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* While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.

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ASIA PACIFIC

Coming soon: Changes to simplify SIR compliance for listed introductions

2025-05-30

On 25 July 2025, we will implement changes to help introducers comply with reporting obligations for listed introductions that have a specific information requirement (SIR).

These include:

- improving Inventory chemical records so it's easier for introducers to find the information they need when there are SIRs
- updating and expanding guidance so it's easier for introducers to work out if they need to provide information to AICIS
- Improving SIR online forms so it's easier for businesses to give information to AICIS

How we're improving Inventory chemical records

There are about 4,000 chemicals on the Inventory with SIRs. AICIS will improve as many of these records as possible.

- We will surface information from the 'secondary notification' section of NICNAS assessment reports in the specific information requirement field in Inventory chemical records. This means the chemical records will include more details about obligations to provide information and the circumstances that apply, which will reduce the need to locate and interpret information in the secondary notification section of NICNAS assessment reports.
- We will not disclose protected information, such as protected chemical names and CAS numbers.
- The records will clearly indicate if chemicals were assessed as polymers of low concern (PLC) – since different information requirements apply for a PLC.

To be able to publish more detailed information about the SIR obligations in Inventory chemical records, we will formally vary the SIR terms of listing. In doing this, there will be neither an increase nor decrease in the regulatory requirements for businesses, but it will be easier to comply with the requirements. The information that we surface in the SIR term of listing in the Inventory chemical record will also be published in the next

Regulatory Update

version of the downloadable Inventory (version 7 intended to be released in August 2025).

We will also add new features in relevant Inventory chemical records by:

- adding links to guidance to make it easier for introducers to work out if they need to submit information to AICIS
- displaying a new link in many chemical records to allow users to directly open the associated NICNAS assessment report
- making it clearer that an assessment report cannot be linked to the chemical record (if applicable) because of protected information.

New and improved SIR forms

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Updated, fit-for-purpose online forms will make it easier to submit information in AICIS Business Services. It will be especially beneficial for importers and manufacturers that know:

- the identity of the chemicals they're introducing and/or the SIR details AND
- why they are reporting the information to AICIS. **Read More**

AICIS, 30-05-25

https://www.industrialchemicals.gov.au/news-and-notices/coming-soonchanges-simplify-sir-compliance-listed-introductions

3M Australia issued Clean-up Notice for legacy PFAS at quarry

2025-05-30

The NSW Environment Protection Authority (EPA) has issued a Clean-Up Notice to 3M Australia Pty Ltd (3M Australia) after PFAS chemicals were detected at Brogans Creek Quarry in the State's Central West.

The notice comes after PFAS – per- and polyfluoroalkyl substances – were identified in soil, sediment, groundwater and surface water across a 100-hectare area of the inactive limestone guarry site, which was historically leased by 3M Australia to test PFAS-containing firefighting foams.

While the scale of the onsite contamination is significant, the guarry's remote setting and separation from residential areas means there is limited potential for human exposure.



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Director Operations David Gathercole said the notice is the first time the NSW EPA has identified and taken regulatory action against 3M Australia a subsidiary of the global 3M Company.

"This is a significant moment for the EPA and one that represents an important milestone in our efforts to address legacy environmental harm," Mr Gathercole said.

"Though this is only the first step in what will likely be a complex and lengthy remediation process, 3M Australia has so far been cooperative voluntarily offering to conduct investigations to better understand the extent and nature of legacy PFAS contamination at the site.

"This Clean-Up Notice formalises 3M Australia's commitment and allows us to regulate and oversee the clean-up process, ensuring it's completed within appropriate time frames and is fit-for-purpose to achieve a positive outcome for the environment."

In addition to the contamination identified at the guarry, PFAS above the relevant national drinking water guidelines were detected in waters up to 8 kilometres downstream of the site, including in the upper reaches of the Capertee River within the Capertee National Park.

Precautionary advice was provided to the NSW National Parks and Wildlife Service (NPWS) following detection of PFAS in the river, and NPWS has installed signage in the National Park advising visitors not to use river water for drinking or cooking purposes.

PFAS detections in the river are below the Australian national recreational water guidelines, meaning it remains safe for water-based activities such as swimming, canoeing and boating.

Under the Clean-Up Notice, 3M Australia has 60 days to submit a detailed plan to the EPA outlining how it will assess the PFAS pollution and manage any associated environmental risks.

See the Clean-Up Notice here.

Find out more about PFAS in NSW.

Read More

NSW EPA, 30-05-25

https://www.epa.nsw.gov.au/news/epamedia/250530-3m-australiaissued-clean-up-notice-for-legacy-pfas-at-quarry

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AMERICA

Ontario Introduces Working for Workers Seven Act, 2025

2025-05-29

IUN. 06, 2025

On May 28, 2025, the Ontario government introduced Bill 30, the Working for Workers Seven Act, 2025 (Bill 30). Bill 30 continues the province's ongoing "Working for Workers" legislative initiative, proposing significant amendments to various employment-related statutes, including the Employment Standards Act, 2000, Occupational Health and Safety Act, and Workplace Safety and Insurance Act, 1997.

Key proposed amendments that employers should take note of are addressed below.

Employment Standards Act, 2000 (ESA)

If passed, Bill 30 would:

Job Posting Platform Requirements

- Define "job posting platform" as online platforms displaying publicly advertised job postings, excluding single-employer platforms (i.e. a platform operated by an employer that only advertises positions with that employer) and platforms meeting prescribed criteria.
- Require operators of job posting platforms to implement mechanisms for users to report fraudulent job postings.
- Mandate written policies addressing fraudulent job postings, including procedures for handling such reports.
- Require platforms to display reporting mechanisms conspicuously and post their fraud policies where users can readily access them.
- Establish record retention requirements for fraud policies (three years after the applicable policy ceases to be in effect).
- Prohibit complaints under section 96(1) of the ESA for violations of job posting platform requirements.

Read More

FTR Now, 29-05-25

https://hicksmorley.com/2025/05/29/ontario-introduces-working-forworkers-seven-act-2025/



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Stronger Workplaces for Nova Scotia Act Amendments in Effect in July and September 2025

2025-05-29

On September 20, 2024, Nova Scotia's Stronger Workplaces for Nova Scotia Act, which amended the Workers' Compensation Act, the Occupational Health and Safety Act, and the Labour Standards Code, received Royal Assent. Portions of the Stronger Workplaces for Nova Scotia Act are already in effect. This article will review the changes coming into effect in July and September 2025.

The Stronger Workplaces for Nova Scotia Act amends the Workers' Compensation Act to include Section 89A, which outlines the duties of employers and employees regarding the early and safe return to work of injured workers. This change will come into effect on July 15, 2025.

Starting September 1, 2025, the act will also amend the Occupational Health and Safety Act to include psychological health and safety in the definition of "health and safety" and require employers to establish policies to prevent workplace harassment.

• Employers may want to review and update their current policies on harassment, occupational health and safety, and safe return to work to comply with the new regulations and address the Nova Scotian government's focus on preventing workplace harassment and psychological harm.

Changes Coming in July 2025

The Stronger Workplaces for Nova Scotia Act amends the Workers' Compensation Act by adding Section 89A and changing Subsection 89(3), which provides the definitions for "alternative employment" and "suitable work," to apply to Section 89A as well. These changes come into effect on July 15, 2025.

Section 89A essentially codifies an employer's and employee's duties and the actions when an employee is injured and returns to work. It states,

(1) The employer of an injured worker shall co-operate in the early and safe return to work of the worker by

(a) contacting the worker as soon as practicable after the injury occurs and maintaining communication throughout the period of the worker's recovery and impairment;

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(b) attempting to provide suitable work that is available and, where possible, restores the worker's pre-injury earnings;

Read More

Ogletree, 29-05-25

https://ogletree.com/insights-resources/blog-posts/stronger-workplaces-for-nova-scotia-act-amendments-in-effect-in-july-and-september-2025/

EUROPE

EU closing in on the 2030 climate and energy targets, according to national plans

2025-05-28

EU Member States have significantly closed the gap to achieving the 2030 energy and climate targets, according to the European Commission's assessment of the National Energy and Climate Plans (NECPs). EU countries have substantially improved their plans following Commission recommendations in December 2023. As a result, the EU is closing in collectively on a 55% reduction in greenhouse gas (GHG) emissions, as committed in the European Climate Law, and reaching a share of at least 42.5% of renewable energy.

The Commission's assessment shows that the EU is currently on course to reduce net GHG emissions by around 54% by 2030, compared to 1990 levels, if Member States implement fully existing and planned national measures and EU policies. In the current geopolitical context, this demonstrates that the EU is staying the course on its climate commitments, investing with determination in the clean energy transition and prioritising the EU's industrial competitiveness and the social dimension.

Strategic initiatives such as the Clean Industrial Deal and the Affordable Energy Action Plan will complement NECPs in mobilising investments in industrial decarbonisation and clean technology, making the best use of Europe's homegrown renewable potential and energy efficient solutions, helping to deliver lower and more stable energy prices over time.

Member States are demonstrating political resolve to reduce our dependence on imported fossil fuels, improve the resilience and security of energy supplies and infrastructure, accelerate the integration of the



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internal energy market and support those who need it the most with investments and skills development.

The Commission's assessment provides a solid foundation for discussions on the next steps in the EU's decarbonisation journey towards 2040 and reaching climate neutrality by 2050. The Commission will intensify work with Member States to close the remaining gaps and implement additional guidance, set out in today's assessment.

Read More

European Commission, 28-05-25

https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1337

Joint call for EU action to protect waste management from surging lithium battery fires

2025-05-19

The undersigned associations representing the entire public and private waste management value chain, extended producer responsibility organisations and public service unions, are expressing concerns over a significant increase in fire incidents within the European waste management sector, largely attributed to the misplacement of lithium batteries. These incidents present substantial safety hazards for workers, cause substantial damage to critical infrastructure, and jeopardise the financial stability of waste management operators, as well as the achievement of the European Union's circular economy goals. We are calling upon the European Commission to take decisive regulatory action to mitigate these risks and protect Europe's waste management infrastructure and workers.

Read More

EURIC, 19-05-25

https://euric.org/resource-hub/position-papers/joint-call-for-eu-action-toprotect-waste-management-from-surging-lithium-battery-fires

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EU Member States approve renewal of reprotoxic 'Toxic 12' pesticide: PAN Europe condemns misuse of 'negligible exposure' clause

2025-05-21

EU Member States approved the renewal of 8-hydroxyquinoline (quinolin-8-ol), a pesticide classified as toxic for reproduction. The substance, known to affect healthy pregnancies and be toxic to children's development, was renewed for seven years as a candidate for substitution by using an exceptional 'negligible exposure' clause. Instead of banning it, Member States approved its use in permanent greenhouses for 'drip irrigation'. PAN Europe strongly condemns this decision.

"This decision undermines the core purpose of the Pesticide Regulation, which is to protect people and the environment and remove harmful substances from the market," said Salomé Roynel, Policy Officer at PAN Europe.

The renewal during the last Standing Committee on Plants, Animals, Food and Feed (SCoPAFF) meeting on May 14-15, was granted based on the "negligible exposure" clause of the EU Pesticide Regulation. This exceptional legal provision allows the continued use of highly hazardous substances only if it is demonstrated that the pesticide product is used in closed systems or under conditions that effectively exclude human contact (including for operators, workers, residents, and bystanders) and where residues in food are not detectable, meaning they remain below the default value of 0.01 mg/kg or the relevant Level of Quantification (LOQ).

Since the Pesticide Regulation came into force in 2011, no hazardous ('cut-off') substance has ever been approved under the 'negligible exposure' clause, due to the absence of clear guidance and robust assessment criteria. This renewal marks a dangerous first. With discussions between Member States and the Commission still ongoing over a guidance document on how to assess negligible exposure, approving 8-hydroxyquinoline now risks enshrining flawed methods and unrealistic assumptions in future pesticide approvals.

Read More

PAN, 21-05-25

https://www.pan-europe.info/press-releases/2025/05/eu-member-statesapprove-renewal-reprotoxic-%E2%80%98toxic-12-pesticide-pan-europe



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Regulatory Update

PAN Europe and Générations Futures ask the European Commission to ban neurotoxic acetamiprid at once 2025-05-21

Acetamiprid is a neonicotinoid insecticide that is massively used in the EU as an agricultural pesticide and as a biocide. New scientific evidence shows that it presents a risk of developmental neurotoxicity, thus potentially harming fetuses. Générations Futures and PAN Europe sent a letter to DG Sante, presenting 16 new scientific publications pointing to problems, including neurotoxicity to humans. Publications also confirm the risk posed by this insecticide to wild pollinators and birds.

Acetamiprid is one of the last neonicotinoid insecticides allowed on the EU market for over 20 years. Others have been banned to protect bees or human health. Evidence shows that acetamiprid residues in food are frequent, while its use as a biocide can lead to close contact with humans, including children.

In 2023, PAN Europe submitted [1] a series of new scientific publications to the European Commission, pointing at the risk of developmental neurotoxicity: acetamiprid passes the placental barrier and interacts with neurons of developing fetuses. The European Commission sent a mandate to EFSA, asking to assess this new information. In 2024, EFSA published an opinion [2], which led to a significant reduction of Maximum Residue Levels of acetamiprid in food [3].

Read More

PAN, 21-05-25

https://www.pan-europe.info/press-releases/2025/05/pan-europe-and-g%C3%A9n%C3%A9rations-futures-ask-european-commission-ban-neurotoxic

'Forever chemicals' are everywhere: so why isn't the EU banning them all?

2025-05-30

One of the most lobbied files in Brussels right now is the proposed universal restriction on PFAS, per- and polyfluoroalkyl substances, better known as the 'forever chemicals'.

These persistent, harmful substances are in everything from your waterproof coat to your fridge, from your frying pan to your mobile phone,

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from your drinking water to your glass of wine. It's likely we all have PFAS in our blood and this could have serious implications for our health.

Growing scientific research shows that exposure to PFAS may lead to negative health impacts, including by altering the immune system, increasing cancer risk, or affecting reproductive functions. A comprehensive ban is long overdue.

The universal PFAS restriction proposal, covering almost all PFAS uses, is currently undergoing scientific analysis at the EU's Chemicals Agency before it is passed to the EU Commission for final drafting, and then a vote by member states.

Earlier this year journalists via the Forever Lobbying Project, alongside Corporate Europe Observatory, mapped the intense lobby battle underway on this file, revealing the extent of the lobbying and the disinformation put forward by the industry to defend these substances, the dire health and environmental effects of which have been known for years.

EU environment commissioner Jessika Roswall has said that the commission will implement a ban on consumer uses of PFAS, "such as cosmetics, food contact materials, and outdoor clothing."

Read More

Euobserver, 30-05-25

https://euobserver.com/green-economy/araaf3ce41

CCS Reality Check – Risks and Priorities

2025-05-19

This paper explores how Europe's industrial transformation can reach climate neutrality with minimal, if any, reliance on Carbon Capture and Storage (CCS). It outlines a robust alternative pathway based on electrification, circular economy practices, efficiency measures, and fossilfree technologies already on the market.

It warns that large-scale CCS risks diverting scarce public funds from proven solutions and highlights how so-called "hard-to-abate" sectors like steel and cement can be decarbonised without CCS.

A must-read for policymakers and investors seeking smart, cost-effective climate action.



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Read More

EEB, 19-05-25

https://eeb.org/library/ccs-reality-check-risks-and-priorities/

INTERNATIONAL

Proposed PFAS Remediation Standard

2025-05-21

The proposed standard will focus on PFAS investigation and remediation.

ASTM International's environmental assessment, risk management, and corrective action committee (E50) has approved the development of a proposed standard that will cover remedial investigations and remediation actions for Per- and Polyfluoroalkyls (PFAS) (WK94490).

The proposed standard would serve as a companion to ASTM's standard on PFAS screening and initial site investigation (E3358). As such, the proposed guide will continue to add key considerations and best practices to successfully complete site investigations, nature and extent definition, and discuss some established remediation technologies along with several promising technologies for PFAS remediation. Discussion topics to be included in WK94490 will include:

- PFAS identification;
- Nature and extent definition;
- Risk assessment;
- Geological and groundwater modeling;
- Remedy selection;
- Remedy implementation; and
- PFAS site management.

ASTM welcomes participation in the development of its standards. Become a member at www.astm.org/JOIN.

Read More

ASTM, 21-05-25

https://www.astm.org/news/proposed-environmental-remediationstandard

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REACH Update

JUN. 06, 2025

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EU recyclers' position on the REACH Revision 2025-05-09

Chemicals are present in nearly every product and process in modern life - from industrial manufacturing to everyday items like electronics, textiles, and furniture. The EU's REACH Regulation (Registration, Evaluation, Authorisation and Restriction of Chemicals) plays a central role in ensuring that these substances are safely used, protecting both human health and the environment.

As REACH applies to all chemical substances, including those found in recovered materials, it has significant implications for the recycling industry. This means that recyclers, although not the original producers of the substances and usually not adding any new ones, are requested to navigate complex and costly obligations. Ahead of the upcoming REACH revision, it is crucial to ensure that EU regulation, in the guest of protecting human health and the environment, does not hinder the transition to a circular economy. Overly restrictive or unclear chemical rules can unintentionally hinder recycling, limit the use of secondary raw materials, and ultimately undermine EU ambitions on resource efficiency, circularity, and strategic autonomy.

As part of its first 100 days, the von der Leyen Commission launched the Clean Industrial Deal to strengthen Europe's industrial competitiveness while achieving climate neutrality by 2050 and making the EU a circular economy leader by 2030. A key part of this plan is the Chemicals Industry Package, which includes simplifying REACH and addressing "forever chemicals." During the April CARACAL meeting, the Commission clarified that the goal of revising REACH is not deregulation but reducing administrative burden.

To ensure the REACH revision supports both circularity and the protection of human health and the environment, EuRIC - the European Recycling Industries' Confederation – outlines key recommendations for a targeted and balanced revision.

Read More

EURIC, 09-05-25

https://euric.org/resource-hub/position-papers/eu-recyclers-position-onthe-reach-revision



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Janet's Corner

JUN. 06, 2025

Get ready to test your wits!

2025-06-06

Time for some fun!

We've got 5 fun questions for you, and a fantastic prize awaits the winner. Below are the questions:

- 1. Why did the noble gas go to therapy?
- 2. Which element is always dramatic?
- 3. Why don't chemists trust atoms anymore?
- What do you call an educated tube of hydrochloric acid? 4.
- 5. Why was the benzene ring always calm?

Send your answers to Aaron P.

Time for some fun!

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Hazard Alert

CHEMWATCH

Bromoform

2025-06-06

Bromoform (CHBr3) is a pale yellowish liquid with a sweet odour similar to chloroform. It is soluble in about 800 parts water and is miscible with alcohol, benzene, chloroform, ether, petroleum ether, acetone, and oils. It is also non-flammable and readily evaporates into the air. Bromoform is produced naturally by phytoplankton and seaweeds in the ocean and this is thought to be the predominant source to the environment. However, locally significant amounts of bromoform enter the environment formed as disinfection by-products known as the trihalomethanes when chlorine is added to drinking water to kill bacteria. [1,2]

USES [2,3]

Bromoform is used as an intermediate in geological assaying and as a solvent for waxes, greases, and oils. It is also used in shipbuilding, aircraft, and aerospace industries and as an ingredient in fire-resistant chemicals and gauge fluid. Traces of bromoform are likely to be present in swimming pools, municipal waters, and wastes as a result of chlorination in the presence of naturally occurring bromide ions and humic substances. It is hypothesised that bromoform may be formed by the haloform reaction which occurs during the chlorination of water.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

Studies have indicated that bromoform can easily enter the body after swallowing them in water or breathing them in air. In addition, they can enter the body through the skin (for example, by washing or showering in water containing these chemicals). Some portion of bromoform entering the body may be broken down to other compounds. Bromoform and its breakdown products can be removed from the body by being exhaled from the lungs. These chemicals leave the body fairly rapidly. Bromoform does not tend to build up in the body; 50-90% of the amount that enters the body is removed within 8 hours. The principal route of human exposure to bromoform is from drinking water that has been disinfected with chlorine, bromine, or bromine compounds. Bromoform has been detected in swimming pools that have been disinfected with bromine or bromine compounds; therefore, exposure to low levels could occur from inhalation of bromoform that has evaporated into the air or through the skin from bromoform in the water. In addition, exposure could also



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occur from inhalation of ambient air near factories or laboratories that use bromoform. Another place for exposure is near a chemical waste site where bromoform leaked into water or soil.

HEALTH EFFECTS [4]

Acute Health Effects

Human exposure to large amounts of bromoform through inhalation and oral exposure can result in unconsciousness. Animal studies, combined with limited observations in humans, indicate that the principal adverse health effects associated with short-term inhalation or oral exposure to high levels of bromoform are CNS depression, resulting in the slowing down of normal brain activities, sedation, narcosis, and sleep, and liver and kidney injury.

Carcinogenicity

The only available human cancer study suggested a positive correlation between levels of bromoform in drinking water and the incidence of several tumour types. However, this study was considered to be incomplete and preliminary because the study design did not permit consideration of variables such as personal habits, residential histories, and past exposures. Animal studies have demonstrated an increase in the incidences of liver and intestinal tumours following oral exposure to bromoform. EPA considers bromoform to be a probable human carcinogen and has ranked it in EPA's Group B2.

Other Effects

The long-term effects of exposure to bromoform in humans have not been studied. Animal studies indicate effects on the liver, kidney, and CNS from chronic oral exposure to bromoform. The Reference Dose (RfD) for bromoform is 0.02 milligrams per kilogram body weight per day (mg/ kg/d) based on hepatic lesions in rats. The United States Environmental Protection Agency has determined that there are insufficient data to calculate a Reference Concentration (RfC) for bromoform.

SAFETY

First Aid Measures [5]

Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids

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open. Cold water may be used. WARM water MUST be used. Get medical attention.

- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Workplace Controls & Practices [4]

Control measures include:

- Enclosing chemical processes for severely irritating and corrosive chemicals;
- Using local exhaust ventilation for chemicals that may be harmful with a single exposure; and
- Using general ventilation to control exposures to skin and eye irritants.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.



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- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

Personal Protective Equipment [5]

- Splash goggles;
- Lab coat;
- Vapour respirator Be sure to use an approved/certified respirator or equivalent;
- Gloves;

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator (A self contained breathing apparatus should be used to avoid inhalation of the product);
- Boots;
- Gloves;

Please note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

OSHA: The Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for bromoform:

- General Industry: 29 CFR 1910.1000 Table Z-1 0.5 ppm, 5 mg/m3 TWA: Skin
- Construction Industry: 29 CFR 1926.55 Appendix A 0.5 ppm, 5 mg/ m3 TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards 0.5 ppm, 5 mg/m3 TWA: Skin

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for bromoform of 0.5 ppm, 5.2 mg/m3

Hazard Alert

CHEMWATCH

TWA; Skin; Appendix A3 - Confirmed Animal Carcinogen with Unknown **Relevance to Humans**

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for bromoform of 0.5 ppm, 5.2 mg/ m3 TWA; Skin

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JUN. 06, 2025

Chemical reaction linking sugar metabolism and cellular protection discovered

2025-06-04

When we consume foods containing sugar and starch, they are converted into energy in the body's cells through a process called glycolysis.

However, this process has a downside—it produces byproducts that can harm cells and have been linked to diseases such as diabetes and age-related disorders.

Until now, research has primarily focused on the harmful effects of these byproducts. But a new study from the Department of Forensic Medicine at Aarhus University uncovers the mechanistic basis for how these byproducts may also activate the body's own crucial defense mechanisms.

In a study recently published in the journal Nature Chemical Biology, researchers reveal that two reactive byproducts of sugar metabolism methylglyoxal and its metabolite lactoylglutathione—react with the amino acid cysteine, which occurs naturally in the body.

It happens extremely fast

"These reactions are interesting because they involve cysteine—and unlike the known harmful reactions, they form products that can likely be released from the proteins again. Notably, the reaction with lactoylglutathione proceeds extremely quickly and is therefore expected to play a signaling role in cells," explains Professor Mogens Johannsen, one of the researchers behind the study.

"In fact, while our study was under review, other articles were published showing that the products of the cysteine reaction actually help the cell adapt and protect itself—a bit like a thermostat that regulates heat as needed," he adds.

The discovery is particularly noteworthy because methylglyoxal has until now been primarily known for participating in slow, harmful, and irreversible chemical reactions with the amino acid arginine, which may contribute to the development of diabetes and age-related diseases.

May lead to new anti-aging strategies

The study opens the door to entirely new hypotheses about how cells might use these rapid reactions to "sense" dangerous states and activate protective mechanisms. This could influence how we understand—and

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potentially treat—diseases like diabetes and age-related disorders in the future. In the long run, it may even lead to new strategies in anti-aging.

"We're excited about this discovery because it follows decades of research focused on slow, damaging reactions. Now we are discovering reactions that proceed at a completely different speed, are reversible, and potentially have signaling or regulatory functions," says Ph.D. Jakob Hansen, another researcher in the study, which documented the rapid reactions.

The next steps will be to map in greater detail how these reactions and their products contribute to the regulation of the cell's defense systems and whether the processes can potentially be controlled.

The discovery was made possible by a new advanced form of metabolomics developed at the Department of Forensic Medicine. This method enables identification of reactions between chemical compounds in living cells.

The scope of the method goes beyond the current discoveries and is expected to also help uncover how drugs or illicit substances react with the body's own metabolites—allowing researchers to identify new biomarkers.

Phys Org, 4 June 2025

https://phys.org

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Atmospheric chemistry keeps pollutants in the air 2025-06-03

Nitrates in the atmosphere reduce air quality and play an important role in climate change. An international team led by Hokkaido University researchers has revealed how chemical processes in the atmosphere have led to persistently high nitrate levels despite a reduction in emissions over the past few decades. These findings, published in Nature Communications, will help improve climate modelling by refining our ability to assess and predict atmospheric nitrate levels.

Atmospheric nitrate levels peaked between 1970 and 2000. The levels decreased somewhat with the decrease in the emission of nitrate precursors since the 1990s, but the drop in nitrate levels is smaller than the drop in the emission of precursors -- something is keeping nitrates in the atmosphere.

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Nitrates can exist in either a gaseous or particulate form in the atmosphere. Gaseous nitrate is more easily deposited out of the atmosphere, while the particulate form -- particularly finer particles -- can be transported over long distances. Understanding the balance between gaseous and particulate nitrates is therefore important in getting a picture of the atmospheric dynamics and persistence of nitrates.

The persistence of atmospheric nitrates in source regions is explained by a buffering effect, where gaseous nitrates are converted to particulate nitrates, contributing to their persistence. The impact of this buffering over long timescales and at long ranges is unclear, but nitrates deposited in Arctic ice cores show the same patterns as atmospheric nitrates. These sites are far from the sources, so the continuing high deposition rates don't reflect local processes near the source but must be due to atmospheric transport and other processes in the atmosphere.

To understand these dynamics, a research team led by Professor Yoshinori lizuka at the Institute of Low Temperature Science, Hokkaido University, examined the nitrate deposition history from 1800 to 2020 in an ice core taken from southeastern Greenland. As expected, nitrate levels within the core increased from the 1850s, peaking between the 1970s and 2000s before declining somewhat but remaining high. Overall, the increase in nitrates up to the 1970s happened more gradually than the increase in precursors, and the decrease after the 1990s was also slower and smaller than the decrease in precursor emission.

The delayed effect and persistence of nitrates indicates factors other than the emission of precursors are affecting nitrate levels. The researchers investigated these factors with a global chemical transport model and found that the difference between nitrate and precursor levels correlated with atmospheric acidity and not with other meteorological factors, such as air temperature.

In other words, the persistence of nitrates has been driven by chemical processes happening in the atmosphere rather than meteorological conditions or atmospheric dynamics. Changes in atmospheric acidity altered the proportion of nitrate that was gaseous or particulate. This affects the lifetime of nitrates in the atmosphere. Atmospheric acidity has increased the fraction of nitrates in particulate form, enabling this pollutant to persist longer and travel farther.

"Ours is the first study to present accurate information for records of particulate nitrates in ice cores, which has been a very challenging problem," says lizuka. "As it is more difficult to reduce anthropogenic

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emissions of substances that lead to increased nitrates, accurate measurements of particulate nitrates in the ice cores provides data for increasing the accuracy of predicting the amplification of Arctic warming in the future."

"It was difficult to present accurate nitrate from ice cores, but our team was able to do so this time." says lizuka. "In the future, nitrate will replace sulfate as the primary aerosol in the Arctic, suggesting this result leads to the higher accuracy of future predictions of Arctic warming amplification."

Science Daily, 3 June 2025

https://sciencedaily.com

Scientists Uncover "Alien" Chemistry Under Earth's Largest Lithium Deposits

2025-06-04

A new study published in Science Advances reveals a surprising twist: much of the world's lithium is found in salty waters with a chemistry unlike that of other natural saline waters, such as the ocean. This discovery could reshape the future of lithium mining and improve how we manage wastewater from extraction processes.

Lithium plays a vital role in powering the renewable energy revolution. About 40 percent of the global supply comes from massive salt flats, known as salars, located high in the Andes Mountains of South America and across the Tibetan Plateau in Asia. In these remote, arid landscapes, lithium is not mined from rock, but instead is dissolved in underground pools of highly salty water known as brine, hidden just beneath the crust of sparkling salt deposits.

"We discovered that the pH of brines in these regions is almost entirely driven by boron, unlike seawater and other common saline waters. This is a totally different geochemical landscape, like studying an extraterrestrial planet," said Avner Vengosh, distinguished professor of environmental quality and Chair of the Division of Earth and Climate Sciences at Duke University's Nicholas School of the Environment, who oversaw the research.

A solution's pH is a measure of how acidic or alkaline it is. In most natural waters, chemical reactions involving a molecule called carbonate primarily govern a solution's ability to control changes in pH — a measure known as alkalinity. But the Duke team uncovered a dramatically different scenario



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at the Salar de Uyuni, a giant salt pan situated on a Bolivian plateau, where the world's largest known lithium brine deposit exists underground.

Insights from the Salar de Uyuni

The researchers analyzed the pH and chemistry of brines and salts associated with a pilot mining operation at the Salar de Uyuni. Mining lithium from salt pans traditionally involves pumping natural brine from underground into a series of shallow, above-ground ponds. Liquid evaporates from successive ponds, leaving behind increasingly concentrated brine containing lithium and boron, plus undesirable salts. Lithium is eventually extracted at a processing facility.

The team found that pH levels in natural brine samples from the salar hovered around neutral. By contrast, brine samples from evaporation ponds were highly acidic. Computer modeling showed that high concentrations of boron were the primary drivers of pH in both cases.

Specifically, the natural brines contain high levels of boron in different forms — including the molecule boric acid and compounds called borates — whose relative distribution controls pH. Evaporation in the ponds increases the overall concentration of boron and triggers the breakdown of boric acid, generating hydrogen ions that reduce the pH.

"Through a chain of geochemical reactions, the carbonate alkalinity is diminished in the brine from the Salar de Uyuni, while boron alkalinity becomes predominant," said lead author Gordon Williams, a Ph.D. student in the Vengosh Lab.

"The integration of the chemical analysis with geochemical modeling helped us to quantify the different molecular structures of boron that contribute to alkalinity in these lithium brines," added Paz Nativ, a postdoctoral researcher in the Vengosh Lab.

Global Implications for Lithium Mining

To corroborate their findings, the team gathered data on more than 300 analyses of lithium-rich brine from various salt pans, including in Chile, Argentina, and Bolivia — collectively known as the Lithium Triangle and the Tibetan Plateau. Modeling showed that boron exerted the most influence on alkalinity, and therefore pH, in most of those brines as well.

"In addition to the new data we generated, we compiled a geochemical database of lithium brines from around the world and consistently found that boron is often the predominant component in brine alkalinity and

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controls brine pH, reinforcing the results from the Salar de Uyuni in Bolivia," Williams explained.

The research is the first to demonstrate the role of boron in controlling the chemical changes that occur during lithium brine evaporation in salt pans, according to the researchers. The findings could inform future lithium mining technologies as operators explore ways to more efficiently extract lithium and safely manage wastewater, they added.

Sci Tech Daily, 4 June 2025

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https://scitechdaily.com

Bluer and better: Improving the water solubility and acid stability of guaiazulene

2025-06-04

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Guaiazulene belongs to the class of azulene compounds, known for their vibrant blue color. Guaiazulene produces a blue color more saturated than that of naturally derived blue pigments and contains antioxidant properties.

Although it is often found in topical creams for skincare, it has also been touted as a potential food coloring agent. Yet this potential has been stymied because of its poor water solubility and color degradation under acidic conditions.

A group of researchers, however, has overcome this common stumbling block by introducing guaiazulene into a hydrophilic poly(allylamine).

Details of the team's breakthrough are published in the New Journal of Chemistry.

"We prepared a carboxylic acid, a common type of acid found in many citrus fruits and vinegars, with a guaiazulene skeleton, which can be easily condensed with amines," explains Kouki Oka, an associate professor at Tohoku University who led the research group.

"We then synthesized a blue polymer, incorporating the guaiazulene skeleton into the side chain. The synthesis was carried out by reacting the carboxylic acid with a highly hydrophilic poly(allylamine) condensation agent."

The quaiazulene introduction degree was easily adjustable by changing the equivalent amount of carboxylic acid with the guaiazulene skeleton.



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The polymer with a 3.2% introduction degree was more than 10,000 times more water-soluble than guaiazulene alone.

Oka and his colleagues also measured the absorption spectra of guaiazulene and guaiazulene-substituted poly(allylamine) in acidic solution. While the absorption spectrum of guaiazulene changed significantly in shape and maximum wavelength after one month, the absorption spectrum of guaiazulene-substituted poly(allylamine) showed no significant change.

This indicated that the introduction of guaiazulene into poly(allylamine) improves its stability under acidic conditions.

Oka believes that the results will lead to more than just the development of blue colorants under acidic conditions. "This could lead to the development of new functions for hydrophobic and acid-sensitive materials, something that has been difficult to achieve in the past."

Phys Org, 4 june 2025

https://phys.org

Researchers develop recyclable, healable electronics

2025-06-02

Between upgrades and breakdowns to cellphones, tablets, laptops, and appliances, so many electronics are getting tossed in the trash that they've taken on a name of their own: e-waste.

According to a 2024 report issued by the United Nations, the amount of e-waste worldwide has almost doubled in the past 12 years, from 34 billion to 62 billion kilograms -- the equivalent of 1.55 million shipping trucks -- and it's estimated to hit 82 billion kilograms by 2030. Just 13.8 billion kilograms -- about 20 percent of the total -- is expected to be recycled, a number projected to remain flat.

Put simply, we're throwing away more and more electronics, and recycling isn't keeping up. But a new study in Advanced Materials by two Virginia Tech research teams offers a potential solution to the e-waste problem: a recyclable material that could make electronics easier to break down and reuse.

Chemistry and engineering have an answer

Michael Bartlett, associate professor of mechanical engineering, and Josh Worch, assistant professor of chemistry, come from different fields, but

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together they created a new class of circuit materials. With significant work from their team of postdoctoral and graduate student researchers, including Dong Hae Ho, Meng Jiang, and Ravi Tutika, the new circuits are recyclable, electrically conductive, reconfigurable, and self-healing after damage. Yet they retain the strength and durability of traditional circuit board plastics -- features rarely found together in a single material.

The new material starts with a vitrimer, a dynamic polymer that can be reshaped and recycled. This versatile material is combined with droplets of liquid metal that do the work of carrying the electric current, the way rigid metals do in a traditional circuit.

This is a fundamentally different approach from other recyclable or flexible electronics. By combining the high-performance, adaptable polymers with electrically conductive liquid metals, the new circuit holds up under a host of challenges.

"Our material is unlike conventional electronic composites," said Bartlett. "The circuit boards are remarkably resilient and functional. Even under mechanical deformation or damage, they still work."

A second life

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Recycling traditional circuit boards involves several energy-intensive deconstruction steps and still yields large amounts of waste. Billions of dollars of valuable metal components are lost in the process.

Recycling the team's circuit board is straightforward and can be accomplished in multiple ways.

"Traditional circuit boards are made from permanent thermosets that are incredibly difficult to recycle," said Worch. "Here, our dynamic composite material can be healed or reshaped if damaged by applying heat, and the electrical performance will not suffer. Modern circuit boards simply cannot do this."

The vitrimer circuit boards also can be deconstructed at their end of life using alkaline hydrolysis, enabling recovery of key components such as the liquid metal and LEDs. Fully reusing all components of the conductive composites in a closed-loop process remains a goal for future research.

While it may not be possible to curb the amount of electronics that are discarded by the world's consumers, this work represents a key step toward keeping more electronics out of landfills.

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This research was supported by Virginia Tech through the Institute for Critical Technology and Applied Science and Bartlett's National Science Foundation Early Faculty Career Development (CAREER) award.

Science Daily, 2 June 2025

https://sciencedaily.com

Turning Waste Into Energy: New Enzyme Revolutionizes Biofuel Production

2025-05-29

The natural protein, known as CelOCE, was developed at the Brazilian Center for Research in Energy and Materials and is ready for immediate integration into industrial processes.

Breaking down plant material into usable fuel has long been one of science's biggest energy challenges. At the heart of this process is cellulose, the most abundant renewable polymer on Earth.

While it's made entirely of glucose, its tightly packed crystalline structure, along with its entanglement with other plant components like lignin and hemicellulose, makes it incredibly tough to break down. Nature does it slowly and only with the help of complex enzyme systems.

Now, scientists from the Brazilian Center for Research in Energy and Materials (CNPEM), together with partners in Brazil and abroad, have discovered an enzyme that could transform this process. Their breakthrough enzyme has the power to unlock cellulose more efficiently than ever before. This could pave the way for large-scale production of second-generation ethanol, a clean fuel made from agricultural waste like sugarcane bagasse and corn straw. The findings were recently published in the journal Nature.

"We've identified a metalloenzyme that enhances cellulose conversion through a previously unknown mechanism of substrate binding and oxidative cleavage. This discovery establishes a new frontier in redox biochemistry for the depolymerization of plant biomass, with broad implications for biotechnology," Mário Murakami, head of the CNPEM biocatalysis and synthetic biology research group and coordinator of the study, told Agência FAPESP.

The newly discovered enzyme was named CelOCE, which stands for cellulose oxidative cleaving enzyme. It cleaves cellulose using an unprecedented mechanism, allowing other enzymes in the enzyme

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cocktail to continue their work and convert the fragments into sugar. "To use a comparison, the recalcitrance of the crystalline structure of cellulose stems from a series of locks that classical enzymes cannot open. CelOCE opens these locks, allowing other enzymes to do the conversion. Its role isn't to produce the final product but to make the cellulose accessible. There's a synergy, the potentiation of the action of other enzymes by the action of CelOCE," comments Murakami.

Paradigm shift

According to the researcher, the addition of monooxygenases to the enzyme cocktail about two decades ago was the first revolution. These enzymes directly oxidize the glycosidic bonds in cellulose, facilitating the action of other enzymes. It was the first time that redox biochemistry was used as a microbial strategy to overcome the recalcitrance of cellulose biomass. And that set a paradigm. Everything that was discovered at that time was based on monooxygenases. Now, for the first time, that paradigm has been broken with the discovery of CelOCE, which is not a monooxygenase and provides a much more significant result.

"If we add a monooxygenase to the enzyme cocktail, the increase is X. If we add CelOCE, we get 2X: twice as much. We've changed the paradigm of cellulose deconstruction by the microbial route. We thought that monooxygenases were nature's only redox solution for dealing with the recalcitrance of cellulose. But we discovered that nature had also found another, even better strategy based on a minimalist structural framework that could be redesigned for other applications, such as environmental bioremediation," says Murakami.

The researcher explains that CelOCE recognizes the end of the cellulose fiber, attaches itself to it, and cleaves it oxidatively. In doing so, it disrupts the stability of the crystalline structure, making it more accessible to the classical enzymes, the glycoside hydrolases. A very important fact is that CelOCE is a dimer, consisting of two identical subunits. While one subunit "sits" on the cellulose, the other one is free and can perform a secondary oxidase activity, generating the necessary co-substrate for the biocatalytic reaction.

"This is really very innovative because monooxygenases depend on an external source of peroxide, whereas CelOCE produces its own peroxide. It's self-sufficient, a complete catalytic machine. Its quaternary structural organization makes it possible for the site that isn't engaged on cellulose to act as its peroxide generator. This is a huge advantage because peroxide is a highly reactive radical. It reacts with a lot of things. It's very difficult to

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control. That's why, on an industrial scale, adding peroxides to the process is a major technological challenge. With CelOCE, the problem is eliminated. It produces the peroxide it needs in situ," emphasizes Murakami.

A Natural Catalyst Found in Sugarcane Waste

CelOCE is a metalloenzyme: this is its exact classification because it has a copper atom embedded in its molecular structure, which itself acts as a catalytic center. It was not created in a laboratory but discovered in nature. However, to get to it, the researchers had to mobilize a formidable amount of science and equipment.

"We started with samples of soil covered with sugarcane bagasse that had been stored for decades in an area adjacent to a biorefinery in the state of São Paulo. In these samples, we identified a microbial community highly specialized in the degradation of plant biomass, using a multidisciplinary approach that included metagenomics, proteomics, carbohydrate enzymology by chromatographic, colorimetric and mass spectrometric methods, fourth-generation synchrotron-based X-ray diffraction, fluorescence and absorption spectroscopies, site-directed mutagenesis, genetic engineering of filamentous fungi using CRISPR/Cas and experiments in 65-liter and 300-liter pilot plant bioreactors. We went from biodiversity exploration to mechanism elucidation to an industrially relevant scale in a pilot plant with the possibility of immediate real-world application," says Murakami.

The researcher emphasizes that this was not a laboratory bench result that still needs to be validated before it can be used on an industrial scale. The proof of concept has already been demonstrated on a pilot scale, and the newly discovered enzyme can be immediately incorporated into the production process – which is extremely relevant for Brazil, as a major producer of biofuels, and for the world, in a context of urgent energy transition due to the climate crisis.

Brazil has the only two biorefineries in the world capable of producing biofuels from cellulose on a commercial scale. The trend is for these biorefineries to multiply here and be replicated in other countries. One of the biggest challenges so far has been the deconstruction of cellulose biomass: how to break it down and convert it into sugar. CelOCE is expected to significantly increase the efficiency of this process.

"Currently, efficiency is in the 60% to 70% range, and in some cases it can reach 80%. That means that a lot is still not being used. Any increase in yield means a lot, because we're talking about hundreds of millions of tons

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of waste being converted," Murakami argues. He adds that it is not just about increasing the production of ethanol for vehicles, but also for other products, such as aviation biofuel.

Sci Tech Daily, 29 May 2025

https://scitechdaily.com

Graphene Oxide Derivative Could Replace PFAS 2025-05-29

Northwestern University researchers have developed a new water- and oil-resistant material that could become a safe, viable replacement for harmful plastics and toxic per- and polyfluoroalkyl substances (PFAS) in food packaging.

Derived from graphene oxide, the material is non-toxic, environmentally friendly and affordable. When applied to paper-based food and beverage packaging, the material not only provides exceptional barrier properties but also significantly enhances the product's overall strength. This could mean an end to flimsy paper plates and soggy takeout containers. After use, packaging treated with the material can be readily composted or recycled — closing the loop on a truly sustainable solution.

GO-Eco — a subsidiary of Chang Robotics and a resident startup at Northwestern's Querrey InQbation Lab (The Q) — is commercializing the patent-pending product. Recent independent, third-party industrystandard evaluations have shown that Northwestern's material significantly improves strength and barrier properties compared to current commercially available solutions.

"This is not just a materials innovation; it's a market-ready solution," said Timothy Wei, who co-developed the product. "We are thrilled to be taking GO-Eco from the lab to the factory floor, with applications that could ultimately transform the entire food packaging industry."

Wei is an adjunct professor of mechanical engineering at Northwestern's McCormick School of Engineering, chief scientist at Chang Robotics and former dean of engineering at the University of Nebraska-Lincoln. He co-developed the product with graphene oxide expert SonBinh Nguyen, a professor of chemistry at Northwestern's Weinberg College of Arts and Sciences.

The urgency for new solutions is clear. After analyzing numbers from various sources, the GO-Eco team estimates the U.S. alone produces



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approximately 14 million metric tons of paper-based food packaging and corrugated cardboard each year, generating more than \$60 billion in annual sales. These products are often coated with plastic, foil or PFAS to achieve water- and oil-resistance, despite mounting regulatory pressures to eliminate these materials due to environmental and health risks. While some bio-based alternatives exist, their high cost has rendered them commercially unviable.

The potential solution to this global problem came from decades of research from Nguyen's and Wei's labs. While Nguyen's research group has published extensively on characterizing and manufacturing graphene oxide, Wei brings deep expertise in advanced manufacturing and the food industry. Together, they developed a new proprietary process that harnesses the unique properties of graphene oxide — oxidized singleatom-thick sheets of carbon atoms — to enhance the barrier properties of paper and cardboard products.

After developing the process, the team rigorously tested the material on a diverse range of food- and beverage-packaging prototypes, including cardboard boxes, plastic produce bags and disposable tableware, such as plates, cups and straws. In every instance, the new material rendered these products resistant to water, oil and grease, while simultaneously boosting the strength of the paper substrates. The Q, Northwestern's Office of Undergraduate Research and The Alumnae of Northwestern University initially assisted the research with internship support.

With recent funding from a major national tableware manufacturer and active engagement from multiple industry partners, GO-Eco has advanced product testing from the laboratory stage at The Q to comprehensive, industry-standard evaluations at Western Michigan University's Paper Pilot Plant. These tests confirmed that applying small amounts of graphene oxide increases barrier performance and paper strength by 30 to 50% over what is commonly used in the market. And the cost remains comparable to current commercial barrier products. These findings apply to a broad array of materials — from molded fiber products, such as tableware, to corrugated cardboard packaging.

Through an exclusive licensing agreement with Northwestern and support from The Q, GO-Eco is transitioning the science into a commercialized technology. The team is actively discussing production and pilot testing with several companies. GO-Eco's next steps include scaling production, pursuing FDA food-contact approvals and certifying the recyclability and compostability of paper treated with graphene oxide. It also plans

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to conduct a full-scale production trial for molded fiber and traditional paper-sheet prototypes.

Technology Networks, 29 May 2025

https://technologynetworks.com

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Long-used red pigment carmine has a surprisingly complex porous structure

2025-06-03

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Using advanced electron crystallography techniques, researchers at Stockholm University have succeeded in determining the structure of the historically significant red pigment carmine. It turns out that the substance, used today in products such as candy and paint, has a complex porous structure.

The study is published in the journal Crystal Growth & Design.

Carmine is a natural red coloring agent produced from cochineal extract. The extract from these insects is rich in carminic acid, which is combined with aluminum (AI) and calcium (Ca) to produce carmine. Analysis using advanced electron microscopy techniques has now revealed that this pigment has an unexpected structure. It is a so-called metal complex, built from two calcium ions, two aluminum ions, and four organic ligand molecules of carminic acid.

Together, these components form a well-defined, three-dimensional porous structure that has intrigued researchers at the Department of Chemistry.

"It was truly surprising that such a long-used pigment made from a naturally occurring molecule had this type of structure," says Erik Svensson Grape, former Ph.D. student at Stockholm University and currently a postdoctoral researcher at the University of Oregon and Uppsala University.

He initiated the study of carmine using the new technique, driven by curiosity about how materials are built, and with the hope of discovering new potential applications.

"Chemists have only recently begun to deliberately design and use materials with this type of porous architecture— for example in catalysis, pollutant capture, and energy storage. The first commercially available



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nanoporous materials were only developed in the middle of the 20th century," says Grape.

Why has the structure of carmine remained unknown until now?

"Although carmine is a crystalline substance, it hasn't been possible to grow large enough crystals for analysis using traditional methods like single-crystal X-ray diffraction. But with the help of the new electron microscopy techniques available at Stockholm University—specifically 3D electron diffraction (MicroED)— we've now been able to determine the structure of carmine from real pigment samples," explains Grape.

This new knowledge may open new potential applications for carmine, including in environmental applications.

"The well-defined structure of carmine could make it easier to identify the pigment in historical artifacts. And the porous structure could also lead to new applications and inspire the development of new materials, for example as an adsorbent to capture pollutants," says Grape.

An adsorbent is a material that can concentrate another substance, called an adsorbate, on its surface through a process called adsorption, in which molecules adhere to a surface. Adsorbents are often used to purify water and air, or to separate different substances.

Carmine may also become more relevant as a natural alternative to synthetic coloring agents in the food industry.

"As synthetic food dyes are increasingly scrutinized by the public due to health concerns, natural pigments like carmine may soon be used more often in the food industry," Grape explains.

Phys Org, 3 June 2025

https://phys.org

Anti-aging: Vitamin D shaves three years off your biological age

2025-05-21

Taking a vitamin D supplement – or getting enough of the compound naturally – can knock three years off your biological aging, according to the results of a large, long-term study. This may not seem like a lot, over a lifetime, but it's a significant amount as you become more and more susceptible to age-related diseases.

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Co-led by researchers at Mass General Brigham and the Medical College of Georgia, the The VITamin D and OmegA-3 TriaL (VITAL) study enrolled 25,871 US males aged 50 years and older and females aged 55 years and older to study a range of health biomarkers potentially impacted by both omega-3 and vitamin D supplementation. A subset of 1,054 participants featured in the VITAL Telomere study, where this biological aging marker was the focus.

What they found was that, when assessed at baseline and then again after two and then four years, the subset of participants who had been receiving vitamin D3 (2,000 IU/day) had significantly longer telomeres within their white blood cells than those receiving a placebo. (Omega-3 fatty acid had no effect on this health biomarker.)

So, what has this got to do with anti-aging? Telomeres are the protective "caps" on the ends of chromosomes, essentially shielding the important DNA held within from degrading or fusing with other chromosomes. They naturally shorten with every cell division, and there's a growing body of evidence linking this to limited stem cell function and organ health. As such, short telomeres have been linked to a suite of age-related conditions and diseases.

"VITAL is the first large-scale and long-term randomized trial to show that vitamin D supplements protect telomeres and preserve telomere length," said co-author JoAnn Manson, MD, principal investigator of VITAL and chief of the Division of Preventive Medicine at Brigham and Women's Hospital. "This is of particular interest because VITAL had also shown benefits of vitamin D in reducing inflammation and lowering risks of selected chronic diseases of aging, such as advanced cancer and autoimmune disease."

Until now, studies into telomere length and vitamin D have been small and brief, and produced mixed results. The VITAL Telomere study is the first to show, with robust trial design over a long period, that the compound does indeed appear to offer great benefit in shielding the breakdown of these chromosome caps.

"Our findings suggest that targeted vitamin D supplementation may be a promising strategy to counter a biological aging process, although further research is warranted," said first author Haidong Zhu, a molecular geneticist at the Medical College of Georgia, Augusta University.

For humans, vitamin D3 and D2 are the most important in this group of fat-soluble compounds, helping with a range of functions including

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bolstering the immune system and helping the absorption of calcium – which is also very important for bone health in aging. A deficiency has also more recently been linked to age-related dementia and neurological conditions in newborns.

That said, there are as many studies that have found no evidence that it can ward off depression, and more research is needed to support claims that it can ease the severity of viruses like COVID-19 and the measles.

While it's hard to measure what our bodies absorb from natural sources – food, the Sun – this 2,000 IU/day dose is largely considered safe for most people, with the limit set at around twice that amount. However, it's best to talk to your healthcare provider to make sure there are no other risk factors before upping your D dose.

The study was published in the American Journal of Clinical Nutrition.

New Atlas, 21 May 2025

https://newatals.com

Climate Change Is Affecting the Taste of Wine

2025-05-28

If you drink wine, chances are it already tastes different – rising global temperatures are transforming winegrowing regions around the world.

A major global study led by UBC researchers reveals that temperatures during the growing season have increased globally across the major wine regions. On average, regions have warmed by the equivalent of almost 100 extra growing degree days (GDD) – a measure of the cumulative heat that vines are exposed to, influencing their growth and ripening.

"Europe is feeling the biggest impact, with parts of the continent heating up by as much as 2.5°C since 1980. That kind of change can affect harvest times, grape ripening, and thus the taste of the wine," said Dr. Elizabeth Wolkovich, senior author of the study and an associate professor at UBC's faculty of forestry.

Unlike previous studies focused on a single country or region and often one grape variety, this study analyzed data from winegrowing areas across five continents and considered over 500 varieties. It examined average temperatures, as well as extreme heat, seasonal timing and winter temperatures – offering one of the most comprehensive pictures yet of how climate change is reshaping viticulture.

Gossip

Heat waves and hard limits

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One of the most worrying trends is the growing number of extremely hot days (above 35 C), which can seriously damage grapevines. Parts of eastern and western Europe are now experiencing up to one more of these extreme days per growing season than they were a few decades ago.

"That may not sound like much, but for vines already near their heat limit and for regions in Europe that rarely saw such temperatures before, it's a big challenge. Regions that are already hot, like northern Africa and western Asia, are particularly at risk," said Dr. Victor van der Meersch, study co-author and a postdoctoral researcher at UBC. Even a small temperature increase can lead to heat stress, water shortages and a higher risk of wildfires, making traditional grape-growing practices harder to maintain.

Different impacts on regions

While the study shows a universal warming trend across the world's wine regions, it highlights how climate change is affecting different areas in unique ways. Northern Africa and western Asia saw significant increases in average temperatures and growing degree days, but their increase in extreme heat was comparatively smaller. In contrast, southern and western Europe are seeing nearly five times as many extreme heat days as they did in 1980.

Apart from heat, warmer winters and nights are changing grapevine growth and the timing of key stages like budburst and harvest. The study found that winter temperatures have increased by about 1 C globally, with Oceania (including Australia and New Zealand) and central and eastern Asia seeing some of the largest changes.

New tech, new grapes

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So, what can vineyards do? The study suggests that growers adapt fast, adopting both short-term solutions and long-term planning to deal with hotter, drier and more unpredictable conditions.

In many regions, adaptation is already underway. Many are considering drought-resistant rootstocks and varieties new to their region, as well as adjusting pruning and harvest times.

Dr. Wolkovich notes that switching grape varieties isn't always easy, especially in regions that rely on a few popular types. "We need more diversity in the grapes we grow. Choosing heat-tolerant varieties helps,

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but we also need to be mindful of when those grapes grow and ripen. Timing is everything."

Technology is also helping growers. Soil sensors, satellite imagery and weather stations provide real-time data, allowing winemakers to make smarter decisions about watering, harvesting and crop protection. But such new technology can only go so far, especially as the world continues to heat up. "It's definitely not the end of winemaking as we know it – but it is a major challenge," said Dr. Wolkovich. "The type and quality of wine in our glasses tomorrow will very much depend on what we do in the vineyards today, and especially on the global decisions we make to reduce greenhouse gas emissions."

The study was published today in PLOS Climate.

Technology Networks, 28 May 2025

https://technologynetworks.com

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Too much ginger, turmeric or cinnamon may interfere with prescription medication

2025-05-27

A sprinkle of cinnamon on your porridge, a pinch of turmeric in your curry, or a dash of ginger in your biscuits – these popular spices are kitchen staples around the world. For centuries, spices haven't just been used to flavour food but also valued in traditional Ayurvedic and Chinese medicine for their healing properties.

But could something as innocent as a spoonful of spice interfere with your medication?

Take cinnamon, for example.

Sourced from the bark of cinnamomum trees, it contains active compounds like cinnamaldehyde, eugenol and coumarin. Cinnamon oil, derived from the bark or leaves, is often used in food flavouring, fragrances and herbal remedies.

Cinnamon has been linked to a range of potential health benefits: It's rich in antioxidants, it may reduce inflammation, it helps regulate blood sugar levels, it lowers the risk of heart disease, and even improves brain function. Traditionally, it's also been used to ease digestion and ward off infections.

But a recent study from the University of Mississippi has raised concerns that cinnamon could reduce the effectiveness of certain medications.

In lab tests, cinnamaldehyde was found to activate receptors that speed up how drugs are cleared from the body – potentially making them less effective. While this research is still in the early stages and hasn't yet been tested in humans, it raises important questions about how cinnamon interacts with modern medicines.

Type of cinnamon matters

The type of cinnamon matters too. The cinnamon commonly found in supermarkets – cassia cinnamon – is cheaper, widely available and comes from parts of Asia. Ceylon cinnamon, often labelled as "true cinnamon," originates from Sri Lanka and is generally more expensive.

Cassia cinnamon contains higher levels of coumarin, a natural compound that can harm the liver in high doses, according to studies. Coumarin is also a known anti-coagulant, meaning it helps prevent blood clots, which



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is useful in medicine but risky when combined with blood-thinning drugs like warfarin.

There have been a few case reports suggesting that cinnamon supplements could increase the risk of bleeding when taken with anticoagulants. This is probably due to coumarin affecting liver enzymes responsible for breaking down drugs like warfarin.

Some research also suggests cinnamon could potentially interact with other medications, including painkillers, anti-depressants, anti-cancer drugs and diabetes medications.

But before you throw out your spice rack, it's important to remember: The risks come from high doses, particularly in supplement form. A light sprinkle of cinnamon on your porridge is unlikely to cause problems.

Small doses

Another spice with medicinal promise – and potential risks – is turmeric. Known for its vivid yellow colour and use in both cooking and traditional medicine, turmeric contains curcumin, a compound praised for its antiinflammatory and anti-oxidant effects.

However, information on turmeric's interactions with medications is still limited. Most of what we know comes from lab and animal studies, which don't always translate directly to humans.

Still, there's evidence that curcumin can affect how some drugs are metabolised, particularly by interfering with liver enzymes. This means it could potentially interact with antidepressants, blood pressure medications, chemotherapy drugs and certain antibiotics.

Turmeric also has natural blood-thinning properties, which could amplify the effects of medications like warfarin or aspirin. Animal studies suggest turmeric may also lower blood sugar, meaning it could increase the effects of anti-diabetic drugs or insulin.

Additionally, turmeric has been shown to reduce blood pressure, which, when combined with blood pressure medications, could cause an excessive drop.

As with cinnamon, these effects are most often linked to high-dose supplements, not the small amounts used in food.

Ginger is another spice celebrated for its health benefits, particularly its anti-nausea and anti-inflammatory effects. But its active compounds,

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including gingerol, may also influence how your body handles medications.

Ginger can act as a mild blood thinner, which means combining it with anti-coagulants could raise the risk of bleeding. The evidence is mixed when it comes to ginger and diabetes: While some studies suggest it may lower blood sugar, more research is needed to fully understand the effect it may have when taken alongside anti-diabetic medications.

High doses

While lab studies suggest these spices may affect how the body processes certain medications, the vast majority of these effects have been observed in high doses, usually from supplements, not everyday cooking.

If you're taking medications, especially blood thinners, diabetes medicines, or chemotherapy drugs, it's worth having a guick chat with your doctor or pharmacist before starting any new herbal supplements. But for most people, using spices in typical culinary amounts is safe - and a delicious way to add both flavour and potential health benefits to your meals.

So go ahead: Sprinkle, pinch, or dash – just be mindful of what's in your medicine cabinet – and be wary of taking any herbal supplement in high doses.

In Daily, 27 May 2025

https://indailysa.com.au

Global Warming May Raise Women's Cancer Risk 2025-05-27

Scientists investigating the impact of climate change on women's health have found that increased heat is linked to an increase in rates of breast, ovarian, uterine and cervical cancers. They looked at 17 countries in the Middle East and North Africa, where temperatures are expected to rise by 4 degrees Celsius by 2050, and found that these four cancers became more common and more likely to be fatal with each degree rise in temperature. The increase can't be explained by improved diagnosis or survival rates. The researchers call for the urgent integration of climate change resilience into public health plans.

Scientists have found that global warming in the Middle East and North Africa is making breast, ovarian, uterine, and cervical cancer more common and more deadly. The rise in rates is small but statistically



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significant, suggesting a notable increase in cancer risk and fatalities over time.

"As temperatures rise, cancer mortality among women also rises particularly for ovarian and breast cancers," said Dr Wafa Abuelkheir Mataria of the American University in Cairo, first author of the article in Frontiers in Public Health. "Although the increases per degree of temperature rise are modest, their cumulative public health impact is substantial."

An unhealthy environment

Climate change isn't healthy. Rising temperatures, compromised food and water security and poor air quality all increase the burden of disease and death worldwide. Natural disasters and the strain of unanticipated weather conditions also disrupt infrastructure, including healthcare systems. When it comes to cancer, that can mean people are more exposed to risk factors like environmental toxins and are less likely to receive a prompt diagnosis and treatment. This combination of factors could lead to a major rise in the incidence of serious cancers, but quantifying it is difficult.

To investigate the effects of climate change on women's cancer risk, the researchers selected a sample of 17 Middle Eastern and North African countries: Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudia Arabia, Syria, Tunisia, United Arab Emirates and Palestine. These countries are seriously vulnerable to climate change and are already seeing striking temperature rises. The researchers collected data on the prevalence and mortality of breast cancer, ovarian cancer, cervical cancer, and uterine cancer, and compared this information with changing temperatures between 1998 and 2019.

"Women are physiologically more vulnerable to climate-related health risks, particularly during pregnancy," said co-author Dr Sungsoo Chun of the American University in Cairo. "This is compounded by inequalities that limit access to healthcare. Marginalized women face a multiplied risk because they are more exposed to environmental hazards and less able to access early screening and treatment services."

Running the numbers

The prevalence of the different cancers rose by 173 to 280 cases per 100,000 people for every additional degree Celsius: ovarian cancer cases rose the most and breast cancer cases the least. Mortality rose by 171 to

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332 deaths per 100,000 people for each degree of temperature rise, with the greatest rise in ovarian cancer and the smallest in cervical cancer.

When the researchers broke this down by country, they found that cancer prevalence and deaths rose in only six countries — Qatar, Bahrain, Jordan, Saudia Arabia, the United Arab Emirates and Syria. This could be due to particularly extreme summer temperatures in these countries, or other factors which the model couldn't capture. The rise was not uniform between countries: for instance, the prevalence of breast cancer rose by 560 cases per 100,000 people for each degree Celsius in Qatar, but only 330 in Bahrain.

Although this shows that increased ambient temperature is a probable risk factor for these cancers, it also suggests that temperature has a different effect in different countries - so there are likely to be other factors modifying risk. For instance, increased heat could be associated with higher levels of carcinogenic air pollution in some places.

"Temperature rise likely acts through multiple pathways," said Chun. "It increases exposure to known carcinogens, disrupts healthcare delivery, and may even influence biological processes at the cellular level. Together, these mechanisms could elevate cancer risk over time."

Risk factors

Higher prevalence could also reflect improvements in cancer screening. However, better screening would be expected to result in fewer deaths, as early-stage cancer is easier to treat. But both death rates and prevalence rose, suggesting that the driving factor is exposure to risk factors.

"This study cannot establish direct causality," cautioned Mataria. "While we controlled for GDP per capita, other unmeasured factors could contribute. Nonetheless, the consistent associations observed across multiple countries and cancer types provide compelling grounds for further investigation."

This research also underlines the importance of considering climaterelated risks in public health planning.

"Strengthening cancer screening programs, building climate-resilient health systems, and reducing exposure to environmental carcinogens are

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key steps," said Chun. "Without addressing these underlying vulnerabilities, the cancer burden linked to climate change will continue to grow."

Technology Networks, 27 May 2025

https://technologynetworks.com

Platinum atoms placed with precision transform catalyst speed and efficiency

2025-06-05

A research team led by the Department of Energy's (DOE) Lawrence Berkeley National Laboratory (Berkeley Lab) designed and fabricated catalysts that can increase the speed of carbon monoxide oxidation by nine times. Carbon monoxide oxidation is an important reaction used in numerous chemical industry and environmental cleaning applications. The cutting-edge fabrication approach involved making precise, atomiclevel changes in catalysts to create new, performance-boosting chemical properties.

"Our study provided deep insights into the chemical structure, reaction mechanisms, and performance of these advanced catalysts," said Ji Su, a research scientist in Berkeley Lab's Energy Technologies Area (ETA). "It sets the stage for a new era in superior catalyst design, with potential to dramatically improve the production efficiency of a wide range of chemical industry and environmental applications."

The research was published in Science. The collaborators included Oak Ridge National Laboratory and several other institutions.

A workhorse in the chemical industry

Catalysts are materials that increase the speed of chemical reactions. The chemical industry relies heavily on catalysts to make production more cost-effective and higher quality, with about 95% of fuel and chemical products using one or more catalysts in their manufacturing process. Cars use catalysts to oxidize harmful emissions in exhaust, including unburned fuel and carbon monoxide.

Besides faster reaction speed, another desirable catalyst attribute is selectivity. This refers to the catalyst's ability to activate more efficient reaction pathways, maximize output of desired products, and minimize waste products.

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Traditionally, catalysts have been made by fabricating particles, or clusters of hundreds of atoms. In recent years, researchers have been investigating advanced fabrication techniques that involve manipulating individual metal atoms on a catalyst's surface. The idea is to tailor chemical properties that enable faster, more selective catalytic reactions.

Like mounting a diamond and building with Lego bricks

The team developed a new treatment process that involves loading a single platinum atom onto a specific location on a cerium oxide surface, with the platinum replacing a cerium atom.

"The process is like mounting a diamond on a support structure on a ring," said Su from ETA's Energy Storage and Distributed Resource Division.

Next, in a process like building with Lego bricks, the researchers applied hydrogen molecules to the platinum-cerium structure. The hydrogen molecules split into atoms that bond with the cerium. For comparison, the team also made a control catalyst by randomly loading a platinum atom on a cerium oxide surface, without any hydrogen treatments.

Blazing fast and more selective

The team tested the catalysts' performance in two reactions. The first was oxidation of carbon monoxide to yield carbon dioxide. The second was removal of hydrogen from propane to make propylene, which is an important raw material in plastics. The latter has emerged as a promising alternative to conventional propylene production.

The precisely tailored catalyst oxidized carbon monoxide nine times faster than the control catalyst. It was also 2.3 times more selective at converting propane to propylene.

Two important contributors were the Advanced Light Source and the Molecular Foundry, which are DOE Office of Science User Facilities located at Berkeley Lab. The researchers used the Molecular Foundry's highresolution imaging techniques to visualize platinum inserted into the surface.

They also used the Molecular Foundry to conduct simulations to characterize the atomic structures and reaction pathways. Researchers at the Advanced Light Source applied a technique called ambient pressure X-ray photoelectron spectroscopy to determine the platinum's charge (+2), helping the team better understand the platinum-cerium interactions.

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In addition, the scientists used a neutron scattering technique at DOE's Oak Ridge National Laboratory to characterize the bonding of cerium and hydrogen. Researchers used the synchrotron at Taiwan's National Synchrotron Radiation Research Center to characterize the entire catalyst structure.

The team's paper culminates a series of eight papers published by Su's research group since 2019. Together, the studies paint a comprehensive picture of these innovative catalysts—their fabrication, structure, properties, chemical interactions, and effective performance.

Phys Org, 5 June 2025

https://phys.org

MIT's 'crazy' fuel cell could power electric planes 2025-06-02

Scientists have developed a fuel cell system which they say could ultimately have enough energy capacity to power regional electric aircraft. They state that the technology is capable of carrying over three times as much energy per unit of weight as a lithium-ion battery.

Created by Prof. Yet-Ming Chiang and colleagues at MIT, the current prototype device consists of two chambers linked by a solid ceramic electrolyte material. The fuel, namely liquid sodium metal, is in one of the chambers, while the other is filled with humid air.

Putting it simply, sodium ions pass from the one chamber, through the electrolyte, into the other chamber. Upon contact with the air, they chemically react with the oxygen in the gas, producing electricity. A porous electrode on the air-chamber-side of the electrode assists in this reaction.

The process does create sodium oxide as a byproduct, which the researchers state would soak up excess carbon dioxide from the atmosphere when expelled from aircraft in the exhaust.

Through a cascading series of reactions, the sodium oxide would ultimately form into sodium bicarbonate, aka baking soda. Chiang's team says that if the non-toxic compound were to end up falling into the ocean, it would de-acidify the water, actually helping to reverse one of the damaging effects of greenhouse gases.

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The idea is that in a large-scale application such as an airliner, multiple sodium-air fuel cells could be stacked together. Providing an energy density of about 1,000 watts per kilogram, such a setup should provide enough range for regional passenger flights.

And after each flight, the cells could be quickly "refueled" simply by swapping in freshly-refilled cartridges full of liquid sodium metal. This capability addresses an issue with previously developed sodium-air flow batteries, which showed great promise but were difficult to fully recharge.

Production of the sodium metal reportedly shouldn't be a problem, as it was globally mass-produced as a fuel additive back in the days of leaded gasoline. It utilizes widely available inexpensive sodium chloride salt, and melts into metal form at a temperature of 98 °C (208 °F), just below the boiling point of water.

Although we may not be seeing passenger airliners utilizing the technology in the immediate future, it is hoped that a "brick-sized" 1,000-watt-hour demonstrator fuel cell will be available for use in drones within one year. The technology is being commercialized via MIT spinoff company Propel Aero.

"We expect people to think that this is a totally crazy idea," says Chiang. "If they didn't, I'd be a bit disappointed because if people don't think something is totally crazy at first, it probably isn't going to be that revolutionary."

A paper on the research was recently published in the journal Joule.

New Atlas, 2 June 2025

https://newatlas.com

Hybrid quantum-classical model predicts molecular behavior in solvents

2025-06-05

A team led by Kenneth Merz, Ph.D., Staff at Cleveland Clinic's Center for Computational Life Sciences, showed how quantum computers can be used for investigating how molecules act in aqueous solutions.

One of the most essential components of chemistry is understanding how molecules react in specific liquids. For example, in water-based solvent solutions, a molecule interacts with the water molecules around it, causing it to change its behavior. If researchers can predict how a molecule will

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change when it is in a liquid, they can create more effective drugs and treatments.

Calculating all the possible reactions and outcomes of each molecule in a solvent is too time-consuming and costly for current methods on classical computers. To overcome this, the Merz lab completed the first study to demonstrate implicit solvent simulations using Sample-Based Quantum Diagonalization (SQD) on real quantum hardware, showing a new way forward to better characterize molecules in solution.

The paper, published in a special issue of The Journal of Physical Chemistry, is also the first study to test SQD in the solvent phase. The paper was featured as the cover story for this issue.

To understand how molecules behave in liquids, Dr. Merz and his team used IBM Quantum System One to run SQD, which selects electronic configurations "samples" of a molecule that helps to characterize the energy of a molecule. The samples are then sent to a classical computer that analyzes them and selects the most likely outcomes.

This process is repeated and improved until the most accurate prediction is made. As part of a partnership with IBM, Cleveland Clinic is home to IBM Quantum System One, the first quantum computer dedicated to health care research.

To validate the model, the team tested it on four polar molecules that are commonly observed in chemistry and biology; methanol, ethanol, methylamine and water. Up to 52 gubits were utilized on each test, which achieved a chemical accuracy of less than 1 kcal/mol. These results demonstrate the model's ability to predict the molecules' energies and solvation free energy.

"This study is a significant stride towards practical quantum chemistry on guantum computers," Dr. Merz says. "Quantum hybrid models are still largely unexplored and very few are tested on guantum hardware. By testing this model on quantum hardware, we are demonstrating its abilities to advance chemical research using quantum computers."

Phys Org, 5 June 2025

https://phys.org

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Atmospheric chemistry keeps pollutants in the air 2025-06-03

Nitrates in the atmosphere reduce air quality and play an important role in climate change. An international team led by Hokkaido University researchers has revealed how chemical processes in the atmosphere have led to persistently high nitrate levels despite a reduction in emissions over the past few decades. These findings, published in Nature Communications, will help improve climate modelling by refining our ability to assess and predict atmospheric nitrate levels.

Atmospheric nitrate levels peaked between 1970 and 2000. The levels decreased somewhat with the decrease in the emission of nitrate precursors since the 1990s, but the drop in nitrate levels is smaller than the drop in the emission of precursors -- something is keeping nitrates in the atmosphere.

Nitrates can exist in either a gaseous or particulate form in the atmosphere. Gaseous nitrate is more easily deposited out of the atmosphere, while the particulate form -- particularly finer particles -- can be transported over long distances. Understanding the balance between gaseous and particulate nitrates is therefore important in getting a picture of the atmospheric dynamics and persistence of nitrates.

The persistence of atmospheric nitrates in source regions is explained by a buffering effect, where gaseous nitrates are converted to particulate nitrates, contributing to their persistence. The impact of this buffering over long timescales and at long ranges is unclear, but nitrates deposited in Arctic ice cores show the same patterns as atmospheric nitrates. These sites are far from the sources, so the continuing high deposition rates don't reflect local processes near the source but must be due to atmospheric transport and other processes in the atmosphere.

To understand these dynamics, a research team led by Professor Yoshinori lizuka at the Institute of Low Temperature Science, Hokkaido University, examined the nitrate deposition history from 1800 to 2020 in an ice core taken from southeastern Greenland. As expected, nitrate levels within the core increased from the 1850s, peaking between the 1970s and 2000s before declining somewhat but remaining high. Overall, the increase in nitrates up to the 1970s happened more gradually than the increase in precursors, and the decrease after the 1990s was also slower and smaller than the decrease in precursor emission.

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The delayed effect and persistence of nitrates indicates factors other than the emission of precursors are affecting nitrate levels. The researchers investigated these factors with a global chemical transport model and found that the difference between nitrate and precursor levels correlated with atmospheric acidity and not with other meteorological factors, such as air temperature.

In other words, the persistence of nitrates has been driven by chemical processes happening in the atmosphere rather than meteorological conditions or atmospheric dynamics. Changes in atmospheric acidity altered the proportion of nitrate that was gaseous or particulate. This affects the lifetime of nitrates in the atmosphere. Atmospheric acidity has increased the fraction of nitrates in particulate form, enabling this pollutant to persist longer and travel farther.

"Ours is the first study to present accurate information for records of particulate nitrates in ice cores, which has been a very challenging problem," says lizuka. "As it is more difficult to reduce anthropogenic emissions of substances that lead to increased nitrates, accurate measurements of particulate nitrates in the ice cores provides data for increasing the accuracy of predicting the amplification of Arctic warming in the future."

"It was difficult to present accurate nitrate from ice cores, but our team was able to do so this time." says lizuka. "In the future, nitrate will replace sulfate as the primary aerosol in the Arctic, suggesting this result leads to the higher accuracy of future predictions of Arctic warming amplification."

Science Daily, 3 June 2025

https://sciencedaily.com

International Research Team Builds World's Most Efficient Organic Solar Cell

2025-05-30

As global initiatives to mitigate climate change accelerate, the demand for solar energy continues to rise. However, conventional silicon-based solar panels, which currently dominate the market, contain a variety of hazardous substances. These materials pose significant environmental challenges when the panels reach the end of their life cycle, as their disposal or recycling involves high costs and environmental risks.

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Similar concerns apply to emerging film-type solar technologies, such as perovskite solar cells. Although promising in performance, these next-generation cells also incorporate potentially toxic components, including lead compounds and metal oxides, raising further concerns about long-term sustainability and safe disposal.

To address these issues, researchers have been developing film-type solar cells made entirely from carbon-based, organic materials, known as all-organic solar cells. Unlike their metal-containing counterparts, these organic cells do not involve toxic heavy metals and can be safely incinerated like standard plastics. This makes them a far more environmentally friendly option in terms of both disposal and lifecycle cost.

Despite their environmental advantages, all-organic solar cells currently suffer from low power conversion efficiency (PCE), reaching only about 4%—significantly lower than the >27% efficiency of silicon solar cells and the >26% achieved by advanced perovskite cells. As a result, there is a strong push within the scientific community to advance the technology and improve the performance of all-organic solar cells to make them a viable alternative in the renewable energy landscape.

Breakthrough in all-organic solar cell efficiency

Masahiro Nakano, Associate Professor from Institute of Science and Engineering, Faculty of Chemistry, Kanazawa University, has collaborated with scientists from REIKO Co., Ltd. (Junichi Iwai, President) and Queen's University at Kingston, Canada, and now successfully developed allorganic solar cells with the world's highest efficiency.

While the performance of previous all-organic solar cells was limited to about 4% PCE, the newly developed cells achieve more than twice efficiency than that of previous ones.

Solving the problem of transparent electrodes

Two major problems had previously hindered the performance of allorganic solar cells. First, the availability of highly conductive organic transparent electrode materials suitable for film-type solar cells is limited. Some high-conductivity organic materials had been reported, but their preparation required strong acids, bases, or high-temperature annealing (>150°C), which could damage organic substrate films and organic semiconducting layers.

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To overcome this, the research team developed a transparent electrode based on conductive polymer PEDOT:PSS. The PEDOT:PSS-based electrode can be fabricated at a lower temperature (80°C) without using acids or bases, and it demonstrates sufficient conductivity (sheet resistance: <70 Ω / sq.) for film-type solar cells.

The second challenge lies in stacking multiple layers within the film-type solar cell device without harming the layers beneath. In solution-based processes, the ink used for the upper layers can damage the underlying ones. To This technique involves forming electrodes separately on the barrier films of solar cells and then attaching them to the device, avoiding damages to the bottom organic films during electrode fabrication. By combining the new organic transparent electrode and fabrication method, the research team successfully developed all-organic solar cells with more than twice the power conversion efficiency (8.7%) of previous models (4.0%). This advancement represents a crucial step toward the practical application of high-performance all-organic solar cells.

Future applications and performance improvement goals

Looking ahead, all-organic solar cells hold great promise for applications in environmentally sensitive areas, such as farmland and wearable devices. Their lightweight and flexible nature also allows for installation in locations where conventional solar panels would be impractical. The research team aims to further enhance performance by improving the conductivity of the organic electrodes.address this issue, the researchers developed a lamination method using a carbon nanotube electrode, which allows for the addition of layers without compromising the integrity of those below.

Sci Tech Daily, 30 May 2025

https://scitechdaily.com

MicroRNAs Found To Contribute to Bipolar Disorder, PTSD and Parkinson's

2025-06-03

A study in Nature Aging from researchers at the UC Davis School of Medicine has identified specific microRNAs — non-coding RNAs that regulate gene expression within cells — that likely contribute to bipolar disorder, depression, schizophrenia, post-traumatic stress disorder (PTSD) and Parkinson's disease.

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"To our knowledge, this is the first study to identify microRNAs that contribute to the development of psychiatric and neurodegenerative diseases," said Aliza Wingo, senior author of the study. Wingo is a professor in the UC Davis Department of Psychiatry and Behavioral Sciences and a staff psychiatrist at VA Northern California Health Care.

MicroRNAs act like brakes

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Genetic instructions for living organisms are contained within the DNA in a cell's nucleus.

Messenger RNA (mRNA) is responsible for carrying protein-making instructions from the DNA in the cell's nucleus to the cytoplasm, the gelatinous liquid that fills the cell.

In the cytoplasm, the mRNA instructs the cell's protein-making machinery — organelles like ribosomes — to make specific proteins based on the instructions received from the DNA.

But a different and very small type of RNA, microRNAs, can put the brakes on this protein-making process.

First discovered in 1993, microRNAs can stick to mRNA and prevent the protein encoded on it from being made.

As a braking mechanism, microRNA regulates the cell, making sure it develops normally. But research shows abnormal regulation from microRNA can contribute to health disorders.

More than 2,000 microRNAs have been discovered in humans. Abnormal regulation from microRNAs — and how it may contribute to a wide range of diseases — has become a new area of focus for researchers.

Study methods

The study used post-mortem brain samples from 604 donors (432 female and 172 male) recruited by the Religious Orders Study/Rush Memory and Aging Project. The longitudinal study was launched in 1994. The participants were older, over 70 at the time of death, with a median age of death of 90 years.

The researchers looked at tissue from the dorsolateral prefrontal cortex, a region toward the front of the brain involved in cognitive processes, working memory and planning.



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From the samples, the researchers identified genetic variants associated with brain microRNA levels.

Then, they combined this information with results from genome-wide association study (GWAS) data for 16 psychiatric and neurodegenerative diseases.

Findings

The researchers identified 49 unique microRNAs associated with one or more brain traits, including major depression, PTSD, bipolar disorder, schizophrenia and Parkinson's disease.

Performing further analyses, they identified four unique microRNAs that likely contribute to the development of the following psychiatric and neurodegenerative diseases:

- miR-499a-5p: bipolar disorder and schizophrenia
- miR-92b-3p: Parkinson's disease
- miR-190b-5p: PTSD
- miR-1908-5p: bipolar disorder and major depressive disorder

"Interestingly, miR-499a-5p contributes to the risk of both bipolar disorder and schizophrenia, and miR-1908-5p to the risk of both bipolar disorder and major depression," said Wingo. "These findings suggest potential shared mechanisms between these pairs of conditions through microRNAs."

The researchers also looked at microRNA expression quantitative trait loci (<u>miR-QTLs</u>). These are genetic variants that can influence the levels of microRNAs.

Nearly half (224 of 470) of the analyzed microRNAs were shown to have associated miR-QTLs, pointing to potential genetic factors influencing microRNA.

Limitations

The authors note several limitations of the study. All the subjects were older adults of European ancestry. Subsequent studies that include people of diverse ancestry and a wider age range may offer more insights. Another limitation is that the study focused only on one specific brain region — the dorsolateral prefrontal cortex — and may not be typical of other brain regions.

Understanding contributors to disease

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"We know microRNAs regulate gene expression, with a single microRNA potentially influencing hundreds of genes," said Thomas Wingo, co-senior author of the study. Wingo is a professor in the UC Davis Department of Neurology and specializes in specializes in treating patients with mild cognitive impairment and dementia. "Our findings advance understanding of how microRNAs contribute to the risk of major psychiatric disorders and Parkinson's disease."

Technology Networks, 3 June 2025

https://technologynetwork.com

Synthetic compound shows promise against multidrug resistance

2025-06-02

Antimicrobial resistance directly causes more than 1 million deaths every year and contributes to more than 35 million more, according to the World Health Organization. Staphylococcus aureus and Enterococcus sp., 2 gram-positive pathogens highly likely to develop resistance to known treatments, can cause dangerous hospital-acquired and communityacquired infections.

This week in Microbiology Spectrum, researchers describe a newly synthesized compound called infuzide that shows activity against antimicrobial resistant strains of S. aureus and Enterococcus in laboratory and mouse tests.

In addition, the findings suggest that infuzide kills bacteria in ways that differ from other antimicrobials, which may help keep resistance at bay.

Infuzide emerged from more than a decade of work by interdisciplinary researchers looking for ways to create compounds that could act against pathogens in ways similar to known pharmaceutical compounds.

Those include hydrazones, inorganic synthesized compounds that previous studies have shown to demonstrate antibacterial activity, including against resistant strains.

The researchers synthesized 17 new compounds that contained hydrazones, and among those infuzide showed activity against grampositive S. aureus and Enterococcus.

"We started the project as a collaboration, looking for ways to synthesize compounds and connecting them with compounds that might have

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biological activities," said medicinal chemist Michel Baltas, Ph.D., from the Laboratoire de Chimie de Coordination at the University of Toulouse in France.

Baltas co-led the new work, along with Sidharth Chopra, Ph.D., from the CSIR-Central Drug Research Institute in Lucknow, India.

The researchers found that infuzide specifically attacks bacterial cells.

In lab tests, they compared the antimicrobial effects of infuzide against vancomycin, a powerful antibiotic representing the standard of care in treating resistant infections.

They found that infuzide more quickly and effectively reduced the size of bacterial colonies than the standard drug.

In tests of resistant S. aureus infections on the skin of mice, the compound effectively reduced the bacterial population.

The reduction was even higher, the researchers reported, when infuzide was combined with linezolid, a synthetic antibiotic.

Infuzide did not show significant activity against gram-negative pathogens, though Baltas said the group is looking for small changes to infuzide that might expand its antimicrobial activity.

The researchers synthesized the compounds without the need of solvents, which can be expensive and environmentally hazardous.

The simplicity of the chemical reactions, Baltas said, would make it easy to make large quantities to be used in new treatments.

"I am sure the same reactions can scale up."

In addition, the group has been investigating the effects of synthesized compounds on other infectious diseases, including tuberculosis. "We have many other candidates to make antimicrobial compounds," Baltas said.

Science Daily, 2 June 2025

https://sciencedaily.com

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CHEMWATCH

Scientists Surprised as Crystal Structures Morph Into Super Catalysts

2025-06-04

Experiments at BESSY II show that during electrolysis, the structure breaks down into ultrathin nickel sheets, exposing the active catalytic centers to the electrolyte.

Hydrogen can be produced through the electrolysis of water. When the electricity for this process comes from renewable sources, the resulting hydrogen is carbon-neutral. This "green" hydrogen is considered a key component of the future energy system and is also needed in large quantities as a raw material for the chemical industry.

Electrolysis relies on two main reactions: hydrogen evolution at the cathode and oxygen evolution at the anode (OER). However, the oxygen evolution reaction tends to slow down the overall process. To accelerate hydrogen production, researchers must develop more efficient and durable catalysts for the OER step.

Clathrates, a structure built of cages

Currently, nickel-based compounds are regarded as effective and affordable catalysts for the alkaline oxygen evolution reaction. This is the focus of Dr. Prashanth Menezes and his team.

"The contact between the active nickel centers and the electrolyte plays a crucial role in the efficiency of a catalyst," explains Menezes. In conventional nickel compounds, this contact surface is relatively limited. "We therefore wanted to test whether nickel-containing samples from the fascinating class of materials known as clathrates could be used as catalysts," he says.

The materials are made of Ba8Ni6Ge40 and were produced at the Technical University of Munich. Like all clathrates, they are characterised by a complex crystalline structure of polyhedral cages, in this case, formed by germanium and nickel, enclosing barium.

This structure gives clathrates special properties that make them interesting as thermoelectrics, superconductors, or battery electrodes. However, until now, no research group had considered of investigating clathrates as electrocatalysts.



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Experiments at universities and BESSY II

The electrochemical measurements showed that the Ba₈Ni₆Ge₄₀ as a catalyst exceeded the efficiency of nickel-based catalysts at a current density of 550 mA cm^{2}, a value also used in industrial electrolysis. The stability was also remarkably high: even after 10 days of continuous operation, the activity did not decrease significantly.

The team used a combination of experiments to find out why the material is so remarkably well suited. At BESSY II, they studied the samples using in situ X-ray absorption spectroscopy (XAS), while basic structural characterization were carried out at the Freie and Technische Universität Berlin.

From cage to sponge

Their analysis showed that the Ba8Ni6Ge40 particles in the aqueous electrolyte undergo a structural transformation under an electric field: germanium and barium atoms dissolve out of the former threedimensional framework.

"The germanium and barium atoms make up almost 90 % of the clathrate starting material, and they are completely washed out, leaving behind highly porous, sponge-like nanolayers of the remaining 10% nickel that offer a maximum surface area," says Dr. Niklas Hausmann from Menezes' team. This transformation brings more and more catalytically active nickel centres into contact with the electrolyte.

"We were actually surprised by how well these samples work as OER catalysts. We expect that we can observe similar results with other transition metal clathrates and that we have discovered a very interesting class of materials for electrocatalysts," says Menezes.

Sci Tech Daily, 4 June 2025

https://scitechdaily.com

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