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JUN. 27, 2025

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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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CHEMICAL EFFECTS
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### **ASIA PACIFIC**

#### Draft Environmental Code of the People's Republic of **China Released for Public Consultation: New Era for Green Compliance**

#### 2025-06-20

The Draft Environmental Code of the People's Republic of China (referred to as the "Code") has been released for public consultation on the National People's Congress of China Website, with the consultation period ending on June 13. This landmark legislation marks a significant step in China's environmental governance.

What Is the Environmental Code of China?

As the second law in China to be titled a "Code", the Environmental Code represents a major milestone in China's legislative history. It is a comprehensive framework consisting of five sections:

- General Provisions 1.
- 2. ollution Prevention and Control
- **Ecological Protection** 3.
- 4. Green and Low-Carbon Development
- 5. Legal Liability and Supplementary Provisions

The Code includes 1,188 provisions and approximately 160,000 words, consolidating and replacing ten existing environmental laws, including the Environmental Protection Law, Marine Environmental Protection Law, and laws on air, water, soil, and noise pollution.

#### Read More

REACH24, 20-06-25

https://www.reach24h.com/en/news/china-draft-environmental-codereleased-public-consultation.html

#### India's OTR Implementation under BIS Scheme-X **Delayed: New Date and Key Updates**

#### 2025-06-16

India's Bureau of Indian Standards (BIS) has announced a significant postponement of the Omnibus Technical Regulation (OTR) implementation under Scheme-X, a move that directly impacts

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manufacturers of heavy machinery and electrical equipment. Originally set for August 2025, the new compliance deadline is now September 1, 2026, offering much-needed relief and preparation time for both local and international industries. This update follows months of stakeholder feedback on application complexity, testing challenges, and regulatory clarity. Read on to discover what's behind the delay, the new requirements, and how your business can stay ahead in the evolving landscape of BIS certification and OTR compliance.

#### What Is Scheme-X?

The Bureau of Indian Standards (BIS) has established a new scheme called Scheme-X. Scheme-X permits manufacturers to continue with their operations in India by offering a license or certificate of conformity. The products' safety and quality are guaranteed by the license. The two main product categories are covered by Scheme-X:

- Low-voltage control and switch equipment
- Omnibus Technical Regulation (OTR)-covered machinery and electrical equipment

The Ministry of Heavy Industries created both categories in an effort to address quality and safety issues in the heavy industries sector. The Bureau of Indian Standards (BIS) will be the certifying and enforcing body for the machines, or as it may be, electrical equipment, in accordance with the ministry's stated QCO.

#### Read More

REACH24, 16-06-25

https://www.reach24h.com/en/news/industry-news/indias-otrimplementation-under-bis-scheme-x-delayed.html

### AMERICA

#### **Research reveals 'forever chemicals' present in beer** 2025-05-21

Infamous for their environmental persistence and potential links to health conditions, per- and polyfluoroalkyl substances (PFAS), often called forever chemicals, are being discovered in unexpected places, including beer. Researchers publishing in ACS' Environmental Science & Technology tested beers brewed in different areas around the U.S. for these substances.



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They found that beers produced in parts of the country with known PFAS-contaminated water sources showed the highest levels of forever chemicals.

"As an occasional beer drinker myself, I wondered whether PFAS in water supplies was making its way into our pints," says research lead Jennifer Hoponick Redmon. "I hope these findings inspire water treatment strategies and policies that help reduce the likelihood of PFAS in future pours."

PFAS are human-made chemicals produced for their water-, oil- and stainrepellent properties. They have been found in surface water, groundwater and municipal water supplies across the U.S. and the world. Although breweries typically have water filtration and treatment systems, they are not designed to remove PFAS. By modifying a U.S. Environmental Protection Agency (EPA) testing method for analyzing levels of PFAS in drinking water, Hoponick Redmon and colleagues tested 23 beers. The test subjects were produced by U.S. brewers in areas with documented water system contamination, plus popular domestic and international beers from larger companies with unknown water sources.

#### Read More

ACS, 21-05-25

https://www.acs.org/pressroom/presspacs/2025/may/research-reveals-forever-chemicals-present-in-beer.html

#### EPA Releases Meeting Minutes and Final Report from Science Advisory Committee on 1,3-Butadiene

2025-006-12

Released June 12, 2025

Today, the U.S. Environmental Protection Agency (EPA) released the meeting minutes and final report from the April 1-4, 2025, Science Advisory Committee on Chemicals (SACC) virtual public meeting regarding the draft 2024 Toxic Substances Control Act (TSCA) risk evaluation for 1,3-butadiene. The meeting minutes and final report are available in docketEPA-HQ-OPPT-2024-0425 on regulations.gov and through the SACC webpage for the 1,3-butadiene meeting.

In December 2024, EPA released its draft risk evaluation for 1,3-butadiene for public comment and peer review, followed by a supplement in March 2025. This supplement refines the cancer risk estimates from exposure to

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1,3-butadiene in air from releasing facilities. These refined facility specific risk estimates provide important updated estimates for incorporation into the risk evaluation. In the draft risk evaluation, EPA preliminarily determined that 1,3-butadiene presents an unreasonable risk of injury to human health for workers and the general population from inhalation exposure.

EPA is in the process of reviewing feedback from the meeting and will use this feedback, along with feedback received from the public, to inform the final risk evaluation for 1,3-butadiene.

The SACC serves as a primary scientific peer review mechanism of EPA's Office of Chemical Safety and Pollution Prevention. It provides independent scientific advice and recommendations to EPA on the scientific basis for risk assessments, methodologies and pollution prevention measures and approaches for chemicals regulated under TSCA.

For additional information, contact the Designated Federal Official, Alie Muneer at muneer.alie@epa.gov.

#### Read More

US EPA, 12-06-25

https://www.epa.gov/chemicals-under-tsca/epa-releases-meetingminutes-and-final-report-science-advisory-committee-13-0

#### EPA Releases Draft Charge Questions for SACC Meeting on Phthalates and Memorandum on a Proposed Refinement for Estimating Phthalate (DBP) Skin Exposures

2025-06-16

Released June 16, 2025

The U.S. Environmental Protection Agency (EPA) is announcing the release of the draft charge questions for discussion at the upcoming SACC meeting to review all documents released thus far on the risk evaluations of five phthalates. The documents under review include the draft risk evaluations for dibutyl phthalate (DBP), di(2-ethylhexyl) phthalate (DEHP), and dicyclohexyl phthalate (DCHP), as well as cross-cutting documents related to all five chemicals. The five phthalates are: DBP, DEHP, DCHP, butyl benzyl phthalate (BBP), and diisobutyl phthalate (DIBP). In addition, EPA



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is also releasing a memorandum describing a proposed refinement of the approach for estimating skin exposures for DBP.

#### **SACC Meeting**

EPA will hold its virtual public meeting of the SACC on August 4 – 8, 2025, where the charge questions will guide the discussion. EPA will also hold a preparatory virtual public meeting on July 21, 2025, for the SACC and the public to consider and ask questions regarding the scope and clarity of the draft charge questions. EPA will publish registration links for the August SACC meeting and July preparatory meeting on the SACC website approximately one month prior to each meeting. If the public would like their comments on the documents related to the phthalates to be considered by the SACC during the peer review meeting, they must be submitted by July 21, 2025, to the peer review docket EPA-HQ-OPPT-2024-0551 at www.regulations.gov. Read the draft charge questions.

#### **Memorandum on DBP Dermal Absorption Data**

The Draft Risk Evaluation for Dibutyl Phthalate (DBP) includes skin exposure estimates which used skin absorption data from guinea pigs. The rate of skin absorption used for estimating occupational and consumer skin exposure was then refined using data that is more relevant to absorption through human skin, as described in the memorandum. The availability of chemical- and species-specific skin absorption data will allow for the implementation of a more refined approach for estimation of skin exposures in the final risk evaluation. Read the Memorandum.

#### **Next Steps**

After the agency has considered public comments and the feedback from the SACC, EPA will issue final risk evaluations for DBP, DEHP, BBP, DIBP and DCHP.

#### Read More

#### US EPA, 16-06-25

https://www.epa.gov/chemicals-under-tsca/epa-releases-draft-chargequestions-sacc-meeting-phthalates-and-memorandum

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## **Regulatory Update**

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### **EUROPE**

IUN. 27, 2025

#### **Council and Parliament agree on simplified and more** efficient handling of chemical assessment data 2025-06-11

#### The Council and the European Parliament reached a provisional deal on the OSOA (one substance one assessment) package, which aims to streamline assessments of chemicals across relevant EU legislation, strengthen the knowledge base on chemicals, and ensure early detection and action on emerging chemical risks. The package contains three proposals: a directive concerning the re-attribution of scientific and technical tasks, a regulation aimed at enhancing cooperation among Union agencies in the area of chemicals, and a regulation establishing a common data platform on chemicals.

The co-legislators maintain the objectives of the legislative package but enlarge the information available in the common platform (i.e. to include scientific data submitted voluntarily), clarify how medical data should be treated, and ensure that the content of the platform is publicly available, in line with EU legislation on access to information.

#### Gathering data just once

The OSOA package creates a common platform that integrates existing databases and offers a 'one-stop shop' for chemical data from EU agencies and the Commission. It enables knowledge sharing from one legislative area to another and mandates the systematic collection of human biomonitoring data to inform policymakers about chemical exposure levels.

A monitoring and outlook framework will detect chemical risks early, support fast regulatory responses, and track impacts through an early warning system and indicators. It also empowers the European Chemicals Agency (ECHA) to generate data when needed and ensures transparency of scientific studies

#### Main elements of the agreement

The deal reached today makes sure that over time the common data platform to be hosted by ECHA should provide access to all chemicals data generated or submitted as part of the implementation of about 70 pieces of EU legislation.



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The agreement requires ECHA to create and manage a database, inside the common data platform, that lists alternatives to substances of concern (chemicals that presents a potential risk to human health or the environment). This database should include alternative technologies and materials that do not require such substances of concern.

The agreement specifically supports the voluntary submission of scientific data to be included in the platform.

#### Data on medicinal products

The deal reached today considers that certain categories of newly generated data relating to chemical substances present in medicinal products from the European Medicines Agency (EMA) must be addressed as well.

The Commission will carry out an assessment to analyse whether in the future it is appropriate to include in the platform further categories of chemicals data related to medicinal products (for instance, other elements than active substances, substances that are now considered non-relevant, or data held by national agencies).

The co-legislators also agreed that legacy data from EMA (i.e. data generated and submitted before the entry into force of the regulation) will be gradually integrated into the platform, starting six years after the regulation enters into force.

#### **Public access**

The co-legislators agreed that the platform should give access to data that is already public in line with the rules of the originating legal acts. Horizontal legislation governing public access to information (Regulation (EC) no 1049/2001) will apply to all data that is not confidential.

#### Human biomonitoring studies

The package will help ECHA, and other agencies, to generate studies for multiple purposes. The agreement proposes already a practical application of this possibility. Four years after the regulation on the common data platform enters into force, ECHA should commission a Union-wide human biomonitoring study to better understand the population's exposure to chemicals. Human biomonitoring data from the EU and national research programs will also be included in the platform.

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#### Next steps

IUN. 27, 2025

The provisional agreement reached with the European Parliament now needs to be endorsed and formally adopted by both institutions.

#### Background

Global chemicals production is projected to double by 2030, according to the UN Environment Programme (Global Chemicals Outlook II, 2019), underscoring the growing importance of the EU's chemical regulations.

The "one substance one assessment" was part of the Chemicals Strategy for Sustainability, that the Commission made public on 14 October 2020. As a core element of the European Green Deal's zero pollution ambition, the strategy aims to strengthen protection for people and the environment while driving innovation toward safe and sustainable chemicals.

#### Read More

Council of the EU, 11-06-25

https://www.consilium.europa.eu/en/press/press-releases/2025/06/12/ council-and-parliament-agree-on-simplified-and-more-efficient-handlingof-chemical-assessment-data/

#### Safety evaluation of the food enzyme glucan 1,4-αmaltohydrolase from the genetically modified Escherichia coli strain MLAVSC

#### 2025-06-12

The food enzyme glucan 1,4-α-maltohydrolase (4-α-d-glucan αmaltohydrolase, EC 3.2.1.133) is produced with the genetically modified Escherichia coli strain MLAVSC by Advanced Enzyme Technologies Ltd. The genetic modifications do not give rise to safety concerns. The food enzyme is free from viable cells of the production organism and its DNA. The food enzyme is intended to be used in three food manufacturing processes. Since residual amounts of food enzyme total organic solids (TOS) are removed in one food manufacturing process, dietary exposure was calculated for the remaining two processes. It was estimated to be up to 0.172 mg TOS/kg body weight (bw) per day in European populations. Genotoxicity tests did not indicate a safety concern. The systemic toxicity was assessed by means of a repeated dose 90-day oral toxicity study in rats. The Panel identified a no observed adverse effect level of 1000 mg



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# **Regulatory Update**

TOS/kg bw per day, the highest dose tested, which when compared with the estimated dietary exposure, results in a margin of exposure of at least 5814. A search for the homology of the amino acid sequence of the glucan 1,4-α-maltohydrolase to known allergens was made and matches with three respiratory allergens and one injected allergen were found. The Panel considered that a risk of allergic reactions upon dietary exposure to the food enzyme cannot be excluded, but that the likelihood is low. Based on the data provided, the Panel concluded that this food enzyme does not give rise to safety concerns under the intended conditions of use.

#### Read More

EFSA, 12-06-25

https://www.efsa.europa.eu/en/efsajournal/pub/9483

#### Input to the EU Environment Council Meeting, Luxembourg, 17 June 2025

#### 2025-06-10

In this letter, the EEB provided input to the EU Environment Council Meeting, taking place in Luxembourg on June 17th, 2025, addressing all Environment Ministers of EU Member States, the Commission President, Executive Vice-President for the Clean, Just and Competitive Transition, and Commissioners for Environment, Water Resilience and a Competitive Circular Economy, Climate, Net Zero and Clean Growth, Energy and Housing, Health and Animal Welfare, and the Chair of the European Parliament Environment Committee.

The EEB's demands come structured according to our understanding of the 17 June Council Agenda, alongside our vision of what is needed for a sustainable and resilient Union, under the following headlines:

- 6. Regulation on circularity requirements for vehicle design and on management of end-of-life vehicles (General Approach)
- 7. COP 30 (and EU NDC)
- Danish Council Presidency Programme 8.
- 9. Water Resilience Strategy

#### Read More

EEB, 10-06-25

https://eeb.org/library/input-to-the-eu-environment-council-meetingluxembourg-17-june-2025/

## CHEMWATCH

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## IUN. 27, 2025

### New survey finds many UK adults are worried about the impact of harmful chemicals on the environment

**Regulatory Update** 

#### 2025-06-05

Today is World Environment Day, and a new survey[i] conducted by Ipsos and commissioned by CHEM Trust has found that almost 7 in 10 (68%) [ii] of UK adults surveyed aged 16-75 are worried about the potential impact of harmful synthetic chemicals in the products they use, on the environment.

The survey also found that:

- 70%[iii] of UK adults surveyed aged 16-75 would be likely to stop buying a product they regularly use if they learnt it contains chemicals that have a negative impact on wildlife.

 64%[iv] of UK adults surveyed aged 16-75 would be likely to pay more for products manufactured using chemicals that are safer for wildlife. Not a single river in England is in good chemical health due to a cocktail of chemicals, including highly persistent chemicals such as PFAS. Harmful chemicals have also been found in some of the UK's most iconic wildlife species, such as otters, harbour porpoises, freshwater fish and seabirds.

#### Read More

ChemTrust, 05-06-25

https://chemtrust.org/news/harmful-chemicals-survey/

### **INTERNATIONAL**

#### New Study Reveals Alarming Levels of 'Forever Chemical' TFA in bread, pasta, and breakfast cereals

2025-06-03

PAN Europe and Global 2000 call for an immediate ban of PFAS pesticides

A new study reveals alarmingly high levels of the 'forever chemical' trifluoroacetic acid (TFA) in everyday cereals and cereal products. The findings point to widespread contamination from PFAS pesticides, showing TFA levels three times higher than in a comparable study from eight years ago. While EU regulators are currently advancing the classification of TFA as toxic for reproduction, PAN Europe and Global 2000



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## **Regulatory** Update

urge policymakers to act without delay and stop this avoidable pollution of food and water by banning PFAS pesticides today.

The study, carried out by PAN Europe's member Global 2000 in Austria, is a follow-up of the recently published EU-wide study of TFA in wine. [1] The organisation analysed 48 cereal varieties and cereal products purchased in Austria, including pasta, baked goods, breakfast cereals, and whole grains, equally split between organic and conventional sources.

"The level of TFA, especially in bread and pasta, is very worrying and demands immediate action to prevent further TFA emissions into the environment. In conventional grain products, the average levels were so high that a health risk to children can no longer be ruled out," warns study author Helmut Burtscher-Schaden, an environmental chemist at GLOBAL 2000. This conclusion was reached by comparing the levels found with the current risk assessments of the health authorities in the Netherlands and Belgium.

#### **Read More**

#### PAN, 03-06-25

https://www.pan-europe.info/press-releases/2025/06/new-study-revealsalarming-levels-%E2%80%98forever-chemical%E2%80%99-tfa-breadpasta-and

#### International E-Waste Day 2025 to focus on Critical Raw Materials

#### 2025-06-10

As the demand for smartphones, electric vehicles, solar panels, and other technology continues to surge, so does the need for the materials that make them work. This year, International E-Waste Day – taking place on 14 October 2025 – will spotlight Critical Raw Materials (CRMs), the elements that are mined in only a handful of countries and that are crucial to foster the green and digital transition.

#### Why are Critical Raw Materials so critical?

Geopolitics are highlighting how important these materials are. And while many people have heard about CRMs by now, not all of them know that these elements can be recovered from unused or broken electronic products sleeping in our drawers and attics. This is why the 8th edition of the International E-Waste Day (#ewasteday) will focus on raising awareness about this fact.

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## IUN. 27, 2025 Regulatory Update

In Europe, the recent CRM Act sets ambitious targets: by 2030, 10% of annual CRM consumption should be sourced domestically, 40% should be processed within the EU, and 25% should come from recycling. This last goal cannot be reached without higher volumes of e-waste being collected and more specialised technology being developed.

Pushed by this legislation, there are currently new innovative technologies being developed to enable efficient recycling of CRMs, which are only available in very small quantities in the used electronic equipment and require a very elaborate treatment. Well-functioning processes have been in place for many years, though, for materials such as copper or aluminium.

#### Read More

weeforum, 10-06-25

https://weee-forum.org/ws\_news/international-e-waste-day-2025-to-focus-on-critical-raw-materials/

# Probiotic-powered dissolvable battery activates in acidic environments and leaves no toxic residue

#### 2025-06-06

In the "Mission: Impossible" films, superspy Ethan Hunt—played by Tom Cruise—gets orders from his superiors on various devices that selfdestruct in five seconds. Could electronics disintegrate into nothing in real life? Binghamton University Professor Seokheun "Sean" Choi has researched disposable "papertronics" over the past 20 years, but the hardest part about making so-called transient electronics is the battery.

"Transient electronics can be used for biomedical and environmental applications, but they must disintegrate in a biosafe manner," said Choi, a faculty member at the Thomas J. Watson College of Engineering and Applied Science's Department of Electrical and Computer Engineering.

"You don't want to have toxic residues inside your body. That type of device is called bioresorbable electronics. For transient or bioresorbable electronics, the key challenge is the power source—but most power sources, like lithium-ion batteries, include toxic material."



# Bulletin Board

# **Regulatory Update**

#### Read More

PHYS.org, 06-06-25

https://phys.org/news/2025-06-probiotic-powered-dissolvable-batteryacidic.html#google\_vignette

### CHEMWATCH

# letin Board

# **REACH Update**

#### Scientific research needed to protect health, the environment and competitiveness

#### 2025-06-11

JUN. 27, 2025

The European Chemicals Agency (ECHA) has updated its report on Key Areas of Regulatory Challenge with new topics in line with the European Union's Competitiveness Compass and the Clean Industrial Deal. Specific scientific research is needed to better protect people and the environment from hazardous chemicals and to develop balanced and effective regulatory measures.

Helsinki, 11 June 2025 – The report introduces new topics to reflect ECHA's growing responsibilities. It also covers emerging topics in waste and recycling that aim to support circularity and enhance Europe's industrial competitiveness.

For example, more specific research is needed on:

- chemical emissions and exposure from the waste stage of materials to help create more accurate emission estimates to avoid potentially over-conservative regulatory measures;
- recycled non-fossil fuel resources, to improve our understanding of their hazards and support EU policies that aim to reduce pollution and promote sustainable growth; and
- the valuing of environmental impacts to assess the effectiveness and proportionality of chemicals regulation and specific regulatory actions under, for example, REACH and the Batteries Regulation.
- Dr Sharon McGuinness, ECHA's Executive Director, said:

"Since ECHA's first report in 2023, we have seen important, regulatoryrelevant scientific research get underway. For example, new research has been initiated on developing analytical methods to detect and measure PFAS for use by enforcement authorities and on generating monitoring data on a specific phthalate that is a chemical of concern.

"Our updated report reflects the European Commission's Clean Industry Deal and Competitiveness Compass, by inviting more specific research to support the circular economy and innovation in Europe."

Other research needs added to the report include developing better methods to monitor chemicals in water environments, such as rivers, lakes, and oceans, and how chemicals can contaminate drinking water from materials that come into contact with it.



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# **REACH Update**

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#### Background

The Key Areas of Regulatory Challenge report is part of an evolving research and development agenda aiming to support and inspire the research community. The list of research needs is not exhaustive. The report reflects ECHA's current priorities, including the Agency's new tasks. It was originally developed to support the work under the Partnership for the assessment of risk from chemicals (PARC).

PARC is a seven-year EU wide research and innovation programme under Horizon Europe which aims to advance research, share knowledge and improve skills in chemical regulatory risk assessment.

ECHA's role in PARC is to ensure that the funded scientific research addresses current regulatory challenges related to chemical risk assessment and adds value to the EU's regulatory processes.

Read More

ECHA, 11-06-25

https://echa.europa.eu/-/scientific-research-needed-to-protect-healththe-environment-and-competitiveness

## **Janet's Corner**

CHEMWATCH

#### Who Am I?

2025-06-20

I am a shiny, yellow, ductile, and malleable metal, highly prized for my beauty and resistance to corrosion. I am an excellent conductor of electricity and heat, but my rarity makes me more valuable for jewelry and currency than for industrial applications. Historically, my discovery has driven empires and explorations. Who am I?

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



I am a shiny, yellow, ductile, and malleable metal, highly prized for my beauty and resistance to corrosion.



# Bulletin Board

# **Hazard Alert**

### **Sulfur Dioxide**

#### 2025-06-27

Sulfur dioxide in the air results primarily from activities associated with the burning of fossil fuels (coal, oil) such as at power plants or from copper smelting. In nature, it can be released to the air, for example, from volcanic eruptions. [1,2]

#### **USES** [2,3]

Sulfur dioxide is used:

- As a fruit preserving agent and as a food preservative or additive.
- In the fermentation stage of wine making.
- For bleaching textile fibres.
- In the manufacture of paper.
- As a disinfectant in breweries and food factories.
- As a fumigant for grains, grapes and citrus fruits.

#### **EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]**

#### **Exposure Sources**

- Industry sources: Fossil fuel combustion sites particularly coal burning power plants; industrial processes such as wood pulping, paper manufacture, petroleum and metal refining and metal smelting, particularly from sulfide containing ores, e.g. lead, silver and zinc ores all emit sulfur dioxide to air.
- Diffuse sources: Small textile bleaching and food preserving facilities and wineries, fumigation activities all emit sulfur dioxide to air.
- Natural sources: Geothermal activity, including hot springs and volcanic activity; sulfur dioxide is produced from the natural decay of vegetation on land, in wetlands and in oceans all emit sulfur dioxide to air.
- Transport sources: Vehicle exhaust.
- **Consumer products:** Some solvents, dechlorination agents, bleaches and fumigation products.

#### **Routes of Exposure**

Exposure to sulfur dioxide mainly occurs by breathing air that contains it. Exposure may also result from skin contact to sulfur dioxide. The

#### Sulfur dioxide (also sulphur dioxide) is the chemical compound with the formula SO2.

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people most often exposed to sulfur dioxide are workers in plants where it occurs as a by-product, such as in the copper smelting industry and in the processing or burning of coal or oil Other exposures occur in the manufacture of sulfuric acid, paper, food preservatives, and fertilisers The primary way that workers are exposed to sulfur dioxide is through the air. Workers may be exposed to concentrations of sulfur dioxide that are higher than typical outdoor air levels. People living near heavily industrial activities that involve smelting copper or the processing or burning of coal or oil are also likely to be exposed to sulfur dioxide by breathing it. If you breathe air containing sulfur dioxide, you may absorb it into your body through your nose and lungs. Sulfur dioxide can easily and rapidly enter your bloodstream through your lungs. Once in the body, it breaks down to sulfate and leaves through the urine.

#### **HEALTH EFFECTS** [4]

#### **Acute Health Effects**

Short-term exposures to high levels of sulfur dioxide can be life threatening. Exposure to 100 parts of sulfur dioxide per million parts of air (ppm) is considered immediately dangerous to life and health. Previously healthy non-smoking miners who breathed sulfur dioxide released as a result of an explosion in an underground copper mine developed burning of the nose and throat, breathing difficulties, and severe airway obstructions. Exposure of the eyes to liquid sulfur dioxide, (from, for example an industrial accident) can cause severe burns, resulting in the loss of vision. On the skin it produces burns. Other health effects include headache, general discomfort and anxiety. Those with impaired heart or lung function and asthmatics are at increased risk.

Long-term exposure to persistent levels of sulfur dioxide can also affect your health. Repeated or prolonged exposure to moderate concentrations may cause inflammation of the respiratory tract, wheezing and lung damage. Lung function changes have been observed in some workers exposed to 0.4-3.0 ppm sulfur dioxide for 20 years or more. However, these workers were also exposed to other chemicals, making it difficult to attribute their health effects to sulfur dioxide exposure alone. Additionally, exercising asthmatics are sensitive to the respiratory effects of low concentrations (0.25 ppm) of sulfur dioxide.

Studies in animals support the human data regarding respiratory effects of sulfur dioxide. At low levels (less than 1 ppm) of sulfur dioxide exposure, guinea pigs displayed changes in their ability to breathe as deeply or as

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# **Hazard Alert**

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much air per breath. More severe symptoms seen in animals exposed to high concentrations of sulfur dioxide include decreased respiration, inflammation or infection of the airways, and destruction of areas of the lung. It has also proved to be harmful to the reproductive systems of experimental animals and caused developmental changes in their newborn.

#### SAFETY

#### First Aid Measures [5]

- **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes. Get immediate medical attention.
- Inhalation: Move exposed personnel to uncontaminated area. If not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain prompt medical attention and continue with administration of oxygen. If airway obstruction occurs the placement of an artificial airway by an emergency medical technician may be necessary.
- Skin Contact: Immediately flush with large amounts of water. Remove contaminated clothing, including shoes, after flushing has begun.
  Applications of ice water compresses for 30 minutes after flushing may help limit extent of burn.
- Note to Physician: Bronchospasm may be treated with the use of a bronchodilator such as albuterol and an anticholinergic inhalant such as Atrovent.

#### Personal Protective Equipment [5]

- **Respiratory Protection:** Emergency Use: Use SCBA or positive pressure air line with mask and escape pack in areas where concentration is unknown or above the exposure limits.
- Eye Protection: Safety glasses and face shield.
- Skin Protection: General Use: Leather gloves, safety shoes, and safety glasses for handling cylinders. Acid resistant gloves and splash suit when connecting, disconnecting, or opening cylinders. Emergency Use: Totally encapsulated chemical resistant suit.
- **CAUTION:** Contact with cold, evaporating liquid on gloves or suit may cause cryogenic burns or frostbite. Cold temperatures may also cause embrittlement of PPE material resulting in breakage and exposure.

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#### REGULATION

#### **United States**

OSHA Permissible Exposure Limit (PEL) - General Industry See <u>29 CFR</u> <u>1910.1000 Table</u> <u>Z-1</u>	5 ppm (13 mg/m³) TWA	HE14
OSHA PEL - Construction Industry See <u>29 CFR</u> <u>1926.55 Appendix</u> <u>A</u>	5 ppm (13 mg/m³) TWA	HE14
OSHA PEL - Shipyard Employment See <u>29 CFR</u> <u>1915.1000 Table</u> <u>Z-Shipyards</u>	5 ppm (13 mg/m³) TWA	HE14
National	2 ppm	HE4
Occupational	(5 mg/m <sup>2</sup> ) I WA 5 ppm	HE9
Safety and Health (NIOSH)	(13 mg/m <sup>3</sup> ) STEL	HE11
Recommended Exposure Limit (REL)		HE14
American	0.25 ppm	HE9
Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2009)	HE10	
		HE11
-		HE14



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Upper respiratory irritation, nosebleeds
Upper respiratory irritation, nosebleeds
Upper respiratory irritation, nosebleeds
Blindness
Breathing difficulties
Eye and respiratory irritation, eye and skin burning
Decreased lung function, chronic respiratory symptoms
Lower respiratory irritation and symptoms
Upper respiratory irritation

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OSHA Permissible Exposure Limit (PEL) - General Industry See <u>29 CFR</u> <u>1910.1000 Table</u> <u>Z-1</u>	5 ppm (13 mg/m³) TWA	HE14	Upper respiratory irritation, nosebleeds
CAL/OSHA PELs	2 ppm (5 mg/m <sup>3</sup> ) TWA 5 ppm (10 mg/m <sup>3</sup> ) STEL		

International Agency for Research on Cancer (IARC) carcinogenic classification: <u>Class 3</u> (not classifiable as to its carcinogenicity to humans)

- Agency for Toxic Substances and Disease Registry (ATSDR) Inhalation Minimal Risk Level (MRL): <u>0.01 ppm (acute)</u>
- NIOSH Immediately Dangerous to Life or Health (IDLH) concentration: <u>100 ppm</u>

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## Gossip

CHEMWATCH

Ultra-Fast Infrared Nano-Imaging Reveals Exciton Dynamics Inside Carbon Nanotubes

#### 2025-06-23

A research team led by Dr. Jun Nishida (Assistant Professor), and Dr. Takashi Kumagai (Associate Professor) at the Institute for Molecular Science (IMS)/ SOKENDAI, in collaboration with Dr. Taketoshi Minato (Senior Researcher at IMS), Dr. Keigo Otsuka (Assistant Professor at The University of Tokyo) and Dr. Yuichiro K. Kato (Chief Researcher at RIKEN), has successfully visualized the ultrafast dynamics of quasi-particles known as excitons, which are generated in carbon nanotubes (CNTs) upon light excitation.

This was achieved with spatial and temporal resolution beyond the capabilities of conventional techniques, thanks to a cutting-edge instrument called an ultrafast infrared near-field optical microscope. This advanced technique focuses femtosecond infrared pulses into nanoscale regions, enabling the sensitive detection of local light-matter interactions in real space and time.

CNTs are nanometer-scale semiconductor wires with exceptional electrical and optical properties, making them promising candidates for future nanoelectronic and nanophotonic applications.

When exposed to light, CNTs generate excitons--bound pairs of electrons and holes--that govern key processes such as light absorption, emission, and charge transport. However, since excitons are confined to just a few nanometers and exist for only femtoseconds to picoseconds, capturing their behavior directly has remained a significant experimental challenge.

In this study, the team overcame that challenge by first generating excitons in CNTs using visible light pulses, and then probing their dynamics with ultrafast infrared near-field pulses. This approach enabled direct observation of how excitons evolve in both space and time within individual CNTs.

The measurements revealed that subtle structural distortions and interactions with neighboring CNTs – particularly in complex bundled configurations – can largely influence exciton relaxation dynamics. These findings offer new insights into the role of the local nanoscale environment in shaping exciton behavior.

To interpret the experimental data, the researchers also developed a theoretical model that describes the interaction between excitons and the infrared near-field, taking into account dielectric responses from



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intra-excitonic transitions. Simulations based on a point-dipole model successfully reproduced the experimental results, offering a strong theoretical foundation for future studies using this technique.

Dr. Nishida says, "The capability to directly observe quantum particles such as excitons in one-dimensional systems like CNTs marks a major advancement in measurement technology." Prof. Kumagai says, "This achievement paves the way for designing next-generation high-speed nano-optoelectronic devices and quantum photonic technologies based on CNTs."

Technology Networks, 23 June 2025

https://technologynetworks.com

#### Ozempic maker announces not one, but three new weight-loss drugs

#### 2025-06-23

Over the weekend, Novo Nordisk dropped a pile of scientific data on three new experimental weight-loss drugs, including an oral one, showing what appears to be a strategic "something for everyone" plan of attack from the pharmaceutical giant.

Weight loss therapeutics is a lucrative market and one that has now landed Novo Nordisk DKK65.1 billion, or more than US\$10 billion, in profits with nearly half of this from 2024 alone. But the makers of Ozempic and Wegovy have plenty of competition, including a new dark horse from China we recently reported on, made by rising pharma company Sciwind.

This weekend, the company released the results of three clinical trials, in the process giving away an interesting new strategy - to not just provide medication for clinical obesity, but offer easier-to-take options for both post-injection "maintenance" and for people who have a more modest amount of "excess weight" they'd like to shift.

So, to keep it as simple as possible, we'll run through the three – two of which are related but have significant differences in terms of target market.

#### 1. CagriSema

This drug's timeline has been rocky for Novo Nordisk; early trial data published in February resulted in a \$125 billion dip in share value and the eventual ousting of its CEO. But the full, comprehensive trial data is now

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out, and - at least on paper - it is shaping up as the likely successor to Ozempic and Wegovy.

CagriSema is, as the name hints, semaglutide but more – it combines the GLP-1 receptor agonist with a long-acting amylin analog, caggrilintide. Cagrilintide binds to the calcitonin receptor and all three amylin receptors, essentially silencing hunger and boosting satiety that reduces food intake.

Focusing solely on the results of the Phase IIIa REDEFINE 1 obesity trial, CagriSema achieved the highest weight loss recorded so far in trials. After 68 weeks, 3,417 overweight or obese participants lost an average of 20.4% of their body weight. Breaking the figures down, almost 20% of participants lost 30% or more of their body weight, while nearly two thirds of the people enrolled lost more than 20%. This far outperforms semaglutide on its own over 68 weeks (which has a mean of around 15% of body weight lost).

What's more, CagriSema performed slightly better in fat loss versus muscle loss, with around 2-7% more fat loss (so 2-7% less muscle loss) than semaglutide alone.

The main difference between this and Wegovy or Ozempic is that it doesn't just target the GLP-1 receptor to boost insulin and reduce appetite and stomach emptying, it has an equal dose of the amylin analog (cagrilintide), which affects the brain's satiety signals and boosts appetite suppression.

"In REDEFINE 1, CagriSema provided weight loss in the highest range of efficacy observed with existing weight loss interventions," said lead investigator Timothy Garvey, MD, a professor at the University of Alabama at Birmingham. "Investigators were allowed some flexibility in dose adjustments to balance efficacy and safety, but regardless of dose adjustments participants lost significant weight. These findings are relatable to clinical practice, where dosing is often adjusted based on individual needs and clinical judgement."

Discontinuation in the trial was reasonably low at 6%, with reported mild to moderate side effects in line with the gastrointestinal issues also seen in people taking semaglutide. The reasons for guitting the trial were nausea (55%), constipation (30.7%) and vomiting (26.1%), and overall side effects were "mostly transient."



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Novo Nordisk will now make a case for its release, as a once-weekly subcutaneous injectable, and if approved it is likely to see the light of day in 2026.

#### 2. Amycretin

Within a day of the CagriSema news, the drugmaker released the findings of two trials involving the experimental weight-loss drug amycretin, which is expected to reach the market in daily oral and weekly subcutaneous injectable form.

Firstly, a phase lb/lla 36-week clinical trial of 125 adults aged 18-55 years and with a BMI of 27-39.9 kg/m<sup>2</sup> (at the high end of overweight through to severely obese) passed efficacy and safety checkpoints and will move straight onto a Phase III larger trial.

Unlike the semaglutide-cagrilintide combo, amycretin is a single-molecule drug that activates both the amylin and GLP-1 receptors. Like CagriSema, it's designed to do what semaglutide does, but enhance satiety and and promote fullness to regulate hunger and metabolism better than a GLP-1 receptor agonist alone.

The trial tested dose tolerance and maintenance treatments (20 mg/week). Overall, a 20-mg dose resulted in an average weight loss of 13.1% over 36 weeks. A subgroup were titrated up to 60 mg/week, and the scientists report "up to 24.3%" weight loss, but no average was detailed; this 60mg subset of participants was primarily testing the drug's safety and tolerability. And 70% of these participants experienced mild or moderate gastrointestinal issues, including nausea or vomiting, though for most the side effects resolved over time.

In another, separate Phase I trial of amycretin, a daily oral dose was tested on 144 participants (BMI of 25–39.9 kg/m<sup>2</sup>) over 12 weeks. Those on the highest dose (100 mg/day) lost an average of 5.3% of their body weight after the three months, and as with the weekly injections, the high dose resulted in common gastrointestinal side effects but were reported as manageable.

Because this was the first human trial for oral amycretin, the researchers were testing for a number of factors and focused more on titrating and the tolerability of different combinations of doses. It too will advance to a Phase III trial that more rigorously studies its weight-loss capabilities longer term.

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While it's so far less impactful than existing and experimental injectable therapeutics, a daily pill has obvious advantages - it's easier, doesn't require the same cold storage, offers flexibility and is likely to appeal to people who would be considered clinically overweight but not obese.

"We are pleased with the promising results of amycretin and the feedback from regulatory authorities and are excited to advance both subcutaneous and oral versions of this molecule into Phase III development for weight management," said Martin Holst Lange, executive vice president for Development at Novo Nordisk. "We understand that addressing obesity is a complex challenge that many patients face. These results reflect our robust pipeline in obesity, our focus on progressing scientific innovation and expanding the range of options available to patients and healthcare professionals."

The CagriSema study was published in The New England Journal of Medicine; while the amycretin (injected and oral) research was published across two papers in the journal The Lancet.

#### Source: Novo Nordisk via Scimex

New Atlas, 23 June 2025

https://newatlas.com

#### New technique rapidly identifies high-performing enzymes for sustainable biomanufacturing 2025-06-26

To make advances in using microbes to sustainably produce materials, it is necessary to find new molecular tools, or enzymes—but this is labor intensive. A Kobe University team has developed a technique that can classify thousands of candidates and a workflow that can evaluate representatives overnight, in what may become a fundamental technology for biomanufacturing.

The work has been published in ACS Catalysis.

As oil reserves dwindle and prices soar, microorganisms can produce useful chemicals and fuels from renewable resources. They can convert raw materials into products under mild conditions through the use of specialized molecular tools called enzymes.

Finding appropriate enzymes, modifying them and putting them together into molecular assembly lines is what biomanufacturing is all about.

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Kobe University bioengineer Hasunuma Tomohisa says, "Who controls enzymes controls biomanufacturing. There are easily accessible databases with more than 200 million enzyme entries, but much of the information on them is speculative and it's time-consuming and labor-intensive to confirm their function."

To solve this issue, Hasunuma and his team came up with a new way of automatically grouping large numbers of enzymes in a way that makes it easy to select a set of meaningful representatives and focus research on those.

In addition, they developed a robotic system that can test the activity of the representative enzymes on a range of raw materials within one day. Together, this would allow them to screen a large variety of enzymes for a given function, and they decided to try it on a class of almost 7,000 enzymes that are involved in a process needed to produce the raw materials for fuels, plastics and flavors.

In ACS Catalysis, the team reports that this approach allowed them to identify an enzyme that has productivity up to 10 times higher than that of the current industry standard. What's equally important, though, is that the newly identified enzyme is also as versatile as that standard; that is, it can perform the reaction on a broad range of raw materials.

"Most of all, this finding demonstrates that our approach is able to identify hitherto unrecognized, highly active and versatile enzymes from these databases," Hasunuma said.

The bioengineer, however, is also keen to point out another benefit of their method, saying, "The large amount of data on both the differences between the enzymes and the differences in their versatility allows us to pinpoint which parts of the enzyme are probably responsible for a given desirable trait. This not only helps us to clarify the action of an enzyme and improve that function in a more targeted way, but also lets us search for that structure in yet other enzymes."

Hasunuma hopes that the technology his team developed will be so useful that it becomes a fundamental technology for biomanufacturing, just like the databases themselves.

But he is already looking for the next thing, "Our technology lets us connect enzyme structure with function on a large scale—this is the perfect training material for an AI. We are thinking about developing an AI

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that can then turn around and use the data in the databases to predict the function of the enzymes more accurately."

Phys Org, 26 June 2025

https://phys.org

# Scientists reprogram ant behavior using brain molecules

#### 2025-06-25

From the bright lights of cities that don't sleep -- where people hustle and bustle through the night to keep subways, servers, and supply chains alive -- to the whisper-dark understory of tropical forests where ants hum in syncopated lines, the planet's most intricate societies hinge on round-the-clock cooperation and finely tuned roles.

Within Atta cephalotes, or leafcutter ants, every role is pre-written in morphology, from curves of the mandible (jaws) to body size, scripting a precise division of labor. The hulking Major ants serve as sentinels, patrolling doorways and repelling intruders; the slightly more diminutive Media ants harvest leaf confetti for nimble Minors, the colony custodians and caretakers; and, at the tiniest tier, pin-sized Minima ants groom fungal gardens and cradle the brood.

Now, researchers led by Shelley Berger of the University of Pennsylvania, have revealed key elements of the leafcutters' genetic code, pinpointing two signaling molecules that can be dialed up or down to reprogram ant duties. Crustacean cardioactive peptide (CCAP), elevated in Media ants, promotes leaf-harvesting tasks and can induce similar behavior in other subcastes. Neuroparsin-A (NPA), abundant in Majors, however, suppresses brood care and is linked to defensive patrols, alternately lowering its levels of NPA prompts caregiving behavior.

Reporting their findings in Cell, the researchers also uncovered a striking parallel: gene-expression patterns that govern division of labor in leafcutter ants mirror those in eusocial naked mole-rats -- mammals that similarly abide by cooperative brood care -- hinting at a convergent molecular mechanism dating back over 600 million years.

"We were amazed to see the apparent similarity of gene regulation between nurses and foragers of ants compared to naked mole-rat mammals -- this was unexpected," says Berger the Daniel S. Och Penn Integrates Knowledge University Professor with appointments in the



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School of Arts & Sciences and the Perelman School of Medicine. "Our results in ants reinforce how single neuropeptides can dramatically alter behavior, which may be applicable to human social behavior -- although humans of course are much more complex."

#### From carpenters to leafcutters

Building on previous research on the carpenter ants, which have a similar but simpler social organization consisting of two roles -- forager and soldier -- the team investigated several different neuropeptides in leafcutters to explore how these principles scaled up to the more nuanced four-subcaste structure of Major, Media, Minor, and Minim.

The researchers created 3D-printed behavioral chambers that allowed them to monitor how ants interacted with leaves, the brood, or fungus. These chambers enabled tracking and guantification of behavior through video analysis, demonstrating how altering CCAP and NPA levels in ants induced dramatic and reproducible shifts in their assigned tasks.

"Generally speaking, specific neuropeptides are more abundant in certain castes, so we looked at the levels of neuropeptides in the brains of each caste," explains Karl Glastad, assistant professor at the University of Rochester and former postdoctoral researcher in the Berger lab. "In Majors, the neuropeptide that dictates leafcutter behavior is low and the neuropeptide that stops nursing is high, so if we increase the former, it leads to leafcutter behavior, and if we decrease the latter, it leads to nursing and caretaking of brood."

Glastad adds that these neuropeptides, once bound to their matching receptors, spark an intricate signaling cascade that ripples through gene networks, like a molecular Rube Goldberg machine, that leads to ants shifting from one specialized task to another.

#### Molecular mechanisms across kingdoms

To further explore the evolutionary depth and implications of this behavioral script, the team investigated naked mole-rats a distant evolutionary cousin whose subterranean colonies echo the caste-like harmony of leaf-cutter nests.

"At first, I thought incorporating naked mole-rats felt like a bit of a boondoggle," laughs Glastad. "But we were amazed to discover that there's actually a lot of similarities in the molecular regulation of these kinds of foraging and caretaking castes between the brains of these two species."

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Despite naked mole-rats lacking the exact neuropeptides like NPA found in ants, the researchers hypothesized that these peptides might still activate ancient, conserved pathways common to both species due to promiscuity of certain, more conserved receptors.

"When we saw these intriguing neuropeptide results, we pursued the idea that maybe this neuropeptide is plugging into some conserved gene pathways that convergently evolved in these very different animals to manage distinct behaviors," Glastad explains. "And remarkably, we found substantial overlap -- enough that the ant neuropeptide could even activate endogenous receptors in the naked mole-rat brain. Discovering that unexpected convergence was incredibly cool and, frankly, fortuitous."

#### A novel role for insulin regulatory pathways?

The findings also reveal intriguing connections to insulin regulation pathways, known for their important role in sugar metabolism.

Particularly, insulin-like peptides such as Ilp1 were prominently expressed alongside NPA, suggesting a previously unappreciated interplay between neuropeptide signaling and insulin pathways in behavioral regulation.

"By discovering, essentially, that there's this link between insulin and maternal caretaking behavior, both with naked mole-rats and then also with leafcutter ants, we speculate that this might open the door for potentially looking at how disorders in insulin regulation may affect these behaviors," says first author Maxxum Fioriti, a graduate researcher in the Berger Lab.

"This connection launches new avenues for research into how insulin might regulate caregiving behaviors in mammals, potentially even humans," Fioriti says, venturing that insulin resistance disorders like diabetes may affect maternal mental health and post-partum depression.

#### **Extending to lifespan plasticity**

Looking ahead, Berger's team is keen to explore the persistence of biological plasticity as it relates to behaviors. They are also interested in extending their work to late life rejuvenation and lifespan plasticity because reproductive ant queens live much longer than workers that don't reproduce.

Berger believes that epigenetics, the study of how gene activity can be turned on or off without changing the underlying DNA, offers powerful



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ways to understand not only behavioral plasticity but lifespan plasticity too.

"We're really interested in how long the reprogrammed behavior persists, and what are the pathways for long-lived queens," she says. "I think both phenomena are of enormous interest in mammalian and human biology -- the long-term effects of the plasticity of behavior and lifespan we're investigating."

Speaking about future research on lifespan plasticity, Fioriti notes that one of the other ant species in the lab has amazing lifespan plasticity, "where instead of having just different behaviors, they can also switch between a long-lived queen versus a short-lived worker."

"We have these comparisons of the ant behavior model with the naked mole-rat, and we're also interested in seeing if we can couple understanding lifespan plasticity between ant and naked mole-rat as well," Fioriti says.

#### Key Takeaways

- Researchers led by Penn Integrates Knowledge Professor in the School of Arts & Sciences and the Perelman School of Medicine Shelley Berger explore the genetic basis of how communal-dwelling organisms like leafcutter ants and naked mole-rats divide labor among their societies
- They discovered that pathways dating back hundreds of millions of years are conserved across animal kingdoms
- Their findings offer fundamental insights into the origins of complex social behaviors and the neuroplasticity of assigned roles

Shelley Berger is the Daniel S. Och University Professor in the Departments of Cell and Developmental Biology at the Perelman School of Medicine and Biology at Penn Arts & Sciences and director of the Penn Epigenetics Institute.

Karl Glastad is an assistant professor of biology at the University of Rochester and a former postdoctoral researcher in the Berger Lab.

Maxxum Fioriti is a Ph.D. candidate at Penn Medicine and a researcher in the Berger Lab.

Other authors include Michael B. Gilbert, Matan Sorek, Tierney Scarpa, Freddy S. Purnell, Daniel Xu, Josue Baeza, Richard Lauman, Balint Z. Kacsoh, and Roberto Bonasio of the Perelman School of Medicine at Penn; Lindsay K. Pino of Talus Bioscience; Anatoly Korotkov, Ali Biashad, Andrei

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Seluanov, and Vera Gorbunova of the University of Rochester; Anastasiia Filippova and Mackenzie W. Mathis of the École Polytechnique Fédérale de Lausanne; and Benjamin A. Garcia of Washington University School of Medicine.

Science Daily, 25 June 2025

https://sciencedaily.com

# Scientists Boost CO<sub>2</sub> Conversion With a Surprisingly Simple Hack

#### 2025-06-23

Acid vapor prevents salt buildup in CO2 reactors, enabling longer, more efficient operation.

A team of researchers at Rice University has found a surprisingly simple way to greatly improve the stability of electrochemical devices that convert carbon dioxide into useful fuels and chemicals: passing the CO2 through an acid bubbler.

Their study, published in Science, tackles a major challenge in CO2 reduction systems—salt buildup in gas flow channels. This buildup reduces efficiency and causes the systems to fail early. By using a method they call acid-humidified CO2 the researchers extended the system's operating life more than 50 times, achieving over 4,500 hours of stable performance in a scaled-up reactor—a major milestone for the field.

#### Turning CO<sub>2</sub> into useful products

Electrochemical CO2 reduction, or CO2RR, is an emerging green technology that uses electricity—preferably from renewable sources to convert climate-warming CO2 into valuable products such as carbon monoxide, ethylene, or alcohols. These products can then be refined into fuels or used in industrial applications, offering a way to turn a major pollutant into a useful resource.

Despite its promise, practical use of this technology has been limited by poor system stability. A common problem is the buildup of potassium bicarbonate salts in the gas flow channels. This happens when potassium ions move from the anolyte through the anion exchange membrane to the cathode reaction zone, where they combine with CO2 under high pH conditions.



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"Salt precipitation blocks CO2 transport and floods the gas diffusion electrode, which leads to performance failure," said Haotian Wang, the corresponding author of the study and associate professor of chemical and biomolecular engineering, materials science and nanoengineering and chemistry at Rice. "This typically happens within a few hundred hours, which is far from commercial viability."

#### A simple acid-based solution

To address this issue, the Rice team applied a clever variation on a common technique. Rather than using water to humidify the CO2 gas entering the reactor, they passed the gas through an acid solution, such as hydrochloric, formic, or acetic acid.

The vapor from the acid is carried into the cathode reaction chamber in trace amounts, just enough to alter the local chemistry. Because the salts formed with these acids are much more soluble than potassium bicarbonate, they don't crystallize and block the channels.

The effect was dramatic. In tests using a silver catalyst — a common benchmark for converting CO2 to carbon monoxide — the system operated stably for over 2,000 hours in a lab-scale device and more than 4,500 hours in a 100-square-centimeter, scaled-up electrolyzer. In contrast, systems using standard water-humidified CO2 failed after about 80 hours because of salt buildup.

#### Compatible across catalysts and materials

Importantly, the acid-humidified method proved effective across multiple catalyst types, including zinc oxide, copper oxide, and bismuth oxide, all of which are used to target different CO2RR products. The researchers also demonstrated that the method could be scaled without compromising performance with large-scale devices maintaining energy efficiency and avoiding salt blockage over extended periods.

They observed minimal corrosion or damage to the anion exchange membranes that are typically sensitive to chloride by keeping the acid concentrations low. The approach was also shown to be compatible with commonly used membranes and materials, reinforcing its potential for integration into existing systems.

To observe salt formation in real time, the team used custom-built reactors with transparent flow plates. Under conventional water humidification, salt crystals began forming within 48 hours. With acid-humidified CO2, however, no significant crystal accumulation was observed even after

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hundreds of hours, and any small deposits were eventually dissolved and carried out of the system.

"Using the traditional method of water-humidified CO2 could lead to salt formation in the cathode gas flow channels," said co-first author Shaoyun Hao, postdoctoral research associate in chemical and biomolecular engineering at Rice. "We hypothesized — and confirmed — that acid vapor could dissolve the salt and convert the low solubility KHCO3 into salt with higher solubility, thus shifting the solubility balance just enough to avoid clogging without affecting catalyst performance."

#### A breakthrough in durability and adoption

The work opens the door to more durable, scalable CO2 electrolyzers, a critical need if the technology is to be deployed at industrial scales as part of carbon capture and utilization strategies. The simplicity of the approach, involving only small tweaks to existing humidification setups, means it can be adopted without significant redesigns or added costs.

"This is a major finding for CO2 electrolysis," said Ahmad Elgazzar, co-first author and graduate student in chemical and biomolecular engineering at Rice. "Our method addresses a long-standing obstacle with a low-cost, easily implementable solution. It's a step toward making carbon utilization technologies more commercially viable and more sustainable."

Sci Tech Daily, 23 June 2025

https://scitechdaily.com

#### Scientists revive legendary golden sea silk using Korean pen shell byssus

#### 2025-06-26

A luxurious fiber once reserved exclusively for emperors in ancient times has been brought back to life by Korean researchers. A team led by Professor Dong Soo Hwang and Professor Jimin Choi has successfully recreated a golden fiber, akin to that of 2,000 years ago, using the pen shell (Atrina pectinata) cultivated in Korean coastal waters.

This breakthrough not only recreates the legendary sea silk but also reveals the scientific basis behind its unchanging golden color. The study was recently published in the journal Advanced Materials.

Sea silk—often referred to as the "golden fiber of the sea"—was one of the most prized materials in the ancient Roman period, used exclusively by



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figures of high authority such as emperors and popes. This precious fiber is made from the byssus threads secreted by Pinna nobilis, a large clam native to the Mediterranean, which uses the threads to anchor itself to rocks.

Valued for its iridescent, unfading golden color, light weight, and exceptional durability, sea silk earned its reputation as the "legendary silk." A notable example is the Holy Face of Manoppello, a relic preserved for centuries in Italy, which is believed to be made from sea silk.

However, due to recent marine pollution and ecological decline, Pinna nobilis is now an endangered species. The European Union has banned its harvesting entirely, making sea silk an artifact of the past—produced only in minuscule quantities by a handful of artisans.

The POSTECH research team turned their attention to the pen shell Atrina pectinata, a species cultivated in Korean coastal waters for food. Like Pinna nobilis, this clam secretes byssus threads to anchor itself, and the researchers found that these threads are physically and chemically similar to those of Pinna nobilis. Building on this insight, they succeeded in processing pen shell byssus to recreate sea silk.

However, their achievement goes beyond mere replication of its appearance. The team also revealed the scientific secret behind sea silk's distinctive golden hue and its resistance to fading over time.

The golden color of sea silk is not derived from dyes, but from structural coloration—a phenomenon caused by the way light reflects off nanostructures. Specifically, the researchers identified that the iridescence arises from a spherical protein structure called "photonin," which forms layered arrangements that interact with light to produce the characteristic shine. Similar to the color seen in soap bubbles or butterfly wings, this structure-based coloration is highly stable and does not fade easily over time.

Moreover, the study revealed that the more orderly the protein arrangement, the more vivid the structural color becomes. Unlike traditional dyeing, this color is not applied but instead generated by the alignment of proteins within the fiber, contributing to the material's remarkable lightfastness over millennia.

Another significant aspect of this research is the upcycling of pen shell byssus, previously discarded as waste, into a high-value sustainable textile. This not only helps reduce marine waste but also demonstrates

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the potential of eco-friendly materials that carry cultural and historical significance.

Professor Hwang noted, "Structurally colored textiles are inherently resistant to fading. Our technology enables long-lasting color without the use of dyes or metals, opening new possibilities for sustainable fashion and advanced materials."

Phys Org, 26 June 2025

https://phys.org

#### The New King of Propylene? Cobalt Catalyst Outperforms Precious Metals

#### 2025-06-20

CoS-1 is a cobalt zeolite catalyst that boosts propylene production efficiently and stably, challenging platinum-based alternatives.

Propane dehydrogenation is an important industrial method for producing propylene without depending on oil. However, most current processes still depend heavily on precious-metal catalysts like those made with platinum. Finding efficient alternatives that use more common, earthabundant metals has proven difficult.

#### Synthesis of high-performance CoS-1 catalyst

In a study published in Nature Catalysis, Prof. Jianping Xiao's team at the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences, along with their collaborators, developed a high-performance cobaltosilicate zeolite catalyst called CoS-1 using a hydrothermal synthesis method. This catalyst contains only tetrahedral cobalt sites and no unstable cobalt species. It achieved a propylene productivity of 9.7 kgC3 per kg of catalyst per hour, outperforming the industrial PtSn/Al2O3 catalyst.

The synthesis involved preparing a gel made from cobalt salts, tetraethyl orthosilicate, tetrapropylammonium hydroxide (TPAOH), urea, and water, followed by crystallization at 180 °C. After calcination to remove the organic template and three rounds of nitric acid washing at 80 °C to eliminate excess cobalt, the resulting CoS-1 catalyst retained only the stable tetrahedral cobalt sites.



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#### Atomic-level insights into catalyst performance

Through density functional theory calculations and ab initio molecular dynamics simulations, researchers studied the stability of different active centers, and uncovered the mechanism behind the high performance of CoS-1 catalyst. They revealed that the flexible zeolite framework obviously lowered the dehydrogenation barriers at isolated cobalt sites due to entropic effects, resulting in a lower barrier of propane dehydrogenation than Pt3Sn alloy.

Microkinetic simulations further showed that while CoS-1 had a lower dehydrogenation barrier, its overall reaction rate at initial conversions was slightly lower than that of Pt3Sn, due to reduced propane concentration at isolated Co sites—an effect of entropy loss during diffusion into the zeolite channels.

The CoS-1 developed in this study exhibits excellent long-time stability. Researchers proved that this can be attributed to the non-bonding adsorption of propylene within the zeolite, which enables rapid product desorption and reducing coke formation.

Sci Tech Daily, 20 June 2025

https://scitechdaily.com

#### Forever chemicals' toxic cousin: MCCPs detected in U.S. air for first time

#### 2025-06-18

Once in a while, scientific research resembles detective work. Researchers head into the field with a hypothesis and high hopes of finding specific results, but sometimes, there's a twist in the story that requires a deeper dive into the data.

That was the case for the University of Colorado Boulder researchers who led a field campaign in an agricultural region of Oklahoma. Using a hightech instrument to measure how aerosol particles form and grow in the atmosphere, they stumbled upon something unexpected: the first-ever airborne measurements of Medium Chain Chlorinated Paraffins (MCCPs), a kind of toxic organic pollutant, in the Western Hemisphere. Their results published today in ACS Environmental Au.

"It's very exciting as a scientist to find something unexpected like this that we weren't looking for," said Daniel Katz, CU Boulder chemistry PhD student and lead author of the study. "We're starting to learn more about

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this toxic, organic pollutant that we know is out there, and which we need to understand better."

MCCPs are currently under consideration for regulation by the Stockholm Convention, a global treaty to protect human health from long-standing and widespread chemicals. While the toxic pollutants have been measured in Antarctica and Asia, researchers haven't been sure how to document them in the Western Hemisphere's atmosphere until now.

MCCPs are used in fluids for metal working and in the construction of PVC and textiles. They are often found in wastewater and as a result, can end up in biosolid fertilizer, also called sewage sludge, which is created when liquid is removed from wastewater in a treatment plant. In Oklahoma, researchers suspect the MCCPs they identified came from biosolid fertilizer in the fields near where they set up their instrument.

"When sewage sludges are spread across the fields, those toxic compounds could be released into the air," Katz said. "We can't show directly that that's happening, but we think it's a reasonable way that they could be winding up in the air. Sewage sludge fertilizers have been shown to release similar compounds."

MCCPs little cousins, Short Chain Chlorinated Paraffins (SCCPs), are currently regulated by the Stockholm Convention, and since 2009, by the EPA here in the United States. Regulation came after studies found the toxic pollutants, which travel far and last a long time in the atmosphere, were harmful to human health. But researchers hypothesize that the regulation of SCCPs may have increased MCCPs in the environment.

"We always have these unintended consequences of regulation, where you regulate something, and then there's still a need for the products that those were in," said Ellie Browne, CU Boulder chemistry professor, CIRES Fellow, and co-author of the study. "So they get replaced by something."

#### Measurement of aerosols led to a new and surprising discovery

Using a nitrate chemical ionization mass spectrometer, which allows scientists to identify chemical compounds in the air, the team measured air at the agricultural site 24 hours a day for one month. As Katz cataloged the data, he documented the different isotopic patterns in the compounds. The compounds measured by the team had distinct patterns, and he noticed new patterns that he immediately identified as different from the known chemical compounds. With some additional research, he identified them as chlorinated paraffins found in MCCPs.



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Katz says the makeup of MCCPs are similar to PFAS, long-lasting toxic chemicals that break down slowly over time. Known as "forever chemicals," their presence in soils recently led the Oklahoma Senate to ban biosolid fertilizer.

Now that researchers know how to measure MCCPs, the next step might be to measure the pollutants at different times throughout the year to understand how levels change each season. Many unknowns surrounding MCCPs remain, and there's much more to learn about their environmental impacts.

"We identified them, but we still don't know exactly what they do when they are in the atmosphere, and they need to be investigated further," Katz said. "I think it's important that we continue to have governmental agencies that are capable of evaluating the science and regulating these chemicals as necessary for public health and safety."

Science Daily, 18 June 2025

https://scienedaily.com

#### Most of Europe's surface water bodies polluted by chemicals, new report shows

#### 2025-02-04

The majority of Europe's surface water bodies are contaminated with chemicals, according to a new report from the European Commission.

The findings paint a stark picture of the continent's struggling water resources, highlighting the urgent need for action.

The Commission's assessment reveals that 39.5 per cent of surface waters, including lakes, rivers, and coastal areas, achieved "good" ecological status in 2021.

Even more alarming is the decline in chemical status, with only 26.8 per cent of these bodies meeting the required standards, a significant drop from 33.5 per cent in 2015.

This decline comes as the EU grapples with increasing water scarcity and droughts, exacerbated by climate change.

The report noted partial improvements - for example, in aquatic plants in lakes - but these did not rescue the overall health of water bodies.

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The situation is better in Europe's groundwater bodies, 86 per cent of which had a good chemical status - although nitrates from farming were polluting groundwater supplies in most EU countries, the data showed.

"The situation for water in the EU is in bad shape," EU Environment Commissioner Jessika Roswall told Reuters in an interview last month. "We have taken water for granted for so long. And I think it's time now that we have this mindset change."

Addressing the issue will be a political challenge - not least because it would involve tackling the substantial impact farming has on water supplies, through irrigation and pollution like nitrates from fertilisers that leach off fields.

Farmers across Europe wielded their political influence last year, staging months of sometimes violent protests against EU rules that resulted in Brussels scaling back some environmental measures.

The Commission said more radical measures were needed to tackle nitrates pollution, but it acknowledged these "could be politically difficult to adopt".

Independent, 4 February 2025

https://independent.co.uk

#### Mist and sea spray create unique conditions for urea to form from simple gases

#### 2025-06-26

Urea is considered a possible key molecule in the origin of life. ETH researchers have discovered a previously unknown way in which this building block can form spontaneously on aqueous surfaces without the need for any additional energy.

Urea is one of the most important industrial chemicals produced worldwide. It is used as a fertilizer, for the production of synthetic resins and explosives and as a fuel additive for cleaning car exhaust gases. Urea is also believed to be a potential key building block for the formation of biological molecules such as RNA and DNA in connection with the question of the origin of life.

Until now, the origin of urea itself on early Earth has not been conclusively clarified.



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A research team led by Ruth Signorell, Professor of Physical Chemistry at ETH Zurich, has discovered a previously unknown reaction pathway for the formation of urea that could provide an answer. The study appears in the journal Science.

#### Chemistry on the water surface

Either high pressures and temperatures or chemical catalysts are needed for the industrial production of urea from ammonia (NH<sub>3</sub>) and carbon dioxide (CO<sub>2</sub>). Enzymes enable the same reaction to take place in humans and animals, removing toxic ammonia from the breakdown of proteins such as urea. As this simple molecule contains nitrogen as well as carbon and probably existed on the uninhabited early Earth, many researchers view urea as a possible precursor for complex biomolecules.

"In our study, we show one way in which urea could have formed on the prebiotic Earth," says Signorell, "namely where water molecules interact with atmospheric gases: on the water surface."

#### Reactor on the edge of a droplet

Signorell's team studied tiny water droplets such as those found in sea spray and fine mist. The researchers observed that urea can form spontaneously from carbon dioxide (CO<sub>2</sub>) and ammonia (NH<sub>3</sub>) in the surface layer of the droplets under ambient conditions. The physical interface between air and liquid creates a special chemical environment at the water surface that makes the spontaneous reaction possible.

As a droplet has a very large surface area in relation to its volume, chemical reactions mainly take place near this surface. Chemical concentration gradients form in this area, which acts like a microscopic reactor. The pH gradient across the interfacial layer of the water droplets creates the required acidic environment, which opens unconventional pathways that would otherwise not take place in liquids.

"The remarkable aspect of this reaction is that it takes place under ambient conditions without any external energy," explains Mercede Mohajer Azizbaig, one of the two first authors. This not only makes the process interesting from a technical perspective but also provides valuable insights into processes that could be significant for evolution.

#### A window into the early days of the Earth

The origin of life is currently the subject of a great deal of wide-ranging research, with different approaches being explored.

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First author Pallab Basuri explains, "Given such a controversial field of research, it was important for us to back up our observations."

Theoretical calculations by co-authors Evangelos Miliordos and Andrei Evdokimov from Auburn University supported the experimental findings and confirmed that the urea reaction on the droplets takes place without any external energy supply.

The results suggest that this natural reaction could also have been possible in the atmosphere of early Earth—an atmosphere that was rich in CO<sub>2</sub> and probably contained small traces of ammonia. In such environments, aqueous aerosols or fog droplets could have acted as natural reactors in which precursor molecules such as urea were formed.

"Our study shows how seemingly mundane interfaces can become dynamic reaction spaces, suggesting that biological molecules may have a more common origin than was previously thought," says Signorell.

In the long term, the direct reaction of CO<sub>2</sub> and ammonia under ambient conditions could also have potential for climate-friendly production of urea and downstream products.

Phys Org, 26 June 2025

https://phys.org



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#### Engineers turn toxic ancient tomb fungus into anticancer drug

#### 2025-06-23

Penn-led researchers have turned a deadly fungus into a potent cancerfighting compound. After isolating a new class of molecules from Aspergillus flavus, a toxic crop fungus linked to deaths in the excavations of ancient tombs, the researchers modified the chemicals and tested them against leukemia cells. The result? A promising cancer-killing compound that rivals FDA-approved drugs and opens up new frontiers in the discovery of more fungal medicines.

"Fungi gave us penicillin," says Sherry Gao, Presidential Penn Compact Associate Professor in Chemical and Biomolecular Engineering (CBE) and in Bioengineering (BE) and senior author of a new paper in Nature Chemical Biology on the findings. "These results show that many more medicines derived from natural products remain to be found."

#### From curse to cure

Aspergillus flavus, named for its yellow spores, has long been a microbial villain. After archaeologists opened King Tutankhamun's tomb in the 1920s, a series of untimely deaths among the excavation team fueled rumors of a pharaoh's curse. Decades later, doctors theorized that fungal spores, dormant for millennia, could have played a role.

In the 1970s, a dozen scientists entered the tomb of Casimir IV in Poland. Within weeks, 10 of them died. Later investigations revealed the tomb contained A. flavus, whose toxins can lead to lung infections, especially in people with compromised immune systems.

Now, that same fungus is the unlikely source of a promising new cancer therapy.

#### A rare fungal find

The therapy in question is a class of ribosomally synthesized and posttranslationally modified peptides, or RiPPs, pronounced like the "rip" in a piece of fabric. The name refers to how the compound is produced—by the ribosome, a tiny cellular structure that makes proteins—and the fact that it is modified later, in this case, to enhance its cancer-killing properties.

"Purifying these chemicals is difficult," says Qiuyue Nie, a postdoctoral fellow in CBE and the paper's first author. While thousands of RiPPs have

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been identified in bacteria, only a handful have been found in fungi. In part, this is because past researchers misidentified fungal RiPPs as nonribosomal peptides and had little understanding of how fungi created the molecules.

"The synthesis of these compounds is complicated," adds Nie. "But that's also what gives them this remarkable bioactivity."

#### Hunting for chemicals

To find more fungal RiPPs, the researchers first scanned a dozen strains of Aspergillus, which previous research suggested might contain more of the chemicals.

By comparing chemicals produced by these strains with known RiPP building blocks, the researchers identified A. flavus as a promising candidate for further study.

Genetic analysis pointed to a particular protein in A. flavus as a source of fungal RiPPs. When the researchers turned the genes that create that protein off, the chemical markers indicating the presence of RiPPs also disappeared.

This novel approach—combining metabolic and genetic information not only pinpointed the source of fungal RiPPs in A. flavus, but could be used to find more fungal RiPPs in the future.

#### A potent new medicine

After purifying four different RiPPs, the researchers found the molecules shared a unique structure of interlocking rings. The researchers named these molecules, which have never been previously described, after the fungus in which they were found: asperigimycins.

Even with no modification, when mixed with human cancer cells, asperigimycins demonstrated medical potential: two of the four variants had potent effects against leukemia cells.

Another variant, to which the researchers added a lipid, or fatty molecule, that is also found in the royal jelly that nourishes developing bees, performed as well as cytarabine and daunorubicin, two FDA-approved drugs that have been used for decades to treat leukemia.

#### Cracking the code of cell entry





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To understand why lipids enhanced asperigimycins' potency, the researchers selectively turned genes on and off in the leukemia cells. One gene, SLC46A3, proved critical in allowing asperigimycins to enter leukemia cells in sufficient numbers.

That gene helps materials exit lysosomes, the tiny sacs that collect foreign materials entering human cells. "This gene acts like a gateway," says Nie. "It doesn't just help asperigimycins get into cells, it may also enable other 'cyclic peptides' to do the same."

Like asperigimycins, those chemicals have medicinal properties—nearly two dozen cyclic peptides have received clinical approval since 2000 to treat diseases as varied as cancer and lupus—but many of them need modification to enter cells in sufficient quantities.

"Knowing that lipids can affect how this gene transports chemicals into cells gives us another tool for drug development," says Nie.

#### **Disrupting cell division**

Through further experimentation, the researchers found that asperigimycins likely disrupt the process of cell division. "Cancer cells divide uncontrollably," says Gao. "These compounds block the formation of microtubules, which are essential for cell division."

Notably, the compounds had little to no effect on breast, liver or lung cancer cells—or a range of bacteria and fungi—suggesting that asperigimycins' disruptive effects are specific to certain types of cells, a critical feature for any future medication.

#### **Future directions**

In addition to demonstrating the medical potential of asperigimycins, the researchers identified similar clusters of genes in other fungi, suggesting that more fungal RiPPS remain to be discovered. "Even though only a few have been found, almost all of them have strong bioactivity," says Nie. "This is an unexplored region with tremendous potential."

The next step is to test asperigimycins in animal models, with the hope of one day moving to human clinical trials. "Nature has given us this incredible pharmacy," says Gao. "It's up to us to uncover its secrets. As

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engineers, we're excited to keep exploring, learning from nature and using that knowledge to design better solutions."

Phys Org, 23 June 2025

https://phys.org

# How your morning coffee is changing the structure of your brain

#### 2025-02-11

A novel placebo-controlled study has found daily caffeine consumption can significantly reduce the volume of gray matter in the human brain. These findings do not immediately suggest caffeine negatively impacts the brain but instead points to how the drug may induce a temporary neural plasticity that researchers think warrants further investigation.

Our brain and central nervous system is generally composed of both gray and white matter. Gray matter consists of neural cell bodies and nerve synapses, while white matter is primarily the bundles and pathways that connect those neural cells.

Prior research has indicated caffeine consumption may be associated with acute reductions in gray matter volume. But other research has also suggested caffeine could confer neuroprotective effects, slowing the cognitive decline associated with diseases such as Alzheimer's and Parkinson's.

The focus of this 2021 study was to specifically investigate the effects of caffeine on gray matter volume in young and healthy subjects. One particular question the researchers wanted to answer was whether the influence of caffeine on gray matter was a result of the drug's effect on sleep, as it has been shown that sleep deprivation or disruption can lead to acute reductions in gray matter.

Twenty subjects were recruited and tasked with two blinded 10-day programs. One period involved taking three tablets of caffeine each day and the other period involved placebo tablets. At the end of each program the participants' gray matter volume was measured through fMRI, and slow-wave sleep activity was measured through EEG.

The results revealed significant reductions in gray matter after 10 days of caffeine. These reductions were not seen after 10 days of placebo. And even more intriguingly, the study found no difference in slow-wave sleep activity between the placebo and caffeine periods. This suggests the



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gray matter reductions detected are not related to sleep disruptions but perhaps a unique side effect of caffeine.

The effect of caffeine on the brain was noted as particularly relevant in the right medial temporal lobe. This area of the brain includes the hippocampus and is responsible for processes such as memory formation and spatial cognition. Interestingly, a 2022 study in mice found chronic caffeine consumption caused notable molecular changes in the hippocampus.

Carolin Reichert, an author on the 2021 study from the University of Basel, noted these caffeine-induced gray matter changes seem to recover quite quickly after caffeine consumption is ceased.

"The changes in brain morphology seem to be temporary, but systematic comparisons between coffee drinkers and those who usually consume little or no caffeine have so far been lacking," Reichert said.

Reichert was also cautious to note their study does not imply caffeine consumption damages cognitive functioning. In fact, there has been a notable volume of research pointing to the contrary, showing caffeine seems to be somewhat neuroprotective, slowing cognitive decline in older subjects at high risk of conditions such as Alzheimer's and Parkinson's.

It is hypothesized these discordant results may be due to the 2021 research's focus on young healthy subjects compared to earlier work looking at older subjects already displaying some degree of neurodegeneration or cognitive decline.

"Our results do not necessarily mean that caffeine consumption has a negative impact on the brain," stressed Reichert. "But daily caffeine consumption evidently affects our cognitive hardware, which in itself should give rise to further studies."

The study was published in the journal Cerebral Cortex.

**Source:** University of Basel

New Atlas, 11 February 2025

https://newatlas.com

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A pink diamond just sold for over US\$14 million—no wonder, when you look at the mysteries behind their chemistry

#### 2025-06-23

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Diamonds might be forever but that doesn't stop them being bought and sold. One stone thought to have once belonged to Marie Antoinette, the last queen of France, has just sold for US\$14 million (£10 million) at an auction in New York—about three times the asking price. Set into a platinum ring and weighing a total of 15.5 grams, the clue to the diamond's uniqueness is in its name: the Marie-Thérèse pink.

This 10.38 carat pink diamond has been changing hands for generations, and previously sold at an auction in Geneva for an unknown amount in 1996. Pink diamonds are very rare and there are many things that scientists still don't know about them.

Diamonds are generally formed under intense heat and pressure deep within Earth's mantle, roughly 150-200 kilometers below the surface. Most natural diamonds crystallize over billions of years, composed almost entirely of carbon atoms arranged in a tightly packed, cube-like structure.

Colored diamonds are geological anomalies. Variations include pink, blue, orange, yellow, red, green, brown and black, most of which can be explained by impurities in their crystal lattice. Yellow diamonds contain nitrogen, for example, while blue ones contain boron.

Pink diamonds are not caused by such impurities. Scientists believe that the pink hue arises from a distortion in the diamond's atomic lattice structure. Intense pressure deep underground creates forces (known as shear forces) that twist and compress atomic layers, which alter how the stone reflects light.

It's this "plastic deformation" which results in the pink coloration, reducing the green light in the visible spectrum so that it shifts the overall color that we see towards pink.

Only a small fraction of diamonds undergo such extreme and precise pressure and temperature conditions during their formation. These factors make their creation very difficult, and it's even harder to predict where they will be formed. As a result, pink diamonds are the rarest of all colored diamonds apart from red ones, which are formed by an even more intense version of the same process.



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Aussie rules

For decades, the Argyle mine in western Australia was the world's primary source of pink diamonds (and also red ones), producing over 90% of the global supply. The mine is located at a unique geological area by a so-called lamproite volcanic pipe, as opposed to the more common kimberlite pipes found at most other diamond mines. Without getting too much into the technicalities, lamproite pipes tend to be less explosive and have more unusual minerals like leucite and rich potassium.

The Argyle mine is located in the Kimberley region, which experienced intense tectonic activity during the Paleoproterozoic era, over 1.6 billion years ago. This meant that the lamproite pipe was formed under extreme pressures and temperatures.

This is believed to have caused the lattice defects in the diamonds that were pushed to Earth's surface, which are responsible for their pink and red colors. The deep mantle depths in the mine were also crucial, since this translates into higher internal pressures and temperatures.

Even so, less than 0.1% of the diamonds extracted from Argyle were classified as pink (and only 0.0000002% were red, if you calculate the proportion of red carats found). The mine then closed in 2020 after 37 years of production because its reserves were exhausted, making pink diamonds even more scarce and valuable.

Other known sources include Brazil, India, Russia and South Africa, but these mines yield pink diamonds far less frequently. The rarity of highquality pink diamonds has made them highly sought-after by collectors and investors alike, as demonstrated by the high sale price of the Marie-Thérèse pink. That diamond was actually pink-purple, with the purple hue caused by hydrogen being absorbed into the atomic structure during the stone's formation, making it rarer still.

Advanced techniques involving shining infrared light and X-rays into the stones—respectively known as infrared spectroscopy and high-resolution X-ray diffraction—have provided scientists with insights into the structural changes that cause pink and red diamonds.

Yet many questions remain unanswered, and the study of pink diamonds continues to be an active area of scientific investigations in mineral physics and crystallography. This has included creating pink diamonds (and other colors such as blues) in the laboratory by replicating the natural processes that form them, but in a more controlled, accelerated way.

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These lab-grown pink diamonds look nearly identical to their natural versions to the human eye, but can yet be differentiated through optical techniques. One method is infrared absorption, which detects how the diamond absorbs light and vibrates at specific frequencies.

Another clue is the presence of sharp peaks in the visible light spectrum that indicate certain impurities, like hydrogen or nitrogen, which are often found in natural stones. In the same style as a CSI investigation, these techniques provide the last word in whether a pink diamond is from a mine such as Argyle, a lab-grown pink, or a clear natural diamond that has been treated pink artificially.

Even after years of improving the process for making pink diamonds synthetically, the mechanical distortions responsible for their exotic color still can't be replicated precisely under laboratory conditions. Scientists don't understand all the atomic processes involved in their coloring becoming permanent to be able to recreate them perfectly.

The same is actually also true for other synthetic diamonds, though they are becoming harder and harder to detect as the technology improves. In short, pink diamonds (and red ones) remain among the most remarkable precious stones in the world. Unless and until that changes, we can keep expecting them to change hands for ridiculous amounts of money.

Phys Org, 23 June 2025

https://phys.org

#### Plastic Bag Bans Can Reduce Shoreline Bag Litter by 47%

#### 2025-06-23

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Plastic shopping bags, which have low recycling rates and often become litter when they blow away in the wind, are among the biggest culprits of plastic pollution in the ocean and along shorelines. Once there, they can entangle animals and break down into harmful microplastics. As awareness of this problem has grown, more than 100 countries have instituted bans or fees on plastic bags. But what effect those policies are having on the amount of plastic litter in the marine environment had not been systematically evaluated until now.

A new study from the University of Delaware and Columbia University took a thorough look at plastic bag bans and fees in jurisdictions across the United States to gauge their effectiveness. The researchers found that



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plastic bag policies led to a 25% to 47% decrease in plastic bags as a share of total items collected in shoreline cleanups relative to areas without policies. This decrease grows in magnitude over time, with no evidence of the rates rebounding.

The study, recently published in the journal Science, was authored by Kimberly Oremus, associate professor in UD's School of Marine Science and Policy, and Anna Papp, an environmental economist who received her doctorate in sustainable development from Columbia University's School of International and Public Affairs in 2025.

Oremus got the idea for the study when she learned that volunteers at coastal beach cleanups in Delaware were using an app called Clean Swell to track the litter collected. The data goes into Ocean Conservancy's Trash Information and Data for Education and Solutions (TIDES) database, which keeps crowdsourced records from thousands of cleanups around the world each year.

"When we found the database that had information on different shoreline cleanups, we realized we could look at the composition of litter before and after a policy to see what effect it had," Oremus said. "And then we could compare that to places that never got a plastic bag policy."

Papp, the study's lead author, said the plastic collected in shoreline cleanups can serve as a proxy for the total amount of plastic litter in the local marine or aquatic environment.

"A lot of the previous economics literature on plastic bag policies has used checkout data at the store level," Papp said. "So we were excited to add to that a direct measurement of plastic litter on these shorelines."

To conduct the study, the researchers looked at tens of thousands of shoreline cleanups and hundreds of local policies to determine how the policies worked in terms of reducing plastic litter in the environment.

"We always remind volunteers and our partner organizations that the data they collect are used to make real change, and these findings are a great example of that," said Allison Schutes, senior director of conservation cleanups at Ocean Conservancy.

They focused on the United States because it has no federal plastic bag policy, allowing them to compare the effects of different types of policies at the town, county and state level within a single country.

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While it might not seem surprising that banning or taxing plastic bags would reduce litter, Oremus said the results were more robust than she had expected.

"There are so many pathways a bag can take from the checkout line at the store," Oremus said. "It's great to see a policy that works in such a clearly measurable way."

Papp added that looking into the plastic bag policies, she was surprised to find that roughly one-third of Americans are living in an area with some sort of plastic bag policy in place.

"It was interesting to quantify the reach of the policies," Papp said. "We compiled over 600 policies for 2007-2023, with a lot of variation in their scope and geographic scale."

The study also found that some types of policies seemed to be more effective than others in reducing plastic litter. For instance, they found more robust impacts from state-level policies than town-level policies, with fees appearing to reduce litter even more than bans, though more study is needed to understand why. Another finding was that the bag bans and fees were most effective in places where the plastic bag litter problem was more severe to begin with.

An important caveat of the research is that despite these policies working to reduce the percentage of plastic bags on the shorelines, the overall percentage of plastic bags is increasing in both places with and without the policies. It's just increasing less in places with these policies than those without. That's because plastic pollution is growing in general, and bag policies can mitigate only some of its impacts.

"We're still getting more plastic bags on shorelines as a percentage of all the cleanup items over time," Oremus said. "It's not eliminating the problem — it's just making it grow more slowly."

With the United Nations Environment Programme announcing the next round of negotiations on an international plastic treaty will happen in August 2025, Oremus and Papp said their study highlights the opportunity for a more comprehensive approach to the problem.

"Overall, our findings do show that plastic bag policies are broadly effective in limiting litter along shorelines," Papp said. "Ours is the first large-scale study to use hundreds of policies and tens of thousands of cleanups to look at their effects. But it is important to keep in mind that



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this is a relative decrease in affected areas compared to areas without policies."

Technology Networks, 23 June 2025

https://technologynetworks.com

#### New Investigation: This Household Chemical "Causes More Cancer Than Any Other"

#### 2024-12-10

Many of us first encountered it in high school biology class, but experts say it lurks in our homes too. Here's where, as a not-for-profit report reveals its consequences.

In an increasingly industrialized world, hazardous chemicals are all around us. Many of them, including within the home, have been found to cause cancer; but researchers are finding that some household toxins are riskier than others. A December 2024 report by the nonprofit investigative newsroom ProPublica has concluded that one widely used chemical "causes more cancer than any other."

The National Academies of Sciences, Engineering, and Medicine's Review of EPA's 2022 Draft Formaldehyde Assessment says several health authorities, including the International Agency for Research on Cancer and the National Toxicology Program, have come to "unequivocal independent conclusions" that formaldehyde—a colorless, flammable gas with a strong odor and a range of applications—is carcinogenic to humans. "The evidence demonstrates that formaldehyde inhalation causes cancer in humans and identifies nasopharyngeal and sinonasal cancers, as well as myeloid leukemia" as the cancer types most closely linked with the chemical, the review committee wrote. (The Cleveland Clinic explains that these types of cancer may affect the nose, sinuses, neck, throat, or other sites within the body's uppermost region.)

The Environmental Protection Agency (EPA) has calculated that formaldehyde exposure within the home could cause 255 cancer cases per million people exposed to the chemical over their lifetimes. This excludes the risk of myeloid leukemia, which the EPA ultimately decided was "too uncertain" to include in official estimates, ProPublica states.

However, the investigative news outlet's new findings suggest that the true numbers are actually far higher. "Even the EPA's alarming estimates of

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cancer risk vastly underestimate—by as much as fourfold—the chances of formaldehyde causing cancer," their analysis states.

Formaldehyde is typically associated with the preservation of cadavers, such as in funeral homes and for medical or scientific research, including in dissection labs in the education setting. However the Environmental Protection Agency says the chemical is also found in:

- Resins used to manufacture composite wood products
- Building materials and insulation
- Household products such as glues, paints and coatings, lacquers and finishes
- Paper products
- Clothing, such as permanent press fabrics
- Preservatives used in some medicines, cosmetics and other consumer products such as dishwashing liquids and fabric softeners
- Fertilizers and pesticides •
- Emissions from un-vented, fuel-burning appliances, like gas stoves or kerosene space heaters
- Cigarette smoke

Cancer isn't the only health concern linked with exposure to formaldehyde. ProPublica warns formaldehyde can also trigger asthma, miscarriages, and fertility problems. The Centers For Disease Control and Prevention (CDC) adds that "formaldehyde can cause irritation of the eyes, nose, and throat, even at low levels for short periods. Longer exposure or higher doses can cause coughing or choking. Severe exposure can cause death from throat swelling or from chemical burns to the lungs."

The Cleveland Clinic lists formaldehyde as a neurotoxin capable of altering or inhibiting function in any part of your nervous system, including the brain, spinal cord and nerves. "These changes can range from mild to severe," the Clinic states. "They may be treatable or long-lasting. In severe cases, neurotoxicity can lead to death."

Though recent legislation has made modest gains in restricting the deadly chemical in manufacturing, the report also says that profit-driven chemical companies are spending big to maintain business as usual. "Trump has already vowed to roll back regulations he views as anti-business-an approach that promises to upend the work of government far beyond formaldehyde protections," ProPublica notes.



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In lieu of legislative change, there are several ways to protect yourself against the effects of formaldehyde—especially in the home. The American Lung Association (ALA) suggests:

- Opting for low-formaldehyde products when building or remodeling
- Keeping your indoor spaces well-ventilated
- Airing out new furniture or pressed wood products before bringing them indoors
- Not smoking or vaping
- Washing new clothes before wearing them

ProPublica has also released a search tool, which allows you to enter your address or other location information in order to determine your personal risk level. Talk with your doctor with any concerns you may have about your exposure to formaldehyde, or any symptoms you may be experiencing.

The Healthy, 10 December 2024

https://thehealthy.com

### Upcycling plastic into painkillers: Microbes transform everyday waste into acetaminophen

#### 2025-06-23

Paracetamol (acetaminophen) production could be revolutionized by the discovery that a common bacterium can turn everyday plastic waste into the painkiller. The new method leaves virtually no carbon emissions and is more sustainable than the current production of the medicine, researchers say.

Paracetamol is traditionally made from dwindling supplies of fossil fuels including crude oil. Thousands of tons of fossil fuels are used annually to power the factories that produce the painkiller, alongside other medicines and chemicals—making a significant contribution to climate change, experts say.

The breakthrough addresses the urgent need to recycle a widely used plastic known as polyethylene terephthalate (PET), which ultimately ends up in landfill or polluting oceans. The strong, lightweight plastic is used for water bottles and food packaging, and creates more than 350 million tons of waste annually, causing serious environmental damage worldwide.

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PET recycling is possible, but existing processes create products that continue to contribute to plastic pollution worldwide, researchers say.

Published in Nature Chemistry, a team of scientists from the University of Edinburgh's Wallace Lab used genetically reprogrammed E. coli, a harmless bacterium, to transform a molecule derived from PET known as terephthalic acid into the active ingredient of paracetamol.

Researchers used a fermentation process, similar to the one used in brewing beer, to accelerate the conversion from industrial PET waste into paracetamol in less than 24 hours.

The new technique was carried out at room temperature and created virtually no carbon emissions, proving that paracetamol can be produced sustainably. Further development is needed before it can be produced at commercial levels, the team says.

Some 90% of the product made from reacting terephthalic acid with genetically reprogrammed E. coli was paracetamol.

Experts say this new approach demonstrates how traditional chemistry can work with engineering biology to create living microbial factories capable of producing sustainable chemicals while also reducing waste, greenhouse gas emissions and reliance on fossil fuels.

Professor Stephen Wallace, lead author, UKRI Future Leaders Fellow and Chair

of Chemical Biotechnology, School of Biological Sciences, University of Edinburgh, said, "This work demonstrates that PET plastic isn't just waste or a material destined to become more plastic—it can be transformed by microorganisms into valuable new products, including those with potential for treating disease."

Ian Hatch, Head of Consultancy at El, said, "We are bringing in exceptional companies like AstraZeneca to work with Stephen and others at the University to translate these cutting-edge discoveries into world-changing innovations.

"Engineering biology offers immense potential to disrupt our reliance on fossil fuels, build a circular economy and create sustainable chemicals and materials, and we would invite potential collaborators to get in touch."



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The research was funded by biopharmaceutical company AstraZeneca.

Phys Org, 23 June 2025

https://phys.org

#### Hydrogen fuel at half the cost? Scientists reveal a gamechanging catalyst

#### 2025-06-20

To reduce greenhouse gas emissions and combat climate change, the world urgently needs clean and renewable energy sources. Hydrogen is one such clean energy source that has zero carbon content and stores much more energy by weight than gasoline. One promising method to produce hydrogen is electrochemical water-splitting, a process that uses electricity to break down water into hydrogen and oxygen. In combination with renewable energy sources, this method offers a sustainable way to produce hydrogen and can contribute to the reduction of greenhouse gases.

Unfortunately, large-scale production of hydrogen using this method is currently unfeasible due to the need for catalysts made from expensive rare earth metals. Consequently, researchers are exploring more affordable electrocatalysts, such as those made from diverse transition metals and compounds. Among these, transition metal phosphides (TMPs) have attracted considerable attention as catalysts for the hydrogen generating side of the process, known as hydrogen evolution reaction (HER), due to their favorable properties. However, they perform poorly in the oxygen evolution reaction (OER), which reduces overall efficiency. Previous studies suggest that Boron (B)-doping into TMPs can enhance both HER and OER performance, but until now, making such materials has been a challenge.

In a recent breakthrough, a research team led by Professor Seunghyun Lee, including Mr. Dun Chan Cha, from the Hanyang University ERICA campus in South Korea, has developed a new type of tunable electrocatalyst using B-doped cobalt phosphide (CoP) nanosheets. Prof. Lee explains, "We have successfully developed cobalt phosphides-based nanomaterials by adjusting boron doping and phosphorus content using metal-organic frameworks. These materials have better performance and lower cost than conventional electrocatalysts, making them suitable for large-scale hydrogen production." Their study was published in the journal Small on March 19, 2025.

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The researchers used an innovative strategy to create these materials, using cobalt (Co) based metal-organic frameworks (MOFs). "MOFs are excellent precursors for designing and synthesizing nanomaterials with the required composition and structures," notes Mr. Cha. First, they grew Co-MOFs on nickel foam (NF). They then subjected this material to a post-synthesis modification (PSM) reaction with sodium borohydride (NaBH4), resulting in the integration of B. This was followed up by a phosphorization process using different amounts of sodium hypophosphite (NaH2PO2), resulting in the formation of three different samples of B-doped cobalt phosphide nanosheets (B-CoP@NC/NF).

Experiments revealed that all three samples had a large surface area and a mesoporous structure, key features that improve electrocatalytic activity. As a result, all three samples exhibited excellent OER and HER performance, with the sample made using 0.5 grams of NaH2PO2 (B-CoP0.5@NC/NF) demonstrating the best results. Interestingly, this sample exhibited overpotentials of 248 and 95 mV for OER and HER, respectively, much lower than previously reported electrocatalysts.

An alkaline electrolyzer developed using the B-CoP0.5@NC/NF electrodes showed a cell potential of just 1.59 V at a current density of 10 mA cm-2, lower than many recent electrolyzers. Additionally, at high current densities above 50 mA cm-2, it even outperformed the state-of-the-art RuO2/NF(+) and 20% Pt-C/NF(-) electrolyzer, while also demonstrating long-term stability, maintaining its performance for over 100 hours.

Density functional theory (DFT) calculations supported these findings and clarified the role of B-doping and adjusting P content. Specifically, B-doping and optimal P content led to effective interaction with reaction intermediates, leading to exceptional electrocatalytic performance.

"Our findings offer a blueprint for designing and synthesizing nextgeneration high-efficiency catalysts that can drastically reduce hydrogen production costs," says Prof. Lee. "This is an important step towards making large-scale green hydrogen production a reality, which will ultimately help in reducing global carbon emissions and mitigating climate change.

Scienced Daily, 20 June 2025

https://sciencedaily.com

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### **Scientists Detect Elusive New Isotope in Landmark** Superheavy Experiment

#### 2025-06-24

A new seaborgium isotope may unlock the path to discovering even shorter-lived superheavy nuclei through K-isomer states.

An international team of researchers from GSI/FAIR, Johannes Gutenberg University Mainz (JGU), and the Helmholtz Institute Mainz (HIM) has successfully produced a new isotope of the element seaborgium. During experiments at the GSI/FAIR accelerator facilities, scientists detected 22 nuclei of seaborgium-257. The findings were published in Physical Review Letters and selected as an "Editor's Suggestion."

This discovery brings the total number of known seaborgium isotopes, an artificial superheavy element with atomic number 106, to 14. To create seaborgium-257, the team used a high-intensity beam of chromium-52 from the UNILAC linear accelerator to bombard high-purity lead-206 targets.

The gas-filled recoil separator TASCA (TransActinide Separator and Chemistry Apparatus) enabled the detection of 22 decay events: 21 fission reactions and one alpha decay. The new isotope has a half-life of 12.6 milliseconds and is located near the enhanced neutron shell gap at neutron number 152.

#### **Fission properties and shell effects**

"Our findings on seaborgium-257 provide exciting hints on the impact of shell effects on the fission properties of superheavy nuclei. As one consequence, it is possible that the next lighter, still unknown isotope seaborgium-256 — may undergo fission in a very short time range of one nanosecond to six microseconds," says Dr. Pavol Mosat, the first author of the publication from GSI/FAIR's research department for the chemistry of superheavy elements (SHE Chemistry).

The upper limit of the expected half-life range is close to or even slightly below what current experiments can detect, unless a so-called K-isomeric state is present. These excited states, which are stabilized by quantum effects, can have longer fission lifetimes and provide an indirect way to study otherwise short-lived nuclei.

A recent breakthrough in this area was the discovery of rutherfordium-252, which has a 60-nanosecond half-life due to a longer-lived K-isomeric state. Exploring the isotopic boundary of seaborgium continues this line of

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research, helping to chart the edges of the so-called island of stability for superheavy elements.

#### Evidence of a K-isomeric state in seaborgium-259

So far, no K-isomeric state has been observed in seaborgium isotopes. In the present experiment, however, the research team also irradiated a lead-208 target and observed strong evidence for the presence of a K-isomeric state in seaborgium-259.

"Our results on a K-isomeric state in seaborgium–259 open a doorway to explore the K-isomer phenomenon in other seaborgium isotopes and to enable the synthesis of the short-lived isotope seaborgium-256 isotope, if a long-lived K-isomeric state exists also in this nucleus," says Dr. Khuyagbaatar Jadambaa, leader of the corresponding experimental program of GSI/FAIR.

"The present work is a great example of the collaborative efforts of different GSI/FAIR departments — besides SHE Chemistry, the Experiment Electronics and Target Laboratory departments were involved — with our international partner institutes," says Professor Christoph E. Düllmann, head of the SHE Chemistry department at GSI/FAIR, professor at JGU and director of HIM. "The further exploration of the stability and the properties of superheavy nuclei jointly with our national and international partners will continue to be an important area of research for our research team."

Dci Tech Daily, 24 June 2025

https://scitechdaily.com

#### **Drinks in Glass Bottles Contain More Microplastics Than Those Plastic Bottles** 2025-06-23

Drinks contained in glass bottles contain more microplastic particles than those in plastic bottles, cartons or cans. This was the surprising finding of a study conducted by the Boulogne-sur-Mer unit of the ANSES Laboratory for Food Safety. The scientists hypothesised that these plastic particles could come from the paint used on bottle caps. These findings have highlighted a source of microplastics in drinks that manufacturers can easily address.

The aim of the ANSES study was to determine the level of microplastic contamination in drinks such as water, soda, iced tea, wine and beer; it also sought to establish the impact of their containers on this level. For most



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of the drinks studied, the level of microplastics was found to be higher in glass bottles than in other containers. For example, on average, in glass bottles of cola, lemonade, iced tea and beer, there were around 100 microplastic particles per litre. This number was five to 50 times lower in plastic bottles and cans.

"We were expecting the opposite result when we compared the level of microplastics in different drinks sold in France" explains Iseline Chaïb, a PhD student in the Aquatic Food Safety Unit (SANAQUA, Boulogne-sur-Mer site), which conducted the study at the ANSES Laboratory for Food Safety. In the absence of toxicological reference data, it is not possible to say whether the levels of microplastics found pose a health risk. The thesis was co-funded by the Hauts-de-France Region and ANSES. The project also received support under the IDEAL State-Region plan contract and from the French National Research Agency (IFSEA University Research School).

In the specific case of water, the level of microplastics was relatively low regardless of the container, with an average of 4.5 particles per litre in glass bottles and 1.6 particles per litre in plastic bottles and cartons. Wine also contained few microplastics, including in glass bottles with corks. The origin of these variations in the level of microplastics in drinks remains to be explored, except for drinks contained in glass bottles with caps.

#### Plastic particles in drinks come from the paint on the caps

The scientists investigated the origin of the microplastics found in drinks packaged in glass bottles with caps. Given their characteristics, they concluded that these particles probably came from the metal caps, and more specifically from the paint that covered them. The first clue: the microplastics found in the drinks were mostly the same colour and had the same composition as the paint on the caps. The second clue: the paint on these caps had tiny scratches that were invisible to the naked eye and had probably been caused by friction between the caps when they were stored before use. This friction, which released particles from the surface of the caps, was thought to be the source of the microplastics found.

#### Clean caps before sealing bottles to reduce the level of microplastics

To confirm the route of contamination of drinks in glass bottles and explore the possibility of reducing microplastic levels, the laboratory tested the effects of different cleaning operations. "We studied three scenarios" explains the PhD student. "We cleaned the bottles and filled them with filtered water so that no microplastics could be detected, then we placed caps on the bottles without treating the caps, after blowing on

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the caps with an air bomb, or after blowing air and rinsing the caps with filtered water and alcohol".

The result? While an average of 287 particles per litre were found in the water of the bottles sealed with uncleaned caps, this number decreased significantly, to 106 particles per litre, when air was blown on the caps before they were placed on the bottles. It fell further to 87 particles per litre when blowing was followed by rinsing.

To prevent plastic particles from being released into drinks contained in bottles sealed with caps, manufacturers could also explore other lines of action, such as changing the conditions in which the caps are stored before use, to avoid friction, or modifying the composition of the paint used on the caps.

Technology Networks, 23 June 2025

https://technologynetworks.com

#### Massive thread of hot gas found linking galaxies — and it's 10 times the mass of the Milky Way 2025-06-19

Astronomers have discovered a huge filament of hot gas bridging four galaxy clusters. At 10 times as massive as our galaxy, the thread could contain some of the Universe's 'missing' matter, addressing a decades-long mystery.

The astronomers used the European Space Agency's XMM-Newton and JAXA's Suzaku X-ray space telescopes to make the discovery.

Over one-third of the 'normal' matter in the local Universe - the visible stuff making up stars, planets, galaxies, life - is missing. It hasn't yet been seen, but it's needed to make our models of the cosmos work properly.

Said models suggest that this elusive matter might exist in long strings of gas, or filaments, bridging the densest pockets of space. While we've spotted filaments before, it's tricky to make out their properties; they're typically faint, making it difficult to isolate their light from that of any galaxies, black holes, and other objects lying nearby.

New research is now one of the first to do just this, finding and accurately characterizing a single filament of hot gas stretching between four clusters of galaxies in the nearby Universe.



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"For the first time, our results closely match what we see in our leading model of the cosmos - something that's not happened before," says lead researcher Konstantinos Migkas of Leiden Observatory in the Netherlands. "It seems that the simulations were right all along."

#### XMM-Newton on the case

Clocking in at over 10 million degrees, the filament contains around 10 times the mass of the Milky Way and connects four galaxy clusters: two on one end, two on the other. All are part of the Shapley Supercluster, a collection of more than 8000 galaxies that forms one of the most massive structures in the nearby Universe.

The filament stretches diagonally away from us through the supercluster for 23 million light-years, the equivalent of traversing the Milky Way end to end around 230 times.

Konstantinos and colleagues characterized the filament by combining X-ray observations from XMM-Newton and Suzaku, and digging into optical data from several others.

The two X-ray telescopes were ideal partners. Suzaku mapped the filament's faint X-ray light over a wide region of space, while XMM-Newton pinpointed very precisely contaminating sources of X-rays - namely, supermassive black holes - lying within the filament.

"Thanks to XMM-Newton we could identify and remove these cosmic contaminants, so we knew we were looking at the gas in the filament and nothing else," adds co-author Florian Pacaud of the University of Bonn, Germany. "Our approach was really successful, and reveals that the filament is exactly as we'd expect from our best large-scale simulations of the Universe."

#### Not truly missing

As well as revealing a huge and previously unseen thread of matter running through the nearby cosmos, the finding shows how some of the densest and most extreme structures in the Universe - galaxy clusters - are connected over colossal distances.

It also sheds light on the very nature of the 'cosmic web', the vast, invisible cobweb of filaments that underpins the structure of everything we see around us.

"This research is a great example of collaboration between telescopes, and creates a new benchmark for how to spot the light coming from the faint

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filaments of the cosmic web," adds Norbert Schartel, ESA XMM-Newton Project Scientist.

"More fundamentally, it reinforces our standard model of the cosmos and validates decades of simulations: it seems that the 'missing' matter may truly be lurking in hard-to-see threads woven across the Universe."

Piecing together an accurate picture of the cosmic web is the domain of ESA's Euclid mission. Launched in 2023, Euclid is exploring this web's structure and history. The mission is also digging deep into the nature of dark matter and energy - neither of which have ever been observed, despite accounting for a whopping 95% of the Universe - and working with other dark Universe detectives to solve some of the biggest and longest-standing cosmic mysteries.

Science Daily, 19 June 2025

https://sciencedaily.com







# **Technical Notes**

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Radiological and chemical hazards of persistent organic pollutants in the textile sector

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The impacts of long-term carbon disulfide exposure on glucose homeostasis and type 2 diabetes: a multifaceted gene-environmentlifestyle interaction study of Chinese adults

Exploring the Nutrient Nexus in Environmental Systems: Nitrogen and Phosphorus Cycling, Removal, Recovery, and Management

Comprehensive Profiling of Phthalic Acid Esters (PAEs) in Air-Conditioning Filters from Diverse Indoor Environments Across 12 Major Cities in China

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Effects of web-based behavioral intervention on fine particulate matter, pulmonary function, and airway inflammation in children: The COCOA randomized controlled trial

<u>Short Communication: Simultaneous Removal of Co-occurring</u> <u>Contaminants Reduces Drinking Water-Attributed Cancer Risk: A United</u> <u>States Case Study</u>

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An evaluation of potential sources of toxic metals in the poultry industry in Bangladesh: Dietary exposure and toxicological implications

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