH: PTSD may be especially responsive to MDMA-assisted therapy because MDMA's acute effects – reduced amygdala reactivity, enhanced prefrontal–amygdala connectivity and increased oxytocin and prosocial trust – directly support fear extinction and trauma-memory reconsolidation during psychotherapy. These mechanisms reduce

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

hyperarousal and avoidance, enabling deeper engagement with traumatic material.

In addition, the structured therapy model and the clear, event-anchored pathology of PTSD align well with MDMA's mechanism of action, yielding more robust and reproducible outcomes than in more heterogeneous conditions (e.g., ASD).

RLS: Can you explain how the gut–brain axis and vagus nerve signaling might contribute to MDMA's long-lasting resilience effects?

KH: MDMA's principal pharmacological actions are monoaminergic, with particularly strong effects on the serotonergic system.

MDMA's GI actions may enhance long-term resilience by modulating the gut–brain–vagus nerve axis. By increasing vagal tone and promoting anti-inflammatory, microbiota-derived metabolites, MDMA can influence immune, endocrine and autonomic pathways that stabilize mood and stress reactivity.

This vagus-mediated homeostatic regulation may help explain the sustained psychological benefits observed after treatment.

RLS: Were there any findings in your literature review that surprised you or challenged your previous assumptions?

KH: One finding that genuinely surprised me is the growing evidence linking MDMA's long-term psychological effects to peripheral mechanisms, particularly the gut–brain–vagus nerve axis.

I had initially assumed, along with many others, that MDMA's resilience-enhancing effects were primarily central, mediated by cortical–limbic plasticity. However, accumulating data suggest that peripheral immune and microbiota–vagal pathways also play a significant role in sustaining mood stability and stress adaptation, broadening our understanding of MDMA's therapeutic potential beyond the brain itself.

RLS: How does MDMA compare with psilocybin or ketamine in terms of safety, efficacy and mechanisms of action?

KH: Given reports that repeated MDMA use can cause adverse effects, I do not recommend MDMA outside rigorously controlled clinical trials or protocols.

The FDA will determine the future of MDMA-assisted psychotherapy based on forthcoming evidence. In parallel, vagus nerve–dependent

gut–brain interventions – such as targeted probiotics, fecal microbiota transplantation or vagus nerve stimulation – may offer alternative approaches for PTSD and other mental health conditions.

RLS: If MDMA ultimately gains regulatory approval, how do you envision it being integrated into mainstream psychiatry?

KH: If approved, MDMA-assisted therapy would likely be implemented in a tightly regulated, team-based model.

Certified clinics would be staffed by trained MD/PhD/therapist dyads, and therapy would follow standardized preparation, dosing and integration sessions. Patients would undergo rigorous screening, including assessment of cardiovascular risk and concomitant medications such as monoamine oxidase inhibitors or selective serotonin reuptake inhibitors (SSRIs) and would provide informed consent.

Follow-ups would be measurement-based, with registries established to monitor long-term safety. Clinicians would receive ongoing training and credentialing to maintain high standards of care. Digital tools, such as tele-preparation and integration, along with equity safeguards, would help broaden access while maintaining strict risk management.

RLS: What do you see as the most important scientific or clinical question that must be answered before MDMA can move into mainstream psychiatric practice?

KH: The pivotal question is: What durable, incremental benefit does MDMA provide over optimized, evidence-based psychotherapy alone – and in whom?

Answering this will require large, well-blinded, multi-site trials with active psychotherapy controls assessing 12–24-month outcomes, safety (including cardiovascular and misuse risks) and functional recovery. Embedded biomarker/predictor work (e.g., comorbidities, SSRI use, autonomic markers) should identify responders and refine dosing and therapy fidelity.

Technology Networks, 5 November 2025

https://technologynetworks.com

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

A surprising new method finally makes teflon recyclable

2025-11-27

New research has identified a straightforward and environmentally friendly way to decompose Teflon, one of the most resilient plastics in use today, and convert it into valuable chemical ingredients.

Scientists at Newcastle University and the University of Birmingham have created a clean, energy-saving process for recycling Teflon (PTFE), which is widely recognized for its role in non-stick cookware and in products that must withstand high temperatures and harsh chemicals.

The team found that discarded Teflon can be broken apart and reused with only sodium metal and mechanical movement by shaking -- all at room temperature and without toxic solvents.

Their study, published in the Journal of the American Chemical Society (JACS), outlines a low-energy and waste-free alternative to standard fluorine recovery techniques.

Breaking Carbon-Fluorine Bonds to Recover Useful Fluoride

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.

"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 of the University of Birmingham added: "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."

Why Recycling PTFE Is So Difficult

Polytetrafluoroethylene (PTFE), often called Teflon, is valued for its resistance to heat and chemicals, making it a key material in cookware,

electronics, and laboratory tools. However, those same strengths have made it extremely difficult to recycle.

When PTFE is burned or incinerated, it releases persistent pollutants known as 'forever chemicals' (PFAS), which remain in ecosystems for decades. As a result, traditional disposal methods pose significant environmental and public health risks.

Mechanochemistry Provides a Cleaner Path Forward

To address this challenge, the researchers used mechanochemistry, a sustainable approach in which mechanical force drives chemical reactions rather than high heat.

Inside a sealed steel container called a ball mill, small pieces of sodium metal are ground together with Teflon. This grinding causes the materials to react at room temperature, breaking the carbon-fluorine bonds within Teflon and producing harmless carbon along with sodium fluoride, a stable salt widely used in fluoride toothpaste.

The team also demonstrated that the sodium fluoride generated through this method can be used immediately, without additional purification, to synthesize other valuable fluorine-containing compounds used in pharmaceuticals, diagnostic tools, and specialty chemicals.

Confirming Clean Reactions With Advanced NMR Analysis

Associate Professor Dr. Dominik Kubicki, who leads the University of Birmingham's solid-state Nuclear Magnetic Resonance (NMR) team, explained: "We used advanced solid-state NMR spectroscopy -- one of our specialities 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."

Toward a Circular Fluorine Economy

This discovery points toward a circular system in which fluorine can be recovered from industrial waste instead of being lost through disposal. Such a model could greatly reduce the environmental impact of fluorine-based chemicals that play essential roles in medicine, electronics, and renewable energy systems.

"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

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

waste and help make the production of vital fluorine-containing compounds more sustainable."

The study also underscores the expanding role of mechanochemistry in green chemistry. This emerging field replaces high-temperature or solvent-heavy reactions with mechanical motion, opening new opportunities 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."

Science Daily, 27 November 2025

https://sciencedaily.com

How carbonates influence CO_2-to-fuel conversion: New insights from gold electrocatalysts

2025-11-25

Researchers from the Helmholtz Zentrum Berlin (HZB) and the Fritz Haber Institute of the Max Planck Society (FHI) have uncovered how carbonate molecules affect the conversion of CO2 into valuable fuels on gold electrocatalysts. Their findings reveal key molecular mechanisms in CO2 electrocatalysis and hydrogen evolution, pointing to new strategies for improving energy efficiency and reaction selectivity.

Introduction to CO2 electroreduction

Turning atmospheric CO2 into fuels through electrocatalysis offers a sustainable alternative to fossil resources, but the process remains inefficient and costly. Competing reactions such as the hydrogen evolution limit performance, and the key to improvement lies at the catalyst interface: hydration layers formed by water and electrolytes regulate how efficiently these chemical transformations occur.

"However, the role of carbonate anions and the nature of the interfacial hydration layers during CO2 electroreduction is still poorly understood," says Dr. Christopher Kley, Helmholtz Young Investigator Group Leader at HZB and the Interface Science Department at FHI.

The role of carbonates and their radicals

To address these questions, Kley's team member Dr. Ya-Wei Zhou established advanced spectroscopic techniques, including attenuated total reflectance surface-enhanced infrared absorption spectroscopy (ATR-SEIRAS).

"This allowed us to detect carbonate anion radicals ($CO_3^{\bullet-}$) originating from hydrated carbonate. Carbonates promote molecular ordering within interfacial hydration layers and the radicals act as proton relay and facilitate charge transfer to gold, accelerating hydrogen evolution," explains Dr. Zhou, first author of the study.

Further analysis using differential mass spectrometry (DEMS) revealed that carbonate radicals are also a carbon source, producing formaldehyde. Complementary isotope-labeled spectroscopy and density functional theory (DFT) modeling by Prof. Nuria Lopez's team at ICIQ in Tarragona (Spain) confirmed that water is the primary proton donor, rather than bicarbonate, shedding light on a long controversy in the literature.

Implications for future research

"These findings provide a new molecular-level perspective on the competition between CO_2 electroreduction and hydrogen evolution on gold electrodes, prompting a reevaluation of the origin of electrocatalytic selectivity that need to be explored for materials systems such as copper which have shown more intricate selectivity trends," says Prof. Beatriz Roldán Cuenya from FHI.

By showing how carbonate molecules shape the local environment at the catalyst surface, the study highlights strategies to enhance reaction efficiency and selectivity, advancing electrocatalytic CO_2 conversion and the development of more effective electrocatalytic systems for sustainable energy applications.

Phys Org, 25 November 2025

https://phys.org

Scientists Unveil Breakthrough Low-Temperature Fuel Cell That Could Revolutionize Hydrogen Power

2025-11-25

Researchers at Kyushu University have created a solid oxide fuel cell (SOFC) exhibiting exceptionally high proton conductivity at 300°C.

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

As worldwide energy needs continue to rise, scientists, industry leaders, and policymakers are collaborating to find reliable ways to meet growing demand. This effort has become increasingly urgent as nations work to confront climate change and reduce dependence on fossil fuels.

Among the most promising technologies being explored are solid-oxide fuel cells, or SOFCs. Unlike batteries, which store energy and then release it, fuel cells generate electricity by continuously converting chemical fuel into power as long as a fuel supply is available. Many people are already familiar with hydrogen fuel cells, which produce electricity and water from hydrogen gas.

SOFCs stand out for their high efficiency and long operational life. However, they have traditionally required extremely high operating temperatures of about 700-800 . Systems built to withstand this heat must rely on specialized, expensive materials, which limits how widely the technology can be used.

In a new study published in Nature Materials, researchers at Kyushu University announce that they have created an SOFC capable of efficient operation at only 300 . According to the team, this achievement could enable affordable, low-temperature SOFC designs and significantly speed up the transition of this technology from the laboratory to real-world applications.

Understanding the Role of the Electrolyte

The heart of an SOFC is the electrolyte, a ceramic layer that carries charged particles between two electrodes. In hydrogen fuel cells, the electrolyte transports hydrogen ions (a.k.a. protons) to generate energy. However, the fuel cell needs to operate at the extremally high temperatures to run efficiently.

"Bringing the working temperature down to 300 it would slash material costs and open the door to consumer-level systems," explains Professor Yoshihiro Yamazaki from Kyushu University's Platform of Inter-/Transdisciplinary Energy Research, who led the study. "However, no known ceramic could carry enough protons that fast at such 'warm' conditions. So, we set out to break that bottleneck."

Electrolytes are composed of different combinations of atoms arranged in a crystal lattice structure. It's between these atoms that a proton would travel. Researchers have explored different combinations of materials and chemical dopants—substances that can alter the material's physical

properties—to improve the speed at which protons travel through electrolytes.

"But this also comes with a challenge," continues Yamazaki. "Adding chemical dopants can increase the number of mobile protons passing through an electrolyte, but it usually clogs the crystal lattice, slowing the protons down. We looked for oxide crystals that could host many protons and let them move freely—a balance that our new study finally struck."

The Breakthrough: Scandium-Doped Oxides

The team found that two compounds, barium stannate (BaSnO3) and barium titanate (BaTiO3), when doped with high concentrations of scandium (Sc), were able achieve the SOFC benchmark proton conductivity of more that 0.01 S/cm at 300 , a conductivity level comparable to today's common SOFC electrolytes at 600-700 .

"Structural analysis and molecular dynamics simulations revealed that the Sc atoms link their surrounding oxygens to form a 'ScO_6 highway,' along which protons travel with an unusually low migration barrier. This pathway is both wide and softly vibrating, which prevents the proton-trapping that normally plagues heavily doped oxides," explains Yamazaki. "Lattice-dynamics data further revealed that $BaSnO_3$ and $BaTiO_3$ are intrinsically 'softer' than conventional SOFC materials, letting them absorb far more Sc than previously assumed."

The findings overturn the trade-off between dopant level and ion transport, offering a clear path for low-cost, intermediate-temperature SOFCs.

"Beyond fuel cells, the same principle can be applied to other technologies, such as low-temperature electrolyzes, hydrogen pumps, and reactors that convert CO_2 into valuable chemicals, thereby multiplying the impact of decarbonization. Our work transforms a long-standing scientific paradox into a practical solution, bringing affordable hydrogen power closer to everyday life," concludes Yamazaki.

Sci Tech Daily, 25 November 2025

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Gossip
NOV. 28, 2025

Lithium mining waste finds purpose in strengthening concrete

2025-11-27

Concrete is the world's most manufactured item, with more than 25 billion tons used in construction each year. It's also responsible for consuming vast quantities of non-renewable resources, and spewing out 8% of all greenhouse gas emissions annually. So any steps we can take towards reducing the impact of its production on the planet is a worthwhile effort.

To that end, researchers in South Australia have found a way to funnel the byproduct of another destructive process – lithium mining – into making stronger and more durable concrete.

The challenge with lithium mining is that we depend heavily on this element to manufacture batteries for electronics and zero-emission electric vehicles – but the process of extracting it is extremely taxing on the environment. It has to be mined out of hard rock deposits containing minerals like spodumene ore, and this produces a lot of waste.

In particular, producing one ton of lithium hydroxide monohydrate generates about 7-10 tons of a byproduct called delithiated β-spodumene (DβS), but its uses haven't been well understood thus far. That results in it being disposed as hazardous waste, which poses environmental risks on top of the damage already caused by getting lithium out of the ground.

Engineers from Flinders University found that DβS exhibits pozzolanic properties, which means it reacts chemically to enhance the strength and durability of concrete by making it less permeable and also resistant to corrosion. Their study revealed when used as a binding agent in producing concrete, DβS can significantly improve mechanical performance and long-term resilience.

The team essentially replaced fly ash – a waste product from coal combustion – in creating geopolymer paste which acts as a binder in concrete. Replacing 25% of the fly ash content with DβS using an optimal alkaline activating solution ratio resulted in a 34% increase in the strength of concrete, compared to an equivalent mix with 100% fly ash. Adjusting the mix ratio of alkaline activating solutions led to a strength increase of 74%.

That shows that DβS can help produce concrete that's stronger than the usual stuff made with fly ash. It's the result of a denser and more robust internal structure of the concrete after 28 days of curing.

"With lithium refining responsible for generating increased volumes of DβS, the capability to reuse this in construction offers a sustainable solution that will reduce industrial waste, prevent potential soil and groundwater contamination, and support circular economic practices in the mining and building sectors," explained structural engineer Dr. Aliakbar Gholampur, who led the study that appeared in the journal Materials and Structures last month.

Dr. Gholampur has been at this for a while now. Back in 2022, he led a study showing how geopolymers reinforced with natural fibers and waste-based sands could feature in new-age concrete mixes with comparable strength and durability.

If you're into sustainable concrete, take a look at our previous stories on the material, including this one about recycling waste concrete from construction sites for new projects, a method for using old concrete in steel-processing furnaces to produce reactivated zero-carbon cement, and a 10x improvement on the already radical concept of a concrete battery.

New Atlas, 27 November 2025

https://newatlas.com

Microplastics Disrupt Gut Microbiome and Fermentation in Farm Animals

2025-11-27

Microplastics, tiny plastic particles pervasive in agricultural environments, interact with and disrupt the microbial ecosystem in the rumen – the first stomach chamber of cattle, reveals an international study.

"Our work is a first step toward understanding the biological consequences of microplastic exposure in farm animals," said lead researcher Daniel Brugger, Associate Professor of Companion and Monogastric Production Animal Nutrition at the University of Helsinki. "There is an urgent need for in-vivo studies to better understand the impacts on animal health and food safety, especially as global plastic production continues to rise."

The findings of a joint study from the University of Helsinki, University of Zurich, University of Hohenheim, and Technical University of Munich not only shed light on how microplastics are transformed within the digestive system of farm animals but also highlight potential risks for animal health, productivity, and food safety.

Using a controlled laboratory fermentation system, researchers incubated rumen fluid from cows with hay or barley and five common types of microplastics found in agricultural settings: polylactic acid (PLA), polyhydroxybutyrate (PHB), high-density polyethylene (HDPE), polyvinyl chloride (PVC), and polypropylene (PP). The microplastics were tested in various particle sizes and doses to evaluate their impact on rumen fermentation, microbial activity, and the plastics themselves.

The key findings of the study are:

- All tested microplastics did not remain inert in the rumen; instead, they interacted with the microbial ecosystem, altering fermentation and microbial functions.
- Their presence consistently reduced cumulative gas production, a key indicator of overall fermentation activity, regardless of plastic type, particle size, or dose.
- Total dry-matter disappearance increased with microplastic addition, suggesting that not only feed but also part of the plastic mass was broken down during fermentation, and potentially reduced microplastic size, increasing tissue penetration risk

- In barley-based incubations, microbial activity shifted, with proteins linked to stress responses increasing, while those involved in carbohydrate and amino-acid metabolism decreased - a pattern that is typical of a microbial stress response.

These results indicate that microplastics disturb normal microbial metabolism and are likely to be at least partially degraded into smaller fragments by rumen microbes.

Implications for agriculture and food safety

The study closes an important knowledge gap about how microplastics behave in the digestive systems of farm animals. While previous research has established that livestock are exposed to microplastics through contaminated soils and feed, it was unclear whether these particles remained unchanged or interacted with the microbiome.

"Our study shows for the first time that microplastics do not simply pass through the digestive tract of farm animals. Instead, they interact with the gut microbiome, alter fermentation processes, and are partially broken down," says Jana Seifert, Professor of Functional Microbiology of Livestock at the University of Hohenheim, Germany. "This means farm animals are not passive recipients of plastic pollution; their digestive systems may act as bioreactors that transform microplastics and redistribute them within agricultural systems."

However, the findings also raise significant concerns. A stressed, less efficient microbiome could negatively impact animal health and productivity. Additionally, smaller plastic fragments formed during digestion may be more easily absorbed into tissues, potentially entering the human food chain. This risk could be particularly pronounced in young or stressed animals with more permeable intestinal barriers.

How to avoid plastics ending up to the feed-food chain?

Researchers raise the need for better management of plastic use in agriculture, including silage films, packaging materials, and sewage sludge on fields, to reduce microplastic contamination in animal feed. "Plastic pollution isn't just an environmental issue 'out there.' It has direct biological consequences for farm animals, and potentially for humans, through the food chain," Cordt Zollfrank, Professor of Biogenic Polymers at the Technical University of Munich, Germany, emphasises.

The research also provides a scientific foundation for future risk assessments and monitoring. Regulators, veterinarians, and the feed

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

industry now have experimental evidence that microplastics interact with the rumen microbiome and are partially transformed. This must be considered when defining acceptable contamination levels and developing methods to detect plastics in feed, manure, and animal products.

"Our findings may also help to inform future research on microplastic–microbiome interactions in non-ruminant species, such as pigs, although this still needs to be tested in those animals," says Brugger.

Technology Networks, 27 November 2025

https://technologynetworks.com

The chemist using curry to understand indoor air pollution

2025-11-28

If you're cooking a curry, Ashish Kumar has a piece of advice – switch on your extractor fan. Or, if that's not an option, open a window. Why? Because his research shows that cooking curries in poorly ventilated spaces can lead to high levels of volatile organic compounds (VOCs),1,2 some of which are linked to negative health effects with regular exposure.

Outdoor air quality has long been on the agenda of chemists, policymakers and others. But our understanding and regulation of indoor pollution is at a much earlier stage. Most people spend about 90% of their time indoors, either at home or at work, yet 'we have very little information on what we are breathing and what sort of pollutants are present inside our homes,' explains Kumar. However, the data we do have suggests that these pollutants can sometimes be about five times higher in concentration than in the outside air, he adds.

Kumar, who until recently was a postdoctoral researcher at the University of York, is one of a growing number of scientists working to close this knowledge gap. He was researching how everyday activities in the home influence indoor air quality as part of Ingenious – a UK-based collaboration seeking to better understand air pollution in homes.3 Working with Terry Dillon, one of Kumar's projects involved tracking the emissions released when cooking a chicken curry.

Chicken in a fried onion sauce

Seeking a recipe that reflects typical UK home-cooked curries, Kumar and his colleagues based their study on Madhur Jaffrey's chicken in a fried

onion sauce. 'Coming from India, that is what I am also familiar with,' says Kumar 'It's a common curry that I would cook at my home as opposed to one you would find in a restaurant.'

The experiments were performed in an outbuilding adjacent to York's Wolfson Atmospheric Chemistry Laboratories and analysed with selected ion flow tube mass spectrometry.

Before turning their attention to the full complexity of a curry, Kumar and his colleagues began with its individual ingredients and the emissions they released when heated. First, they measured the VOCs emitted while frying wheat flatbread dough or puri in a variety of oils including rapeseed oil and ghee. Next, they characterised and quantified the compounds released when shallow-frying dried cumin, turmeric and coriander, as well as fresh ginger, garlic and chilli pepper.

They even compared two samples of cumin – one freshly bought from the supermarket and another that had lingered in a cupboard for 18 months, before they tested other dried herbs and spices not included in the curry recipe. 'It's sort of a detective work. You have to find the fingerprints,' says Kumar.

The experiments confirmed that cooking has a significant impact on indoor air chemistry. Across the individual cooking experiments, they identified 105 distinct VOCs in the cooking plumes of the five dried herbs and 11 ground spices. This included 19 aromatics, 14 terpenoids, 15 aldehydes, nine alkanes, six haloalkanes, seven alcohols, seven alkenes, six esters, six furans, seven ketones, five nitrogen-containing compounds, five sulfur-containing compounds and four acids. The age of the cumin made a difference, with the fresher sample emitting much higher levels of monoterpenes, while the older sample emitted about three times more methanol. Ginger released a notable amount of eucalyptol and other monoterpenoids, accounting for nearly a third of its total VOC emissions.

When it came to cooking the full curry, there were two distinct VOC spikes. The first spike in alcohol emissions, dominated by methanol, occurred as onion, garlic, ginger and chilli hit the hot oil. Ethanol levels remained low until the second spike, which came when tomatoes were added to the pan. Aldehyde concentrations rose steadily with heating and surged as the vegetables were added. And, as predicted, the dried spices – turmeric, cumin, chilli powder and coriander – triggered a noticeable release of monoterpenes.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

Kumar notes that many of the emissions aren't necessarily bad for your health per se. However, some VOCs, especially the monoterpenes, are highly reactive and can quickly form harmful byproducts like formaldehyde when oxidised by radicals and ozone in air. 'So it's the secondary products that are much more concerning, rather than the primary emissions.'

Definitely do not stop cooking curry at home, says Kumar, 'that's not what we advise'. But he does recommend using an extractor fan to reduce your exposure to fumes and to cook on the back rings of the hob, where extraction is more effective. This is even more relevant given newer buildings are increasingly designed to retain heat, making them more airtight. 'Without fresh air coming in, we end up breathing the same air day in, day out, exposing ourselves to potentially harmful pollutants.'

Chemistry World, 28 November 2025

https://chemikstryworld.com

New Catalyst Design Solves a Decades-Old Chemical Challenge

2025-11-19

Researchers have created an iron-based catalyst that controls methane's extreme reactivity, opening the door for natural gas to serve as a sustainable feedstock for high-value chemicals, including pharmaceuticals.

Natural gas, one of the most plentiful energy resources on Earth, consists mainly of methane, ethane, and propane. Although it is commonly burned for power and contributes to greenhouse gas emissions, researchers have long looked for ways to convert these stable hydrocarbons into useful chemicals instead. Their low reactivity has made this goal difficult, limiting natural gas as a sustainable starting point for chemical manufacturing.

A research group led by Martín Fañanás at the Centre for Research in Biological Chemistry and Molecular Materials (CiQUS) at the University of Santiago de Compostela has now introduced a method that overcomes this barrier. Their approach converts methane and other components of natural gas into flexible chemical "building blocks" that can be used to create high-value products, including pharmaceuticals. The work, published in Science Advances, marks an important step toward a more efficient and environmentally responsible chemical industry.

In a key demonstration, the CiQUS team produced the bioactive compound dimestrol, a non-steroidal estrogen used in hormone therapy, directly from methane. This milestone shows how their technique can generate complex and valuable molecules from a simple and inexpensive resource.

Taming Free Radicals to Unlock New Chemical Pathways

The researchers focused their approach on a reaction known as allylation, which adds a small chemical "handle" (an allyl group) to the gas molecule. This added group acts as a flexible anchor that allows many different products to be built in later steps, including pharmaceutical ingredients and common industrial chemicals. Until now, a major obstacle was that the catalytic system often generated unwanted chlorinated byproducts, which disrupted the entire process.

To overcome this obstacle, the team engineered a tailor-made supramolecular catalyst. "The core of this breakthrough lies in designing a catalyst based on a tetrachloroferrate anion stabilized by collidinium cations, which effectively modulates the reactivity of the radical species generated in the reaction medium," explains Prof. Fañanás. "The formation of an intricate network of hydrogen bonds around the iron atom sustains the photocatalytic reactivity required to activate the alkane, while simultaneously suppressing the catalyst's tendency to undergo competing chlorination reactions. This creates an optimal environment for the selective allylation reaction to proceed."

Beyond its effectiveness, the method stands out for its sustainability. It uses iron—a cheap, abundant, and far less toxic metal than the precious metals typically used in catalysis—and operates under mild temperature and pressure conditions, powered by LED light. This significantly reduces both environmental impact and energy costs.

This work is part of a broader research line funded by the European Research Council (ERC), focused on upgrading the main components of natural gas. In a complementary advance published in Cell Reports Physical Science, the same team presented a method to directly couple these gases with acid chlorides, yielding industrially relevant ketones in a single step. Both studies, based on photocatalytic strategies, position CiQUS as a leader in developing innovative chemical solutions to harness abundant raw materials.

Transforming Natural Gas into Versatile Chemical Intermediates

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

The ability to convert natural gas into versatile chemical intermediates opens up new possibilities for industry, laying the foundation to gradually replace petrochemical sources with more sustainable alternatives.

Sci Tech Daily, 19 November 2025

https://scitechdaily.com

Surprising twist: Chirality in polymers enhances conductivity after doping

2025-11-25

A new study marks a significant step forward in positioning synthetic polymers as an alternative to expensive, unsustainable minerals used in the manufacture of devices such as conductors, transistors and diodes. These newly tweaked polymers—developed by University of Illinois Urbana-Champaign professors Ying Diao and Joaquín Rodríguez López in collaboration with Jean-Luc Brédas of the University of Arizona, John Reynolds of Georgia Tech and Dali Sun of North Carolina State University—possess special properties enabled by controlled chirality and chemical doping. The study findings are published in the journal Nature Communications.

Understanding chirality and doping in polymers

Chirality, which can arise from persistent twisting of a polymer's backbone, is one of nature's strategies for building complexity. One advantage of chirality is that it allows materials to efficiently funnel electricity by transporting electrons with the same spin direction—or quantum state.

Doping, the addition of chemicals to enhance performance, has long been used to improve conductivity in semiconductors; however, research and development in doping polymer-based semiconductor molecules has lagged.

"We were very surprised to find that structural chirality, which up to now had not been considered a parameter relevant to doping, significantly boosts the chemical reaction that controls doping in polymers," said Diao, who is a professor of chemical and biomolecular engineering at Illinois.

Unexpected results

In the lab, researchers were able to twist polymers using a variety of solvent-processing techniques, doing so in a controlled manner while measuring the polymers' conductivity.

"In our previous research, increased chirality was found to be harmful for charge mobility," Diao said. "This is because such twisting caused charges to become more localized, reducing their ability to move freely through the material, which lowered mobility and overall conductivity."

However, the current findings reveal a surprising reversal: after doping the polymer, increased chirality leads to higher conductivity.

Unanswered questions

Diao and Rodríguez López's team said that they are uncertain about how and why this occurs. The primary mechanism proposed—that chirality influences electron spin to enhance conductivity during doping—remains a hypothesis.

"More studies are needed to clarify the exact processes at play when chirality tunes the conductivity in doped polymers, and for this to move on to commercial technologies, we will require further research and validation," Diao said. "Our focus for future work will be on scientifically proving the mechanism that we have hypothesized and exploring the practical uses for the phenomenon."

Phys Org, 25 November 2025

https://phys.org

Toxic waste could become the next clean energy breakthrough

2025-09-26

A sticky, toxic by-product that has long plagued renewable energy production may soon become a valuable resource, according to a new review published in Biochar.

When biomass such as crop residues, wood, or other organic matter is heated to produce clean energy and biochar, it also generates a thick liquid known as bio-tar. This tar easily clogs pipelines, damages equipment, and poses environmental risks if released into the atmosphere. For decades, researchers have sought ways to eliminate or neutralize it.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

Now, a team led by scientists at the Chinese Academy of Agricultural Sciences argues that instead of being treated as waste, bio-tar can be converted into "bio-carbon" -- a novel material with applications ranging from water purification to clean energy storage.

"Our review highlights how turning bio-tar into bio-carbon not only solves a technical problem for the bioenergy industry, but also opens the door to producing advanced carbon materials with high economic value," said senior author Dr. Zonglu Yao.

The review examines how chemical reactions inside bio-tar, particularly those involving oxygen-rich compounds like carbonyls and furans, naturally promote polymerization -- processes where small molecules link together to form larger, more stable carbon structures. By carefully adjusting temperature, reaction time, and additives, researchers can harness this process to produce bio-carbon with tailored properties.

The resulting material, the authors note, is distinct from ordinary biochar. Bio-carbon typically has higher carbon content, lower ash, and unique structural features that make it especially suited for advanced uses. Early studies suggest that bio-carbon could serve as:

- Adsorbents to clean polluted water and air by trapping heavy metals and organic contaminants.
- Electrode materials for next-generation supercapacitors, which are vital for renewable energy storage.
- Catalysts that speed up industrial chemical reactions more sustainably than traditional fossil-based options.
- Clean-burning fuels with lower emissions of harmful nitrogen and sulfur oxides.

Importantly, recent economic and life-cycle assessments suggest that converting bio-tar into bio-carbon can deliver net-positive energy, financial, and environmental benefits. For example, replacing coal with bio-carbon fuels could cut carbon dioxide emissions by hundreds of millions of tons annually, while also generating profits for biomass processing plants.

Still, challenges remain. The chemical complexity of bio-tar makes it difficult to fully control the polymerization process, and large-scale production has not yet been achieved. The authors recommend combining laboratory experiments with computer simulations and machine learning to optimize reaction pathways and design bio-carbon with specific functions.

"Bio-tar polymerization is not just about waste treatment -- it represents a new frontier for creating sustainable carbon materials," said first author Yuxuan Sun. "With further research, this approach could significantly improve the efficiency of biomass energy systems while providing new tools for environmental protection and clean technology."

The study provides a roadmap for scientists and industry partners to turn one of bioenergy's biggest obstacles into a powerful resource for the future.

Science Daily, 26 September 2025

https://sciencedaily.com

Nearly 47 million Americans live near hidden fossil fuel sites

2025-11-20

Fossil fuels pollute the air when they are extracted and when they are burned, but the steps between those two points involve far more than familiar scenes of drilling equipment and smoke-filled power plants. These visible operations represent only the beginning and end of a five-stage process that brings fossil fuels from the ground to their final use.

Oil and gas move through several additional stages before reaching power facilities. They are refined to remove unwanted materials, stored in specialized facilities, and transported across the country. These activities form a vast mid-supply chain network that stretches across the United States and often operates out of public view.

Millions Live Near Fossil Fuel Infrastructure

A new analysis led by Boston University researchers provides the first nationwide estimate of how many people live close to this infrastructure. Published in Environmental Research Letters, the study finds that 46.6 million people in the contiguous United States live within 1.6 km (roughly a mile) of at least one component of the fossil fuel supply chain. This accounts for 14.1% of the population.

Previous studies have shown that communities near extraction sites and end-use facilities experience higher rates of adverse birth outcomes and asthma, and there is growing interest in potential links to other conditions, including leukemia. However, the health effects of living near facilities in the middle of the supply chain remain far less understood. Some sites in

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

these stages have been found to emit volatile organic compounds and other harmful pollutants.

"This study helps us get a general size of the potential problem, and really starts the process of doing a better job of understanding exactly what the hazards are and how many people are potentially exposed," said Jonathan Buonocore, the paper's first author, an assistant professor of environmental health at BU's School of Public Health (SPH), and core faculty at BU's Institute for Global Sustainability (IGS). "Especially for these more obscure pieces of energy infrastructure, this is the first step to tracking what emissions and stressors those are imposing on the communities."

Where Americans Live Along the Energy Supply Chain

The researchers also examined how exposure varies across different types of infrastructure. Nearly 21 million Americans live near end-use facilities such as power plants. More than 20 million live within a mile of extraction sites, including oil and gas wells. Storage locations, which include peak shaving facilities, underground gas storage sites, and petroleum product terminals, have over 6 million nearby residents. Fewer people reside near refining or transportation facilities. About 9 million people live close to multiple infrastructure types, meaning they are counted in more than one category.

"There is reason to believe that there could be air pollution coming from each of these stages, from consistent pollution, gas leaks, or blowouts, when gas or oil flows from a well uncontrollably," said Mary Willis, the study's senior author, an assistant professor of epidemiology at SPH, and core faculty at IGS. "All of these stages can reasonably impact a range of population health outcomes, yet the basic information of who is even near the infrastructure components has not been examined to date."

Environmental Inequities and Urban Concentration

The study highlights clear disparities in where fossil fuel infrastructure is located. Communities that are predominantly non-white experience higher exposure across all stages of the supply chain, reinforcing findings from previous environmental justice research.

The analysis also shows that proximity is far more common in urban areas. Almost 90% of the people living near end-use, transportation, refining, and storage sites are located in cities.

Looking at individual infrastructure types revealed trends that could guide future policy. A single piece of storage infrastructure has, on average, 2,900 residents living within a mile, while an extraction site typically has only 17. This reflects the fact that extraction sites are more numerous but located in less populated regions, whereas storage facilities are fewer in number but tend to be placed in densely populated areas.

"That means that if a local policymaker in an urban area were to take interest in reducing exposures, they may receive the most impact per piece of infrastructure if they focus on storage," Buonocore said.

A New National Database Makes This Research Possible

This study is the first to use the Energy Infrastructure Exposure Intensity and Equity Indices (EI3) Database for Public Health, introduced by Buonocore and Willis in spring 2024 at the Power & People Symposium. The research team also included Fintan Mooney, Erin Campbell, Brian Sousa, Breanna van Loenen, Patricia Fabian, and Amruta Nori-Sarma.

Before EI3, information on fossil fuel infrastructure was scattered across local, state, and federal databases, and some data sources required payment or special access. With support from an IGS Sustainability Research Grant jointly funded by IGS and SPH, the team combined available data into a single national resource. Their dataset is hosted on Harvard Dataverse. The grant also helped launch the SPH Energy and Health Lab, which Buonocore and Willis co-direct.

"The study really shows that there are big knowledge gaps across the supply chain, in terms of the hazards people are being exposed to, the consequent health impacts, and who is being exposed," Buonocore said. "With a lot of these different types of infrastructure, the hazards have not been fully characterized. Characterizing hazards and understanding who is most heavily exposed should be the first steps of understanding the possible health impacts. This research takes the first steps down that path."

Looking Ahead to Better Policies and Future Research

Although some states and municipalities regulate where fossil fuel operations can take place, many areas still allow infrastructure to be located very close to homes and schools. The team hopes their work will lead to more studies that can support informed policymaking and improve public health. Future research may include detailed monitoring of air, water, noise, and light pollution near facilities, and investigations using

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

new datasets such as Medicaid records or information on specific groups like pregnancy planners.

"We're really the first group thinking about this as an integrated system. By quantifying all of these factors at once, we're potentially able to, down the line, directly compare: what are the health effects of living near an extraction site, compared to living near a storage site?" Willis said. "Having that in one database is the first step to doing any health studies in the future on this integrated system."

Science Daily, 20 November 2025

https://sciencedaily.com

Electrocatalyst recycles a common pollutant to make ammonia production greener

2025-11-25

Ammonia fuels agriculture, supports industry, and is increasingly viewed as a key player in future clean-energy systems. Yet producing it is heat and pressure intensive. A research team has developed an electrocatalyst that helps turn nitrate—a common pollutant found in groundwater and agricultural runoff—into ammonia under far milder conditions.

Details of their findings are published in the journal Advanced Functional Materials.

"Our new catalyst has two main benefits: first, it reduces the emissions linked to fertilizer and chemical manufacturing, and second, it enables us to essentially recycle nitrate, which would otherwise pollute our water," points out Hao Li, Distinguished Professor at Tohoku University's Advanced Institute for Materials Research (WPI-AIMR).

How the new catalyst works

The catalyst is made from an atomically ordered alloy of ruthenium (Ru) and gallium (Ga), forming a ruthenium-gallium intermetallic compound supported on carbon (RuGa IMC/C). Its structure places individual ruthenium atoms in precise positions surrounded by gallium, which does not react directly but shapes the environment in which each ruthenium site operates.

This fine-tuned arrangement helps guide nitrate (NO_3) toward the reaction steps that produce ammonia (NH_3).

Even at low nitrate concentrations, the catalyst converts nitrate efficiently at a very gentle voltage. It maintains strong selectivity across a broad concentration range and continues operating with steady performance, showing that careful atomic design can support nitrate conversion under realistic environmental conditions.

Insights from simulations and future directions

Computer simulations conducted by the researchers revealed why the structure worked so well. By introducing gallium, the electronic characteristics of ruthenium shift, affecting how nitrogen-containing molecules attach and transform on the surface. This adjustment also slows down hydrogen formation, a competing reaction that often limits ammonia yields.

The catalyst was also evaluated in a zinc-nitrate battery. The system generated consistent power and ran for hundreds of hours, showing that the material can support both chemical production and energy-related applications.

"We hope to convert a widespread pollutant into a valuable product and offer guidance for designing future catalysts that take advantage of controlled atomic ordering," adds Li.

Looking ahead, the researchers plan to expand their theoretical modeling, integrating machine-learning tools to more effectively map reaction pathways. This work aims to accelerate the design of next-generation electrocatalysts for sustainable chemical production.

Phys Org, 25 November 2025

https://phys.org

Wood made transparent using rice and egg whites could replace windows

2025-03-26

Windows and smartphone screens may one day be constructed from transparent wood laced with egg whites and safely composted at the end of their life.

Researchers are interested in using wood to make biodegradable alternatives to glass with better insulating properties, or to replace plastic in electronic devices. Wood has been turned into a transparent material before by modifying or removing the organic polymer lignin from it

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

and then injecting epoxy as a replacement, but this results in a non-biodegradable product.

Now Bharat Baruah at Kennesaw State University in Georgia and his colleagues have developed a process that replaces the synthetic epoxy with natural egg white and rice extract.

"[Previous examples of transparent wood are] very hard to synthesise, hard to make and you spend a lot of time and energy and money to make those, so that's why we thought about creating something that we can make easily and naturally," says Baruah.

He was inspired to use egg whites by buildings in his home state of Assam in India, which date back to the 1500s and use a cement-like mixture that included sand, sticky rice and egg whites. "That was the cement in those days, and those buildings are still there," says Baruah. "They're still there after more than four or five centuries and it was always fascinating to me."

The team took sheets of balsa wood and drenched them with sodium sulphite, sodium hydroxide and diluted bleach inside a vacuum chamber to remove the lignin and hemicellulose, leaving only a paper-like cellulose structure. The voids in the material were then filled with a mixture of rice extract and egg white before being dried in an oven at 60°C (140°F) to create a semi-transparent plate with a slight brown tint. "It's not 100 per cent transparent, but it is semi-transparent," says Baruah. "And it's biodegradable."

Baruah and his colleagues built a small birdhouse fitted with a transparent wood window as a rudimentary mock-up, and found that it stayed 5 to 6°C (9 to 11°F) cooler inside when exposed to a heat lamp than the same birdhouse fitted with a glass window. The research will be presented today at the spring meeting of the American Chemical Society in San Diego, California.

Further research will investigate the strength and thermal properties of the material, as well as techniques to improve the transparency, says Baruah.

New Scientist, 26 March 2025

https://newscientist.com

New CO_2 conversion system slashes energy use and triples formic acid production

2025-11-24

A research team affiliated with UNIST has unveiled a novel electrochemical system that converts carbon dioxide (CO_2), a major contributor to climate change, into high-value chemical products, like formic acid. This new approach drastically reduces energy consumption by nearly 75% and triples the production rates compared to existing methods.

Led by Professor Seungho Cho in the Department of Materials Science and Engineering, alongside Professors Youngkook Kwon and Jae Sung Lee from the School of Energy Chemical Engineering, the researchers have successfully developed an ultra-low voltage electrochemical process for transforming CO_2 into formic acid.

The findings of this research are published online in Angewandte Chemie International Edition.

How the new system works

This innovative system not only lowers the energy required for CO_2 conversion, but also effectively reduces greenhouse gases while producing a high-demand chemical. Conventional processes rely on an oxygen evolution reaction (OER), which consumes 70 to 90% of the total energy consumption and causes the system's operating voltage to rise up to 2 V.

To overcome this challenge, the team replaced OER with a formaldehyde oxidation reaction (FOR). This new setup can generate formic acid efficiently at an ultra-low cell voltage of 0.5 V, with Faradaic efficiencies of 96.1% at the cathode and 82.1% at the anode. Lowering the operating voltage to just a quarter of traditional systems significantly reduces power consumption.

The system achieved a formic acid production rate of 0.39 mmol/cm^2·h, nearly three times higher than previous technologies. Because formaldehyde oxidation produces formic acid instead of oxygen as a paired reaction, the overall process becomes far more energy-efficient.

Breakthrough catalyst and broader applications

This breakthrough was made possible by a specially designed copper-silver composite catalyst tailored for formaldehyde oxidation. Unlike conventional catalysts that tend to lose activity rapidly, this new material

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

maintains high efficiency, enabling sustainable and scalable CO_2 conversion.

Beyond CO_2 reduction, this catalyst and reaction pathway can be applied to eco-friendly, self-sustaining systems for producing ammonia, hydrogen peroxide, and hydrogen without electricity or emissions. In this study, the researchers successfully integrated formaldehyde oxidation with nitrate reduction, oxygen reduction, and hydrogen evolution reactions, demonstrating the production of ammonia, hydrogen peroxide, and hydrogen in an environmentally friendly manner.

Professor Cho explained, "This technology addresses the main inefficiency in CO_2 conversion and makes the most of limited electric energy. Its versatility opens new possibilities for sustainable chemical manufacturing and environmental protection."

The research involved Hyoseok Kim, Wonsik Jang, and Jin Ho Lee from the Department of Materials Science and Engineering, as well as Hojeong Lee from the School of Energy Chemical Engineering at UNIST, who served as first authors.

Phys Org, 24 November 2025

https://phys.org

Graphene-boosted plastic makes auto parts 20% stronger, 18% lighter

2025-11-18

Glass-filled polypropylene is already a very commonly used plastic for automotive parts, but could it be improved? Well, yes. A new substance, Gratek, is claimed to make the plastic 20% stronger yet 18% lighter, thanks to the addition of graphene.

Widely hailed as a "wonder material," graphene takes the form of one-atom-thick sheets of carbon atoms linked to one another in a honeycomb pattern. Along with being the world's strongest human-made substance, it's also very flexible, stretchable and chemically stable, plus it exhibits high electrical and thermal conductivity.

It's no wonder, then, that Nello David Sansone – a post-doctoral researcher working in the University of Toronto's Multifunctional Composites Manufacturing Laboratory – began investigating methods of integrating graphene nanoplatelets into glass-filled polypropylene. He ultimately

developed a technique for doing so while working at auto parts manufacturer Axiom Group, in a partnership with the university.

In previous groups' attempts to incorporate graphene into automotive components, the material had a tendency to cluster during processing, thus concentrating mechanical stress in unwanted areas and leading to failure.

Sansone got around this problem via a proprietary technique which causes the nanoplatelets to bond only to the glass fibers within the polypropylene matrix, keeping them from clumping. Because the graphene strengthens the fibers, fewer of them need to be used, thus Gratek is approximately 20% stronger and 18% lighter than regular glass-filled polypropylene.

And it should be noted, the material is less than 1% graphene overall. Plus as an added bonus, due to the lower glass content in the plastic, it causes less wear and tear on the machines that are cutting and drilling it.

One potential limiting factor to Gratek is the fact that, because of the graphene in it, it's limited to being black in color. With that drawback in mind, Sansone has developed another material, Clatek, which utilizes clay-based halloysite nanotubes in place of the graphene nanoplatelets. It reportedly offers performance similar to that of Gratek, but it's white in color and can be dyed and painted.

Gratek is expected to be contracted to a major automobile manufacturer before the end of this year, while Clatek is expected to be commercially available within two years.

"It has shown real potential to make vehicles lighter, safer, and more sustainable," Sansone told us. "As for what's next for me, I'm now working on commercializing another advanced material formulation, known as AegisX, through my start-up NanoMorphix, where we're developing transparent and textile armor for military, defense, aerospace, and personal protection."

Sansone was recently the recipient of an award from Mitacs, a government-funded non-profit organization that seeks to foster technical innovation in Canada. Past recipients have developed technologies such as a towable crop-waste-to-biofuel converter, a computer-vision-based

CHEMWATCH
Bulletin Board
Curiosities
NOV. 28, 2025

flight recorder, an augmented reality feedback system for athletes and a screw-drive amphibious robot.

New Atlas, 18 November 2025

https://newatlas.com

Technical Notes

NOV. 28, 2025

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

CHEMICAL EFFECTS

High-throughput screening of estrogen receptor activity for personalized mixtures of persistent organic pollutants detected in blood of Swedish adults

What do people need to know about endocrine disrupting chemicals and health? A mental models approach using focus groups of community-engaged research teams and a national survey

Interpretable machine learning framework for predicting pesticide phytotoxicity in wastewater reuse: Integrating molecular, quantum, and experimental descriptors

ENVIRONMENTAL RESEARCH

Current Insights into the Impact of Plastic-derived Pollutants (Phthalates), Microplastics, and Nanoplastics on Hypothalamic Phenotype and Molecular Pathways: A Scoping Review

Sources, health risks, environmental implications, and management strategies of microplastics with a focus on landfill leachate

PHARMACEUTICAL/TOXICOLOGY

Exposure to diesel particulates induces an immunosuppressive microenvironment that promotes the progression of lung cancer

Fiber length and shape-dependent differences in hepatic nanomaterial localization in mice following pulmonary exposure

Low-dose occupational ionising radiation exposure and gastrointestinal cancer mortality among US radiologic technologists, 1983-2021

OCCUPATIONAL

Oxidative stress, inflammation and the metabolic EpOME are associated with occupational exposure to isoflurane

Caudate nucleus atrophy as a neuroimaging feature of mild cognitive impairment induced by occupational aluminum exposure