CHEMWATCH

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ASIA PACIFIC

Agricultural chemical products and approved labels

2026-02-10

Pursuant to the Agricultural and Veterinary Chemicals Code scheduled to the Agricultural and Veterinary Chemicals Code Act 1994, the APVMA hereby gives notice that it has registered or varied the relevant particulars or conditions of the registration in respect of the following products and has approved the label or varied the relevant particulars or conditions of the approval in respect of the containers for the chemical product, with effect from the dates shown.

Table 1: Agricultural products based on existing active constituents

Application no.	149842
Product name	QA Trifluralin 480 EC Herbicide
Active constituent	480 g/L trifluralin
Applicant name	Quantum Agrosciences Holdings Pty Ltd
Applicant ACN	680 792 625
Date of registration	20 January 2026
Product registration no.	96548
Label approval no.	96548/149842
Description of the application and its purpose, including the intended use of the chemical product	Registration of a 480 g/L trifluralin product, formulated as an emulsifiable concentrate (EC) for the control of annual grasses and broadleaf weeds in horticultural and agricultural crops

Read More

APVMA, 10-02-26

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-3-10-feb-26

Veterinary chemical products and approved labels

2026-02-10

Pursuant to the Agricultural and Veterinary Chemicals Code scheduled to the Agricultural and Veterinary Chemicals Code Act 1994, the APVMA hereby gives notice that it has registered or varied the relevant particulars or conditions of the registration in respect of the following products and has approved the label or varied the relevant particulars or conditions of the approval in respect of the containers for the chemical product, with effect from the dates shown.

Table 4: Veterinary products based on existing active constituents

Application no.	150387
Product name	Ketomed 100 mg/mL Injection for Cattle and Horses
Active constituent	100 mg/mL ketoprofen
Applicant name	Bimeda (Australia) Pty Limited
Applicant ACN	058 196 508
Date of registration	20 January 2026
Product registration no.	96679
Label approval no.	96679/150387
Description of the application and its purpose, including the intended use of the chemical product	Registration of a 100 mg/mL ketoprofen injection for the treatment of inflammation and pain in cattle and horses

Read More

APVMA, 10-02-26

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-3-10-feb-26

Approved active constituents

2026-02-10

Pursuant to the Agricultural and Veterinary Chemicals Code scheduled to the Agricultural and Veterinary Chemicals Code Act 1994, the APVMA hereby gives notice that it has approved or varied the relevant particulars or conditions of the approval of the following active constituents, with effect from the dates shown.

Table 6: Approved active constituents

Application no.	148776
Active constituent	Saflufenacil
Applicant name	Anhui Jiuyi Agriculture Co., Ltd.
Applicant ACN	N/A
Date of approval	19 January 2026
Approval no.	96275
Description of the application and its purpose, including the intended use of the active constituent	Approval of the active constituent saflufenacil for use in agricultural chemical products

Read More

APVMA, 10-02-26

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-3-10-feb-26

New veterinary chemical product containing a new veterinary active constituent

2026-02-10

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has before it an application for the registration of a new product, Tessie 0.3 mg/mL Oral Solution for Dogs, containing a new active constituent, TASIPIMIDINE SULFATE.

Mavlab Animal Health Pty Ltd is seeking the registration of the Tessie 0.3 mg/mL Oral Solution for Dogs containing 0.3 mg/mL tasipimidine (equivalent to 0.427 mg/mL TASIPIMIDINE SULFATE) for the short-term alleviation of situational anxiety and fear in dogs triggered by noise or owner departure, in conjunction with approval of TASIPIMIDINE SULFATE as a new active constituent.

TASIPIMIDINE SULFATE

As part of the application to register the product containing TASIPIMIDINE SULFATE, the APVMA has evaluated the safety of the new active constituent, TASIPIMIDINE SULFATE.

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APVMA, 10-02-26

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-3-10-feb-26

AMERICA

Introducing amendments to regulations under Part II of the Canada Labour Code

2026-02-11

Amendments to regulations under Part II of the Canada Labour Code (Code)

As of February 2026, several amendments to Regulations made under the Canada Labour Code (Code) Part II will be published and will come into effect in February 2027. These changes aim to modernize protective measures to better manage emerging workplace risks. Here are the key revised obligations in preparation for the update.

Key revised obligations

1. **Record of Hazardous Substances**

Employers will be required to maintain a record of hazardous substances used, produced, handled, or stored in the work place, including those used, produced, handled, or stored in the work place by contractors. Therefore, hazardous substances related to contractors will need to be added to the existing register.

Information regarding the hazardous substances register can be found in the Guide to Management: Hazardous Substances.

2. **Measurement of Contaminant Concentrations**

Regarding the measurement of chemical agents' concentrations in the air, as well as airborne asbestos fibers that may exceed zero, it will now be required to conduct analyses in the breathing zone of employees most exposed to the highest levels of these contaminants. Furthermore, the approved methods for sampling have been updated to reflect current approaches and to ensure better adaptability to emerging risks.

Information regarding the measurement of contaminant concentrations can be found in the Canadian Occupational Chemical Agent Compliance Sampling Guideline.

3. **Maintaining Chemical Agent Concentrations**

Employers will be required to ensure that the concentration of a chemical agent in the air is kept as low as reasonably achievable when no values have been established by the American Conference of Governmental Industrial Hygienists (ACGIH) in its publication entitled Threshold Limit Value (TLVs) and Biological Exposure Indices (BEIs). This requirement will not apply to airborne dust from grains and flour, nor to airborne asbestos fibers.

Information regarding maintaining chemical agent concentrations can be found in the Canadian Occupational Chemical Agent Compliance Sampling Guideline.

Read More

Government of Canada, 11-02-26

https://www.canada.ca/en/employment-social-development/services/health-safety/reports/amendments-regulations-part-ii.html

As Congress debates changes to the federal chemical safety law, North Carolina's PFAS crisis offers a warning

2026-02-09

North Carolina's struggle with PFAS contamination underscores the unintended consequences that can follow widespread chemical use — even as Congress is considering overhauling the nation's foremost chemical safety law.

That law, the Toxic Substances Control Act, governs how industrial chemicals are reviewed and regulated in the United States. Passed in 1976 and overhauled by a Republican Congress in 2016, the chemical safety law sets standards for the data companies must provide, the timeline federal regulators have to review new chemicals and whether substances can enter commerce.

U.S. Environmental Protection Agency Administrator Lee Zeldin has defended proposed changes to TSCA as a way to make chemical reviews more predictable and efficient while maintaining safety standards. In announcing the proposal, Zeldin said the agency aims to provide "a clear,

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predictable, commonsense approach that's grounded in the law and the science." He added that reforms are intended to protect health and the environment while allowing American manufacturing to thrive.

Read More

NC Health News, 09-02-26

https://www.northcarolinahealthnews.org/2026/02/09/congress-tsca-pfas-north-carolina/

States Implement Bans on "Intentionally Added" PFAS in Consumer Products

2026-02-09

Washington and New Jersey have passed regulations to prohibit per- and polyfluoroalkyl substances (PFAS) in consumer products. Washington's Safer Products for Washington Program will eventually ban certain consumer products with "intentionally added" PFAS. Starting on January 1, 2026, manufacturers must report the intentional use of PFAS in certain product categories such as footwear, hard surface cleaners, and cookware and kitchen supplies. Similarly, New Jersey's regulation, which takes effect in 2028, will restrict the sale of intentionally added PFAS in consumer products and require labeling for consumer-grade cookware containing PFAS.

These states are not the first to implement regulations targeting consumer products with intentionally added PFAS. Maine, Minnesota, and New Mexico have also developed regulations to phase out intentionally added PFAS in consumer products. These regulations broadly define "intentionally added" to mean PFAS that a manufacturer deliberately adds to a product or component. The definition of what constitutes "intentionally added," however, remains largely undefined.

Read More

JDSupra, 09-02-26

https://www.jdsupra.com/legalnews/states-implement-bans-on-intentionally-9990791/

Plastic Pollution and Recycling Modernization Act

2026-02-13

The Plastic Pollution and Recycling Modernization Act will update Oregon's outdated recycling system by building on local community programs and leveraging the resources of producers to create an innovative system that works for everyone. The Oregon legislature passed the Recycling Modernization Act (Senate Bill 582) during the 2021 legislative session. The new law became effective Jan. 1, 2022 and recycling program changes will start in July 2025.

About the new law

This system-wide update will make recycling easier for the public to use, expand access to recycling services, upgrade the facilities that sort recyclables, and create environmental benefits while reducing social and environmental harms, such as plastic pollution. Producers and manufacturers of packaged items, paper products and food serviceware will pay for many of these necessary improvements and help ensure recycling is successful in Oregon.

Read More

Oregon.gov, 13-02-26

https://www.oregon.gov/deq/recycling/pages/modernizing-oregons-recycling-system.aspx

Butylated Hydroxyanisole (BHA); Request for Information

2026-02-11

ACTION:

Notice; request for information.

SUMMARY:

The Food and Drug Administration (FDA or we) is requesting information on the current uses and safety data of butylated hydroxyanisole (BHA) in human food and as a food contact substance. We are requesting this information as part of our systematic process for conducting post-market assessments of chemicals in food. We are conducting a post-market assessment of the safety of BHA in food, considering the latest state of the science. We intend to use the information received and any other available,

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relevant information to determine if BHA remains safe under its current conditions of use in food and as a food contact substance.

DATES:

Either electronic or written comments and scientific data and information on the notice must be submitted by April 13, 2026.

Read More

US FDA, 11-02-26

https://www.federalregister.gov/documents/2026/02/11/2026-02761/butylated-hydroxyanisole-bha-request-for-information

EUROPE

Pesticides found in 70% of European soils, harming beneficial life: Study

2026-02-05

For farmers, sometimes the easiest way to save a crop or prevent catastrophic insect damage is to spray a pesticide. But this common practice is wreaking havoc on the soil, according to new research published recently in the journal Nature.

The study examined soil from 26 European countries, finding that pesticide contamination is widespread beyond agricultural lands and substantially damages the beneficial soil organisms essential for healthy ecosystems.

Researchers found pesticide residues in 70% of the 373 soil samples collected from agricultural fields, grasslands and forests. The contamination emerged as the second-strongest factor shaping soil biodiversity patterns, surpassed only by basic soil properties like texture and pH.

Read More

Mongabay, 06-02-26

https://news.mongabay.com/2026/02/pesticides-found-in-70-of-european-soils-harming-beneficial-life-study/

Consultation response: HSE chemicals legislative reform proposals

2026-02-12

HSE has published its response to its consultation on proposed reforms to chemicals legislation in Great Britain (GB).

The public consultation took place between 23 June 2025 and 18 August 2025 and sought views on HSE's proposals to update 3 chemicals regulations for which is it responsible:

- GB Biocidal Products Regulation (GB BPR)
- GB Classification, Labelling and Packaging (GB CLP)
- GB Prior Informed Consent for the export and import of hazardous chemicals (GB PIC)

The response includes consideration of using powers in the Retained EU Law (Revocation and Reform) Act 2026 to make legislative changes.

Read More

HSE UK, 12-02-26

https://consultations.hse.gov.uk/hse/chemicals-legislative-reform-proposals/

Occupational Exposure Limits for Nanomaterials

2026-02-13

Nanomaterials are increasingly used across a wide range of industries due to their unique properties, such as enhanced mechanical resistance, optical properties, and improved electrical conductivity. Key sectors benefiting from these properties include cosmetics, healthcare, textiles, and electronics. The global nanomaterials market, valued at approximately €9 billion in 2020, is projected to exceed € 30 billion by 2029.1 According to the French nanomaterials register R-nano2, some of the most widely used nanomaterials are silicon dioxide, carbon black, titanium dioxide, calcium carbonate, and aluminium oxide. Although data on the number of exposed workers are scarce, the rapid expansion of the market suggests a growing number of workers exposed to ENMs at their workplaces, raising questions about their protection against adverse health impacts. Occupational exposure is typically higher than public exposure, as nanomaterials are often handled during product manufacturing processes (e.g., coating, painting, embedding nanomaterials in a matrix), even if the final consumer product does not contain them in the free form. The

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most common exposure pathways are inhalation, dermal exposure, ocular contact, and ingestion. This dossier will focus on inhalation, which is the most common exposure route and the primary source of potential adverse health outcomes.

Read More

ITA, 13-02-26

https://epub.oeaw.ac.at/0xc1aa5572_0x004148b5.pdf

INTERNATIONAL

Hair extensions may contain chemicals linked to cancer and reproductive issues

2026-02-11

Dozens of hair extensions—including artificial and natural braids—may contain synthetic chemicals that are a health and environmental hazard, a new study shows. At least 12 of the 169 chemicals detected in the new analysis have been associated with cancer, birth defects and reproductive issues and are included in California's Proposition 65 hazardous chemicals list.

The study, published today in Environment & Health, tested 43 hair extensions, including those made with synthetic hair, as well as untreated "raw" human hair and other biobased hair, such as those made from banana-based fibers. All but two of the products contained a hazardous chemical, and nearly 10 percent of them had organotin compounds—synthetic chemicals linked to endocrine-disrupting effects. Some had concentrations above the European Union limits. More research is needed, however, for government agencies to determine whether the chemical levels found in these products requires greater regulation, the study authors say.

Read More

Scientific American, 11-02-26

https://www.scientificamerican.com/article/hair-extensions-may-contain-chemicals-linked-to-cancer-and-reproductive/

Industry's 2025 lobby blitz to undermine chemicals policy reform

2026-02-11

Reform of the EU's chemicals safety rules (REACH) has been on the European Commission's agenda since 2020. But an intensive industry backlash, including throughout 2025 as exposed by this report, has drowned out the health and environmental urgencies to get tough on harmful chemicals. Industry's spin and privileged access to the highest levels of the Commission, alongside the current EU hostility to new green rules and mania for deregulation, appear to have fatally undermined a key European Green Deal ambition.

There can be no better symbol of the corporate influence of the chemicals industry than the industry summit being held in Antwerp today (11 February) when Commission President Ursula von der Leyen is expected to report back on how much she has delivered for big business. With industry demands ringing in her ears she will then hotfoot it to the Belgian countryside where the informal European Council summit on 12 February will discuss ideas from the German and Italian governments to further roll back EU social and environmental rules.

Read More

Corporate Europe Observatory, 11-02-26

https://corporateeurope.org/en/2026/02/reaching-out

One in five hazardous mixtures not reported to poison centres

2026-02-11

ECHA Forum's pilot enforcement project found that 19 % of the checked hazardous mixtures were not notified to poison centres.

11 February 2026 – Inspectors in 18 EU/EEA countries checked 1 597 mixtures to verify whether industry complies with the obligation to notify hazardous mixtures to national poison centres. This is regulated under the EU's Classification, Labelling and Packaging (CLP) Regulation. These notifications are crucial for poison centres to provide an adequate medical response in case of exposure to hazardous mixtures. Of all checked mixtures, 19 % were not notified to the authorities.

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The pilot project also aimed to raise the duty holders' awareness of their legal obligations, for example, to place the Unique Formula Identifier (UFI) on the label of their products. The 16-digit, alphanumerical UFI code is a vital tool used by the poison centres to rapidly identify a mixture following an accidental poisoning. In 15 % of inspected mixtures, the required UFI was missing from the product label.

Read More

ECHA, 11-02-26

https://echa.europa.eu/nl/-/one-in-five-hazardous-mixtures-not-reported-to-poison-centres

Janet's Corner

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Who Am I?

2026-02-20

I am the heaviest naturally occurring element that is *not* significantly radioactive, a metal whose density rivals that of Gold and Platinum.

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

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Hazard Alert

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Sulfur Dioxide

2026-02-20

Sulfur dioxide (also sulphur dioxide) is the chemical compound with the formula SO_2. It is a colourless gas with a pungent, irritating and rotten odour. Sulfur dioxide is non-flammable and

reacts easily with other substances to form harmful compounds, such as sulfuric acid, sulfurous acid and sulfate particles.

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 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,

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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 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

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.

REGULATION

United States

OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-1	**5 ppm (13 mg/m³) TWA**	**HE14**	**Upper respiratory irritation, nosebleeds**
OSHA PEL - Construction Industry See 29 CFR 1926.55 Appendix A	**5 ppm (13 mg/m³) TWA**	**HE14**	**Upper respiratory irritation, nosebleeds**
OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	**5 ppm (13 mg/m³) TWA**	**HE14**	**Upper respiratory irritation, nosebleeds**
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	**2 ppm (5 mg/m³) TWA 5 ppm (13 mg/m³) STEL**	**HE4**	**Blindness**
		HE9	
		HE11	**Breathing difficulties**
		HE14	**Eye and respiratory irritation, eye and skin burning**
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2009)	**0.25 ppm (0.65 mg/m³) STEL A4**	**HE9**	
		HE10	**Decreased lung function, chronic respiratory symptoms**
		HE11	**Lower respiratory irritation and symptoms**
		HE14	**Upper respiratory irritation**

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

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

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

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4. http://www.atsdr.cdc.gov/phs/phs.asp?id=251&tid=46
5. http://avogadro.chem.iastate.edu/msds/sulfur_dioxide.pdf
6. https://www.osha.gov/dts/chemicalsampling/data/CH_268500.html
7. http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/639/Workplace_Exposure_Standards_for_Airborne_Contaminants.pdf

Cheaper green hydrogen? New catalyst design cuts energy losses in AEM electrolyzers

2026-02-19

Producing clean hydrogen from water is often compared to storing renewable energy in chemical form, but improving the efficiency of that process remains a scientific challenge. Researchers at Tohoku University have now developed a catalyst design that helps hydrogen form more smoothly under alkaline conditions, a key step toward practical green hydrogen production.

The work is published in the journal ACS Catalysis.

Balancing key steps in hydrogen evolution

Hydrogen generation in alkaline water electrolysis depends on the hydrogen evolution reaction (HER). In anion exchange membrane water electrolysis (AEMWE), this reaction involves two tightly connected steps: splitting water molecules and forming hydrogen gas. If either step slows down, overall performance suffers.

Many existing catalysts improve only one of these steps. Only a partial increase in efficiency can have a detrimental impact on overall output. It is similar to an assembly line where one worker moves faster but the next cannot keep up. To address this imbalance, the research team focused on coordinating both steps at the same time.

The researchers proposed an auxiliary-driving strategy that combines ruthenium (Ru) with vanadium dioxide (VO_2). By surrounding Ru active sites with VO_2, the catalyst is designed to consecutively optimize both the water dissociation step (Volmer step) and the hydrogen formation step (Heyrovsky step).

At the interface between Ru and VO_2, the formation of V-O-Ru conjugated π-bonds dynamically adjusts the electronic structure of the active sites. This promotes faster water dissociation. At the same time, a reversible hydrogen spillover process helps regulate hydrogen adsorption, bringing the catalyst closer to optimal reaction conditions predicted by microkinetic models.

Performance gains in devices and metrics

Under identical testing conditions, the new catalyst showed higher hydrogen evolution activity than conventional Ru/C and Pt/C catalysts. It achieved an overpotential of 12 mV at 10 mA cm^{-2} and a turnover frequency of 12.2 s^{-1}, indicating efficient hydrogen production with low energy loss.

The team also evaluated the catalyst in a working AEMWE device. Using distribution of relaxation time (DRT) analysis, they confirmed that the improved reaction kinetics observed in laboratory tests translated to device-level performance.

"This auxiliary-driving concept allows us to coordinate multiple reaction steps rather than optimizing them separately," said Yizhou Zhang, associate professor at Tohoku University's Advanced Institute for Materials Research. "By engineering the interface between Ru and VO_2, we can improve overall reaction kinetics in alkaline hydrogen evolution."

Implications for green hydrogen and data access

More efficient and durable electrolyzers can reduce the electricity required to produce hydrogen and extend system lifetime. Lowering the cost of green hydrogen could support its broader use in sectors such as steel production, chemical manufacturing, shipping, and large-scale energy storage.

The researchers plan to further refine the interfacial structure and explore whether the auxiliary-driving strategy can be applied to other catalytic systems.

All the key experimental and computational data are also uploaded to the Digital Catalysis Platform, the largest catalysis database to date developed by the Hao Li Lab.

Phys Org, 19 February 2026

https://phys.org

Water can turn into a superacid that makes diamonds

2025-03-24

Water may transform into a superacidic fluid under extreme heat and pressure. These conditions are found only in Earth's interior, within icy planets like Uranus and Neptune – and possibly in controlled laboratory experiments.

"Under immense pressures and temperatures, water exhibits a remarkable property – it becomes an exceptionally potent acid, also known as a 'superacid', which can be billions or even trillions of times stronger than sulphuric acid," says Flavio Siro Brigiano at Sorbonne University in France.

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This superacid transformation appears to occur at temperatures between 1727°C and 2727°C (3140-4940°F) and at intense pressures of 22 to 69 gigapascals. For comparison, 2727°C is the temperature of sunspots on the sun's surface, and 50 gigapascals would correspond to "having 100 elephants standing on the tip of your finger", says Siro Brigiano.

He and his colleagues made this discovery using computer simulations that model the motions of atoms and chemical reactions. They also trained a machine learning model on the simulation results and used it to perform additional calculations in a more computationally efficient way.

The simulations also showed how, under the same extreme conditions, the superacidic water can turn hydrocarbon molecules such as methane into diamond-like structures such as methanium, a chemical transformation previously studied in other superacid solutions. This aspect of water's chemistry may explain earlier research that suggests icy giant planets, including Uranus and Neptune, experience diamond rain, says coauthor Arthur France-Lanord at the French National Centre for Scientific Research.

Superacidic water could also find practical applications like inspiring future lab processes for creating diamonds or even replacing traditional superacids in industrial processes such as petroleum refining, says France-Lanord.

The description of water's superacid transformation is "intriguing", but the real-world applications may be limited by the need for extreme conditions, says Joel Bowman at Emory University in Atlanta, Georgia. And superacidic water's relationship with diamond rain also remains speculative, he says.

A next big step would be to collect direct experimental evidence for water's superacid chemistry, says France-Lanord. He and his colleagues are exploring ways to do that in the lab, at lower pressures and temperatures – which could also make practical applications more feasible.

New Scientist, 24 March 2025

https://newscientist.com

Breakthrough Calcium-Ion Battery Could Challenge Lithium for Clean Energy

2026-02-16

A next-generation calcium battery breakthrough could challenge lithium and transform clean energy storage.

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A research team at The Hong Kong University of Science and Technology (HKUST) has reported a major advance in calcium-ion battery (CIB) development that could influence how energy is stored in everyday technologies. By integrating quasi-solid-state electrolytes (QSSEs), the scientists created a new type of CIB designed to improve both performance and environmental sustainability.

The innovation could support renewable energy storage, electric vehicles, and other power-hungry applications. The results were published in Advanced Science in a paper titled "High-Performance Quasi-Solid-State Calcium-Ion Batteries from Redox-Active Covalent Organic Framework Electrolytes."

Growing Demand for Lithium Alternatives

As global investment in renewable energy accelerates, the need for dependable, high-capacity batteries continues to rise. Lithium-ion batteries (LIBs) currently dominate the market, but concerns about limited lithium supplies and constraints in energy density have pushed researchers to search for alternatives. Exploring battery chemistries beyond lithium has become increasingly important for long-term energy security and sustainability.

Calcium-ion batteries offer several advantages. Calcium is widely available, and CIBs operate within an electrochemical window comparable to that of LIBs. Despite this promise, practical challenges have slowed their progress. Efficient movement of calcium ions inside the battery has been difficult to achieve, and maintaining stable performance over repeated charging cycles has proven problematic. These limitations have prevented CIBs from competing directly with commercial lithium-ion systems.

Redox Covalent Organic Framework Electrolytes

To address these technical barriers, the team led by Prof. Yoonseob KIM, Associate Professor in the Department of Chemical and Biological Engineering at HKUST, developed redox covalent organic frameworks that function as QSSEs. These carbonyl-rich QSSEs achieved strong ionic conductivity (0.46 mS cm−1) and Ca2+ transport capability (>0.53) at room temperature.

Through a combination of laboratory experiments and computational simulations, the researchers determined that Ca2+ ions move quickly along aligned carbonyl groups within the ordered pores of the covalent

organic frameworks. This structured pathway enables faster ion transport and contributes to improved battery stability.

High Performance Over 1,000 Cycles

Using this approach, the team built a full calcium-ion battery cell that delivered a reversible specific capacity of 155.9 mAh g–1 at 0.15 A g–1. Even at 1 A g–1, the cell retained more than 74.6% of its capacity after 1,000 charge and discharge cycles. These results demonstrate the potential of redox covalent organic frameworks to significantly strengthen CIB technology and move it closer to practical use.

Prof. Kim said, "Our research highlights the transformative potential of calcium-ion batteries as a sustainable alternative to lithium-ion technology. By leveraging the unique properties of redox covalent organic frameworks, we have taken a significant step towards realizing high-performance energy storage solutions that can meet the demands of a greener future."

Sci Tech Daily, 16 February 2026

https://scitechdaily.com

Metals can be squeezed into sheets just a few atoms thick

2025-03-12

Sheets of bismuth, gallium, indium, tin and lead can now be made just a few atoms thick by crushing them at a high temperature and pressure between two sapphires

Sheets of metal just two atoms thick can be produced by squashing molten droplets at great pressure between two sapphires. The researchers who developed the process say the unusual materials could have applications in industrial chemistry, optics and computers.

Last year, scientists created a gold sheet that was a single atom thick, which they dubbed "goldene" after graphene, a material made of a single layer of carbon atoms. Such materials have been described as two-dimensional, as they are as thin as chemically possible.

But making other 2D metals hadn't been possible until now. The new technique, developed by Luojun Du at the Chinese Academy of Sciences and his colleagues, can create 2D sheets of bismuth, gallium, indium, tin and lead that are as thin as their atomic bonds allow.

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To squeeze the metal, the researchers used two extremely flat sapphire crystals with a thin layer of molybdenum disulfide (MoS2) as the jaws of a vice. They placed powdered metal between these jaws, heated it up to 400°C until it formed a droplet, then crushed it at an enormous pressure of up to 200 megapascals. The metal was compressed until it was a few atoms thick – or, in the case of bismuth, just two – then allowed to cool. When the pressure was removed, the 2D metal was sandwiched between the MoS2 sheets, which then slipped away from the sapphires.

Du says the process was conceived eight years ago, but only recently bore fruit when the team discovered that the MoS2 layers kept the thin metal sheets stable. "A single layer of free-standing metal atoms is simply unstable from a thermodynamic point of view. Therefore, we [had to] develop entirely new techniques," says Du. "The process seems simple, but it works."

As well as making extremely thin layers of atoms, the researchers were able to fine-tune the squeezing pressure and make metal plates three, four or more atoms thick with precision.

2D metals could have unusual properties that help scientists explore macroscopic quantum phenomena and superconductivity, says Du, and may lead to ultra-low power transistors, transparent displays for computers and extremely efficient catalysts for chemical reactions.

One issue is that the MoS2 encapsulating the metal sheet can't be easily removed. Du says this may be problematic for some applications, but experiments suggest they don't affect electrical conductivity, so they wouldn't prevent the 2D metal being used in electronic devices.

New Scientist, 12 March 2025

https://newscientist.com

Scientists unlock a massive new 'color palette' for biomedical research by synthesizing non-natural amino acids

2026-02-19

Ozempic has been making headlines for its remarkable success in treating obesity and diabetes. Yet it is just one in a rapidly growing class of drugs called peptide therapeutics that sits between small molecules (like aspirin) and biologics (like antibodies). A UC Santa Barbara research team has developed a technique for efficiently synthesizing non-natural amino

acids and applying them to peptide construction. They hope that the methodology, published in the Journal of the American Chemical Society, will significantly advance peptide research, giving scientists greater access to amino acids beyond the 22 found in nature.

"The key advantage is that these amino acids come out of the process already in a form that can be used directly to make peptides, without extra modification steps," said first author Phil Kohnke, a doctoral student in senior author Liming Zhang's lab in the Department of Chemistry & Biochemistry. "Compared to existing approaches, this is one of the most straightforward and broadly useful methods reported so far."

The machinery of life

Amino acids are the building blocks of proteins, making them among the most fundamental biological molecules. Linking together 10 to 50 amino acids produces a peptide. While proteins are longer, more complex and may consist of multiple peptides.

Similar to stacking cups, these building blocks fit together in only one orientation: The amino group of one always links to the carboxylic acid group of another. And just like making color patterns in the stack of cups, the order of amino acids is a defining characteristic of peptides and proteins.

Although there are hundreds of types of amino acids, only 22 are naturally used by lifeforms to build proteins. These include 20 canonical flavors that are coded for in our DNA, and two that are produced by other mechanisms. "Nature uses these to great effect," said Zhang.

Scientists can already produce natural amino acids cheaply. "But we have developed an efficient chemical synthesis for making non-natural or noncanonical amino acids in a way that they can be used directly for peptide synthesis," Zhang said.

A two-step technique

The recently published paper details a new technique for synthesizing amino acids and then binding them together into peptides using a resin scaffold. The team uses gold catalysis to create amino acids from cheap, readily available chemical ingredients. The technique is highly stereoselective, meaning that it can produce amino acids with a specific handedness instead of an undesired mixture of right-handed and left-handed ones.

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Getting amino acids to link together requires exposing and priming the reactive sites. This fact is an asset to chemists, because it enables them to connect the molecules in the proper sequence for the peptide they intend to make. Current synthetic techniques require removing the constituent that shields the amino group as well as activating the acid group during peptide synthesis. However, their method produces amino acids where the acid group is already primed to react; only the amino group requires unmasking.

Similar to the Zhang lab's recent work on oligosaccharides, the team used a resin scaffold to assemble peptides from the amino acids. The framework attaches to one side of the growing peptide, enabling them to add amino acids one by one to the molecule in a rinse-and-repeat process. "We basically attach things to resin and then just grow the chain," he said.

This technique is popular in industry because it greatly simplifies the purification process. Rather than go through the tedious effort of purifying the peptides from a solution, the molecules can be cleaved from the scaffold and washed off. "Our method can be ported into this process with very little friction or accommodation," Kohnke added.

Expanding availability and opening opportunities

Having access to more amino acids opens up entirely new possibilities for biochemists, medical researchers and materials scientists. It's like swapping out a 22-color box of crayons for a palate of 500 different hues.

But making non-natural amino acids is often difficult, expensive or impractical. "Many existing methods either involve many time-consuming steps, only work for a narrow set of molecules, or require further manipulations before being ready for peptide synthesis," Kohnke said. The new technique mostly solves these problems, easily and cheaply producing amino acids that are immediately useful for peptide synthesis.

Zhang is particularly interested in developing new peptide therapeutics. Peptides have found use in over 80 drugs worldwide since insulin was first synthesized in the 1920s, which changed type 1 diabetes from a death sentence to an entirely manageable condition.

While natural peptides are effective, they are fragile—enzymes in the body can destroy them quickly. "By incorporating non-natural amino acids, drug designers can 'armor-plate' the peptide against enzymes or force it into a specific shape to lock onto a receptor better," Zhang explained.

Ozempic itself is one particular success of this approach, containing one non-natural amino acid, in addition to a fatty acid side chain.

The Zhang lab is currently working to automate the process. Realizing the full potential of non-natural amino acids will require making them readily available to non-chemists. On that note, they are actively looking to collaborate with other research teams in making the technique more accessible to drug development and materials research.

Phys Org, 19 February 2026

https://phys.org

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

2025-11-25

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

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

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

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

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

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Understanding the Role of the Electrolyte

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

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

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

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

The Breakthrough: Scandium-Doped Oxides

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

"Structural analysis and molecular dynamics simulations revealed that the Sc atoms link their surrounding oxygens to form a 'ScO_6 highway,' along which protons travel with an unusually low migration barrier. This pathway is both wide and softly vibrating, which prevents the proton-trapping that normally plagues heavily doped oxides," explains Yamazaki. "Lattice-dynamics data further revealed that BaSnO3 and BaTiO3 are intrinsically 'softer' than conventional SOFC materials, letting them absorb far more Sc than previously assumed."

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

"Beyond fuel cells, the same principle can be applied to other technologies, such as low-temperature electrolyzes, hydrogen pumps, and reactors that convert CO2 into valuable chemicals, thereby multiplying the impact of decarbonization. Our work transforms a long-standing scientific paradox into a practical solution, bringing affordable hydrogen power closer to everyday life," concludes Yamazaki.

Sci Tech Daily, 25 November 2025

https://scitechdaily.com

Babies Are Exposed to More PFAS in the Womb Than Previously Thought

New analysis reveals babies are exposed to far more PFAS before birth than was previously believed.

Babies born between 2003 and 2006 were exposed to many more "forever chemicals" before birth than scientists previously understood, according to new research published in Environmental Science & Technology.

Thousands of these chemicals, known as per- and polyfluoroalkyl substances or PFAS, remain in use today, and their human health effects are poorly understood-making it crucial to better understand cumulative PFAS exposure in utero.

The study, led by Shelley H. Liu, PhD, Associate Professor of Population Health Science and Policy at the Icahn School of Medicine at Mount Sinai, is the first to use a data science–based method to estimate a newborn's total PFAS exposure, drawing on advanced chemical detection in umbilical cord blood.

PFAS are a large class of man-made chemicals used in products such as nonstick cookware, stain-resistant fabrics, food packaging, and firefighting foams. They are often called "forever chemicals" because they persist in the environment and the human body.

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What the researchers found

The researchers measured PFAS in archived umbilical cord blood samples collected between 2003 and 2006 from 120 babies in the HOME Study, based in Cincinnati. Looking back two decades allowed the researchers to create a new tool that can be linked to health outcomes in the now-adolescent study participants, which will be a focus of future research.

Using a newer, non-targeted chemical analysis method - a technique that scans for hundreds to thousands of chemicals at the same time rather than testing for a short, predefined list - the research team detected many more PFAS chemicals in umbilical cord blood than traditional testing methods capture, including newer and understudied compounds. The researchers found 42 confirmed or putatively identified PFAS chemicals in cord blood using this non-targeted approach. Many of these PFAS are not commonly screened in traditional testing methods and their health effects are unknown. The results showed that infants are exposed to a wide range of PFAS, including perfluorinated chemicals, polyfluorinated chemicals, and fluorotelomers, before birth.

The researchers created PFAS-omics burden scores, using item response theory methods, to summarize total exposure to PFAS. The PFAS-omics scores can be interpreted as a snapshot in time of a baby's overall PFAS exposure.

Importantly, when researchers used this broader PFAS assessment, they did not observe exposure differences between babies born to first-time mothers and those born to mothers with previous pregnancies - a difference that earlier studies had reported using more limited PFAS panels.

"Our findings suggest that how we measure PFAS really matters," said Dr. Liu, first and co-corresponding author of this study. "When we look more comprehensively, we see that babies are exposed to far more PFAS chemicals before birth than we previously realized - and some of the patterns we thought we understood may change."

Why this matters

Pregnancy is a period of heightened vulnerability. Previous research has linked prenatal PFAS exposure to low birth weight, preterm birth, altered immune responses to vaccines, metabolic changes, and other developmental concerns.

"Our study helps show that prenatal PFAS exposure is more complex and widespread than earlier studies suggested," Dr. Liu said. "Understanding the full picture is essential if we want to protect child health and reduce preventable environmental risks."

The American College of Obstetricians and Gynecologists has identified reducing exposure to toxic environmental chemicals like PFAS as a "critical area of intervention."

What this means for clinicians and patients today

PFAS exposure is not currently measured in routine clinical care, despite growing evidence that these chemicals affect multiple aspects of health.

This research introduces a new way to estimate cumulative PFAS exposure, which could eventually help clinicians:

- Identify individuals with higher exposure burdens
- Monitor at-risk populations more closely
- Inform future preventive medicine strategies

"For now, this work helps lay the scientific foundation," Dr. Liu said. "Our goal is to move toward earlier identification and prevention, especially during sensitive windows like pregnancy."

What's next

The research team plans to:

- Study whether higher cumulative PFAS exposure in early life leads to negative health outcomes
- Investigate the health effects of new and understudied PFAS chemicals identified in cord blood
- Further refine tools that can support primary disease prevention

Technololgy Networks, 19 February 2026

https://technologynetworks.com

Metal oxide electrodes may enable rapid electrochemical detection of microplastics

2026-02-19

Microplastic (MP) pollution poses a major concern, especially in aquatic environments, necessitating efficient detection technologies to safeguard marine life as well as human health. However, conventional detection

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methods like Fourier transform infrared spectroscopy require complex equipment and are often time-consuming, limiting their applicability for real-time monitoring.

In this regard, electrochemical sensing methods, specifically those based on metal oxide electrodes, are highly promising for quick and sensitive detection of MPs.

In a new study, a team of researchers led by Professor Sadia Ameen from the Department of Bio-Convergence Science, Jeonbuk National University, Republic of Korea, has systematically reviewed and summarized the paradigm shift in MP detection methods—from expensive and time-consuming spectroscopic analysis to rapid and economical electrochemical sensing using metal oxide electrodes.

The study was published in Trends in Environmental Analytical Chemistry.

"Our study provides mechanistic insights that are often missing with a detailed explanation of how MPs interact with metal oxide electrode surfaces, including impedance changes and interaction-induced current transients," says Prof. Ameen.

Notably, metal oxide nanostructures, such as zinc oxide, titanium dioxide, and hydrophobic cerium dioxide (CeO_2) with their large surface area and excellent conductivity, enable direct, high-sensitivity detection of trace MPs even in complex environments like wastewater or marine ecosystems, providing a practical on-site monitoring system.

In addition, the detection performance of metal oxide-based sensors can be dramatically enhanced by controlling the morphology and surface chemistry of metal oxides. Moreover, specific morphologies, such as nanorods, nanowires, or porous structures, form "hotspots" that increase sensitivity compared to simple spherical particles.

Furthermore, a material engineering approach, such as hydrophobic CeO_2 nanoparticles that attract hydrophobic plastic particles, can aid in effective detection of MPs by selectively targeting MPs like polyethylene or polypropylene amidst various environmental interferents.

Metal oxide-based electrochemical sensors can be deployed for on-site and real-time monitoring of MPs in rivers, lakes, and oceans. Their portability, rapid response, and low cost make them suitable for continuous environmental surveillance programs, overcoming limitations of laboratory-based spectroscopic techniques.

Moreover, electrochemical sensing platforms based on metal oxides can be used for routine screening of drinking water supplies to ensure compliance with safety standards, particularly for detecting trace-level MPs that escape conventional treatment methods. They can also be applied to detect MPs in seafood and processed food products, supporting food safety assessments and regulatory inspections.

Furthermore, due to their low management requirements, these systems are ideal for handheld or wearable sensing devices for field researchers and environmental inspectors conducting in situ analysis. Lastly, the sensors can aid in risk assessment of combined chemical-plastic exposure in environmental and biological samples, owing to their ability to detect hazardous pollutants adsorbed onto MPs.

"Metal oxide-based sensors will soon be integrated with the Internet of Things and artificial intelligence technologies. Over the next few years, the widespread adoption of this novel next-generation technology is expected to pave the way for improved public health protection, enhanced food safety and consumer confidence, acceleration of technological innovation and green industry growth, extensive interdisciplinary education and research, as well as global environmental resilience and climate adaptation," concludes Prof. Ameen.

Phys Org, 19 February 2026

https://phys.org

Why rejecting the endangerment finding also rejects climate science

2026-02-18

Scientists and policy experts say that by revoking the endangerment finding, the scientific justification for regulating greenhouse gas (GHG) emissions under the Clean Air Act, the Donald J. Trump administration has reached a dangerous milestone in dismissing, ignoring, or directly contradicting scientific information in its policy decisions. But while scientists are dismayed by the action, some see a renewed role for their discipline in influencing climate policy in the US.

The second Trump administration has smacked science with blow after blow—canceling grants, killing funding, slashing budgets, and dismantling federal scientific offices. But rescinding the endangerment finding is probably the most egregious example so far of ignoring science, says Hannah Safford, associate director of climate and environment at the

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Federation of American Scientists. "We've amassed a great deal of science to demonstrate the impact that climate change is having, and the rollback of endangerment kind of says, 'Well, we're just going to put all that science to the side,'" she says.

Julie McNamara, associate policy director in climate and energy at the Union of Concerned Scientists, says that while revoking the endangerment finding is in step with the path this administration has been on, it's still a watershed moment. "It is one of those milestones where you say, 'I can't believe we're here.'"

In the July proposal to rescind the endangerment finding, US Environmental Protection Agency administrator Lee Zeldin claimed that the science on climate change was undecided. As evidence, he cited a report written by the Climate Working Group (CWG), five researchers handpicked by Department of Energy secretary Chris Wright, which claimed the dangers from climate change were overblown.

The report caused an uproar in the scientific community, which lambasted it as cherry-picked, misleading, and fundamentally untrue. The National Academies of Sciences, Engineering, and Medicine put out its own study that directly contradicted the CWG report, and a US district court judge later ruled the CWG illegal.

But the EPA rescinded the endangerment finding anyway. In the final rule (PDF), the agency avoids any debate over the impact of GHG buildup in the atmosphere. Instead, it claims that it lacks the authority to regulate GHGs under the Clean Air Act.

'They're not interested in more scientific information'

The danger of ignoring science and revoking the endangerment finding can't be overstated, McNamara says. "We can't ignore what it means to have the federal government look science in the face and deny its reality," she says. "It's eroding the foundations of what we all say is knowledge, what we all say is real."

Even though the EPA did not end up using the CWG report as justification to remove the endangerment finding, the implied argument that climate science is not real is still there, McNamara says.

"Fundamentally, the EPA's capacity to regulate greenhouse gas emissions is predicated on a scientific question," Safford says. "What we've seen from this administration is that the science on climate change just doesn't matter. It's not that they're feeling the science is unsettled and they

want more information before making a decision," she says. "They're not interested in more scientific information."

Several scientific societies contributed comments to the EPA's proposal to rescind the endangerment finding. The American Geophysical Union, the American Physical Society, and the American Chemical Society all urged the agency to keep the finding intact. "Reversing findings that are based on multiple decades of peer reviewed research without sound scientific rationale is counterproductive and removes scientific input from the policy making process," ACS says in its statement. (ACS publishes C&EN.)

But some scientific societies and science-based organizations have stayed silent. Valeria Sabate, public affairs manager for the American Association for the Advancement of Science, tells C&EN by email that the agency does not have a statement on the endangerment finding. The American Chemistry Council, an industry group, did not reply to a request for its stance on the action.

"Those societies, those interest groups that are specifically designed to support the needs and interests of science and scientists are needed now more than ever to speak up and speak out, because individual [scientists] cannot always do so," McNamara says.

Robert W. Howarth, a biogeochemist at Cornell University, observes that the US is becoming increasingly anti-intellectual and anti-science. "Since the 1950s, the United States has probably been the leading country in the world for all sciences," Howarth says. Scientists from all over have historically come to study and work in the US, turning it into a scientific powerhouse. "We're losing that role," he says. "This anti-science holding pattern is very damaging."

Scientific authority is now not just being disregarded, McNamara adds; it's being actively invoked as an insult or a reason not to listen to someone.

"I always thought that being a scientist was a highly respected thing when I got my PhD," Howarth says. "I don't know if that's true any longer."

Not 'a death blow to climate science'

Despite the setbacks, scientists, environmental groups, and some politicians are making it known that the fight is not over.

A group of 41 senators led by Sheldon Whitehouse (D-RI) has initiated an investigation into the EPA action, accusing the agency of viewing it as a predetermined objective. In a Feb. 13 letter to Zeldin (PDF), the

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group writes, "The collapse of the [CWG] effort simply underscores that EPA attempted, and failed, to manufacture support for a conclusion the established scientific record does not and cannot sustain."

The Attorneys General of Massachusetts and California separately announced they will file lawsuits challenging the EPA's final rule on the endangerment finding. Three environmental advocacy groups, the Environmental Defense Fund—the Sierra Club—and the Natural Resources Defense Council (NRDC), have also vowed to sue the EPA.

And even though the federal government's decision to adopt climate denial in place of climate science as official US government policy is "chilling to the core," scientists' voices are far from useless, McNamara says.

After the CWG released its climate report, "the scientific community roared back and made such a sham of that report in so many ways," she says. "I think the single most important takeaway is that the scientific community got activated, and the scientific community fought back, and the scientific community won, and it's not over yet." Scientists fighting back and raising their voices have been effective in the past, McNamara says, and caused the administration to back down in some cases, such as reversing grant cancellations and decisions on cutting climate and weather research.

Moreover, federal officials aren't the only ones that matter, Safford says. "State and local policymakers have really a great deal of authority around" climate policy, she says.

There's a big role for the scientific community to play in helping climate-policy decisions at the state and local levels, she says, and it can "also come up with new information products and research-based insights."

Many realms outside of the federal government still respect science and scientists, McNamara says. "They'll herald it, speak of it, and will amplify it when science is raised, when a scientist speaks out," she says. This is happening not just in state and local government, but also at universities, academic societies, and science societies.

In the bigger picture, climate scientists are still making progress, Safford says. In the 20th century, one of the US's biggest environmental challenges was industrial pollution. "And so most of our nation's foundational environmental laws—Clean Air Act, Clean Water Act, National Environmental Protection Act—these were all written to try and cut down on point sources of industrial pollution. And they did a really good job in doing that," she says.

But in the 21st century, climate change is the central environmental problem, and it's more of an economic challenge than an industrial one, Safford says. The focus isn't on forcing industry to clean up its act but rather on guiding a society-wide transition to cleaner energy and technologies, she says.

"Regulations certainly play a role in that, though they're imperfect" because they were developed mostly in the 1960s, '70s and '80s, before policymakers knew how to deal with climate change. The Federation of American Scientists recently launched the Center for Regulatory Ingenuity as a way to reimagine how the government creates regulations that work for more-modern problems, such as climate change.

We still need regulations, Safford says. "But I do think there's this vibe that the revocation of the endangerment [finding] is a death blow to climate progress in a way that I think objectively is actually not."

C&en, 18 February 2026

https://cen.acs.org

US chemical giant to stop producing herbicide called 'toxic cocktail' by critics

2026-02-09

The chemical giant Corteva will stop producing Enlist Duo, a herbicide considered to be among the most dangerous still used in the US by environmentalists because it contains a mix of an active ingredient in Agent Orange and glyphosate, which have both been linked to cancer and widespread ecological damage.

The US military deployed Agent Orange, a chemical weapon, to destroy vegetation during the Vietnam war, causing serious health problems among soldiers and Vietnamese residents.

Glyphosate, meanwhile, is a highly controversial and toxic herbicide ingredient that has prompted similar litigation. Both are banned or severely restricted in many industrialized countries.

Despite the risks of combining the substances, the US Environmental Protection Agency has twice approved it for use on food crops. The compound is annually spread on around 4.5m acres of fields in which corn, soybeans and genetically engineered cotton are grown.

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The move will bring to an end a decade of litigation and public pressure campaigns to ban Enlist Duo, and advocates are "celebrating it as a win", said Kristina Sinclair, a staff attorney with the Center for Food Safety (CFS) non-profit, which is a lead plaintiff in the lawsuit.

"After over a decade of legal battles, rather than try to rebut our arguments in court, the manufacturer pulled Enlist Duo from the market," Sinclair said. "Our food system never should have been doused in this toxic cocktail, and now never will be again."

Corteva reported selling more than $1bn in Enlist products in 2022. The Agent Orange chemical 2,4-D will still be used in Enlist One, and a lawsuit that asks a judge to invalidate its approval will continue.

In a statement, a Corteva spokesperson said is stopped producing Enlist Duo because it now only represented 1% of sales.

"This decision is the latest in a series of steps we have taken over the past few years to streamline our portfolio and does not affect the production or availability of Enlist One, which remains a market-leading solution," the spokesperson said.

2,4-D works by attacking the roots and leaves of weeds and causing them to produce unwanted cells, not unlike inducing cancer, to kill or hobble them. The substance is considered a "possible" carcinogen by the World Health Organization, and, among other human health effects, it is linked to non-Hodgkin lymphoma, birth defects, respiratory problems, Parkinson's disease and reproductive harms.

It is also thought to harm hundreds of endangered species, including butterflies, birds, fish, deer, panthers and bats, the CFS wrote in its court filings. The suit additionally alleges the product's approval threatens to increase the spread of new herbicide-resistant weeds because the EPA failed to properly mitigate risks. That forces farmers to manage new "superweeds".

The EPA first approved Enlist Duo in 2014, prompting a lawsuit from the CFS and others arguing that the agency violated federal law by failing to ensure the herbicide would not cause "unreasonable adverse effects on the environment", as required under the nation's pesticide laws. At that time, the EPA declared, without engaging in legally mandated Endangered Species Act consultation, that the chemical cocktail would cause no harm to any endangered species.

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A federal court invalidated Enlist Duo's EPA approval in 2020, but the agency in 2022 reapproved it for seven years of use. Advocates argued that the EPA based its health and environmental impact assessments on earlier usage levels, which dramatically underestimate the threat.

The EPA's reapproval of Enlist Duo despite the court's finding is emblematic of a broader, flawed philosophy at the agency's pesticide division, said Nathan Donley, environmental health director with the Center for Biological Diversity, which has been involved in the suits. The agency always looks for "tweaks", he said.

"Whenever the courts find flaws with their approach, there's never a moment of reflection, there's never an acknowledgment that their process is faulty, there's simply a scramble to figure out the quickest workaround to get it reapproved," Donley said.

"Getting pesticides to market is always the goal for the EPA – and when that's the driving force of a country's regulator, there's only so much you can expect from them," Donley added.

- This article was amended on 9 and 11 February 2026. A comment from a Corteva spokesperson was added. And the subheading and text were changed because an earlier version said that Enlist Duo contains "a mix of Agent Orange and glyphosate"; it includes one ingredient used in Agent Orange, the chemical 2,4-D.

The Guardian, 9 February 2026

https://theguardian

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'Nothing says love like chemicals': Valentine's roses often covered in pesticides, testing finds

2026-02-15

Stay away from roses this Valentine's Day, environmental campaigners have warned after testing revealed them to be heavily contaminated with pesticides.

Laboratory testing on bouquets in the Netherlands, Europe's flower import hub, found roses had the highest residues of neurological and reproductive toxins compared with other flowers.

Red roses were found to be the worst, with one bunch containing traces of 26 different pesticides, half of which are banned for use in the EU.

"Nothing says love like roses coated in a fine chemical cocktail," said Roisin Taylor, of Verde Flower Co in Northumberland, whose business focuses on sustainable flowers and who has been campaigning to raise awareness of pesticides in the industry.

"Things like clofentazine, a chemical found to disrupt the working of your thyroid, or even carbendazim, which is believed to be a human cancer-causing chemical, or maybe chlorfenapyr, which has been found to, ironically, lead to cardiac arrest when exposed in high dose.

"All of these chemicals are also currently banned for use in the EU. We couldn't, as flower farmers, legally use these toxic chemicals here in the UK."

Valentine's Day is the flower industry's busiest time of the year. According to analysts, about 200m roses are produced to meet the demand for lovers' gifts on 14 February in Europe alone.

More than half on sale in the UK have been sourced from the Netherlands. But for most stems, that is just the last leg of a much longer journey from farms in countries such as Colombia, Kenya and Ethiopia, where the climate allows for year-round production and laxer regulatory regimes allow for more powerful pesticides.

To determine the levels of pesticide residues on flowers likely to be on sale this Valentine's Day, Pesticide Action Network Netherlands (Pan-NL) randomly tested 17 bouquets – five bunches of roses, eight mixed bouquets, and four bunches of tulips.

The highest concentration of pesticide residues was found on a bouquet of red roses bought from a Dutch garden centre, with 65.8 mg/kg. Of 26 pesticides detected on the sample, 13 were banned for use in the EU.

None of the bouquets tested were pesticide-free, but the roses and mixed bouquets contained the most residues. Among those, the analysis found 87 different pesticides, including eight metabolites, roughly equally split between insecticides and fungicides.

Of the 79 active substances found, almost a third were banned for use as "plant protection products" in the EU and the Netherlands, while 78% "pose[d] a significant risk to human health and/or the environment", said Pan-NL. Among the pesticides Pan-NL found on the flowers were known neuro- and reproductive toxins, as well as carcinogens and endocrine disruptors.

The findings come amid growing concerns in the floristry sector around the chemicals to which workers are exposed and their health effects. But in producer countries, such as Kenya, the problems are even more acute.

David Bek, a professor at the University of Coventry who researches the flower industry, described how the farms around Lake Naivasha, Kenya's major flower-producing region, doused crops repeatedly in chemicals to keep pests at bay.

"They are basically flower factories," he said, with flowers grown in vast quantities in sealed polytunnels, then sorted, trimmed, bunched and packed by hundreds of workers in processing areas.

Bek said spraying happened at almost every stage of the production process, but particularly as they prepared to ship. "That's what they have to do to make sure they don't end up with problems that mean the consignment will get rejected when it gets to the border."

So where does that leave those of us looking for a Valentine's gift? Pan-NL recommended "organically grown seasonal flowers or organically grown ornamental plants".

And for those of us who do receive a "poison bouquet"? The advice is clear: "Don't throw the remains on the compost heap or in the organic waste bin, but with residual waste. This prevents the toxins from being recycled in nature."

The Guardian, 15 February 2026

https://theguardian.com

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Chitosan-nickel biomaterial becomes stronger when wet, and could replace plastics

2026-02-18

A new study led by the Institute for Bioengineering of Catalonia (IBEC) has unveiled the first biomaterial that is not only waterproof but actually becomes stronger in contact with water. The material is produced by the incorporation of nickel into the structure of chitosan, a chitinous polymer obtained from discarded shrimp shells. The development of this new biomaterial marks a departure from the plastic-age mindset of making materials that must isolate from their environment to perform well. Instead, it shows how sustainable materials can connect and leverage their environment, using their surrounding water to achieve mechanical performance that surpasses common plastics.

Plastics have become an integral part of modern society thanks to their durability and resistance to water. However, precisely these properties turn them into persistent disruptors of ecological cycles. As a result, unrecovered plastic is accumulating across ecosystems and becoming an increasingly ubiquitous component of global food chains, raising growing concerns about potential impacts on human health.

In an effort to address this challenge, the use of biomaterials as substitutes for conventional plastics has long been explored. However, their widespread adoption has been limited by a fundamental drawback: Most biological materials weaken when exposed to water. Traditionally, this vulnerability has forced engineers to rely on chemical modifications or protective coatings, thereby undermining the sustainability benefits of biomaterial-based solutions.

Now, a recent study led by the Institute for Bioengineering of Catalonia (IBEC), in collaboration with the Singapore University of Technology and Design (SUTD), has overturned this paradigm. Inspired by the arthropod cuticle, the researchers adapted chitosan—the second most abundant organic molecule on Earth after cellulose—to create a biointegrated material that resists hydration and increases in strength to values well above those of commodity plastics when wet.

The method, published in Nature Communications, demonstrates the potential for a paradigm shift in manufacturing, with zero-waste production of both consumables and large objects that could meet the global demand for plastic.

Crucially, the process does not alter the biological nature of chitosan.

"The material is still biologically pure in the eyes of nature; it remains essentially the same molecule found in insect shells or mushrooms," explains Javier G. Fernández, ICREA Research Professor at IBEC, principal investigator of the Biointegrated Materials and Engineering group, and leader of the study. This purity enables seamless reintegration into natural ecological cycles.

A paradigm shift inspired by nature

According to Fernández, most of our current materials, from plastics to engineered biopolymers, are designed to withstand environmental conditions.

"For over a century, we have assumed that in order to succeed in nature, materials must become inert," he says. "This research shows the opposite: Materials can thrive by interacting with their environment rather than isolating themselves from it."

The study was inspired by a serendipitous observation: when zinc is removed from the fangs of the sandworm Nereis virens, the fangs become susceptible to hydration and soften when immersed in water. This finding suggests that metals may play a key role in how natural materials interact with water.

While metals are known to strengthen biological structures, the researchers proposed that they could also control the hydration of chitin-based materials, a natural polymer found in crustacean shells. To test this theory, the team focused on nickel, a naturally occurring trace element that easily interacts with chitin and dissolves in water.

The team incorporated nickel into chitosan—a chitin-derived material obtained from discarded shrimp shells—and processed it into thin films. They report that the material becomes stronger when immersed in water, exhibiting an increase in strength of up to 50% after immersion.

In the new material, water becomes an active structural component. A dynamic network of weak, reversible bonds continuously breaks and reforms due to the mobility of nickel ions and surrounding water molecules. This constant microscopic reconfiguration enables the material to absorb stress and reorganize itself, mirroring the behavior of natural biological structures.

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Fernández summarizes this as "a material where being 'soft' at the molecular scale actually makes it stronger."

Zero-waste production and global scalability

The study also demonstrates a zero-waste manufacturing process. During the initial immersion of the material in water, the majority of the nickel that does not contribute to structural bonding is released. Rather than discarding this mixture, the team designed a loop in which it becomes the input for producing the next batch of material, achieving a 100% efficiency in the use of nickel.

This approach enables the full recovery and reuse of nickel, drastically reducing environmental impact and costs.

Scaling up is equally promising. The authors demonstrate that chitinous polymers are produced on a vast scale in nature, making them ideal candidates for future sustainable manufacturing.

"Each year, the world produces an estimated one hundred billion tons of chitin, equivalent to three centuries' worth of plastic production," states Akshayakumar Kompa, a postdoctoral researcher in Fernandez's group and the study's first author.

Moreover, chitosan can be produced locally rather than relying on a single global source. While shrimp shells remain the main industrial source, they can also be obtained through the bioconversion of organic waste, ranging from urban food residues to fungal by-products.

"The key is to adapt to local sources," says Kompa. "Our goal is to integrate the production of these materials into the local ecosystem by using whatever form of chitosan is available nearby."

A promising substitute for plastics

Early applications are expected to emerge in agriculture, fishing gear and packaging, as well as in other water-related uses, where there is an urgent need for biodegradable, water-resistant materials.

While the team has prioritized industrial scalability and cost, focusing initially on agricultural applications, both nickel and chitosan are individually approved by the FDA for certain medical uses. Consequently, the findings could also pave the way for applications in the medical field, including waterproof coatings for biomaterials.

Furthermore, the material's ability to form watertight containers, demonstrated in the study using cups and large sheets, highlights its potential to replace certain single-use plastics.

The authors emphasize that nickel is probably not the only molecule capable of producing this phenomenon. Now that the principle is understood, other combinations may broaden the possibilities of strengthening biomaterials with water.

"This is the first study. Now that we know this effect exists, we and others can search for new materials and new ways to achieve it," notes Fernández.

This discovery represents a shift in mindset away from the plastic age. Rather than forcing biological molecules to behave like synthetics, the IBEC team embraces the logic of natural systems: dynamic structures, regional production, ecological integration, and zero waste.

For Kompa and Fernández, the message is clear: To build a sustainable future, we must design materials that work with the environment, not isolate from it.

Phys Org, 18 February 2026

https://phys.org

PFAS waxes found on skis and snowboards lead to three Olympic disqualifications

2026-02-18

Three athletes have been disqualified from events at the Milan–Cortina Winter Olympics because of alleged use of ski waxes containing per- and polyfluoroalkyl substances (PFAS). A ban on these waxes was announced by the International Ski and Snowboard Federation (FIS) in 2019 that took effect in 2023 and involves testing for fluorinated ski waxes using Fourier Transform Infrared (FTIR) spectroscopy. These are the first Winter Olympics to feature such a prohibition.

Last week, two female South Korean cross-country skiers and a Japanese male snowboarder were disqualified from Olympic events after their equipment tested positive for PFAS waxes. The three have only been excluded from the events where their equipment tested positive for PFAS and can still take part in other events. The Japanese snowboarder, Shiba Masaki, pushed back and pointed out that he had used the same board and wax in elite competitions leading up to these Olympics and never tested positive.

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'I have undergone fluorine testing at every World Cup competition using the same board and wax configuration, and have never tested positive,' Masaki posted on Instagram. 'When it comes to waxing, we do our own work during practice, but during competition we officially requested a professional serviceman to finish the board.'

Meanwhile, South Korean media outlets reported that the Korean Sport and Olympic Committee indicated that the women's cross-country team ordered wax that complies with FIS rules, but the products that their long-term supplier delivered were apparently contaminated.

The hydrophobic qualities of PFAS-containing products provide athletes with 'a big advantage in wet or humid conditions', but they also do not biodegrade, FIS explained. 'Evidence emerged that PFAS from melted snow run-off had contaminated water and food cycles. Later, a 2022 survey found over 80% of waterways in the United States contained PFAS.' In addition, FIS emphasised that PFAS do not break down inside the human body and have been linked to several illnesses and conditions.

Recent research has also revealed highly elevated levels of PFAS in the bodies of ski wax technicians, measured as blood PFAS concentration, compared with other occupations and the general population.

Rebecca Aicher, project director for the American Association for the Advancement of Science's Center for Scientific Evidence in Public Issues, says ski wax is a known source of PFAS. 'Scientists in the US have sampled snow at ski resorts and near ski resorts, and they found that the ski wax is often found in higher concentrations in snow where people have used ski waxes that have PFAS,' she tells Chemistry World. 'They also have found differences in natural areas versus areas with high amounts of skiers,' she continued. 'So, the PFAS in the ski wax, however you use it, is showing up on the snow.'

One of tricky things with PFAS-containing products is tracking the supply chain, Aicher notes. 'I don't know how ski wax is labelled … and I don't know if body that that would ban it would also then provide a list of brands that do not contain PFAS,' she adds.

Beyond PFAS in waxes used on skis and snowboards, Aicher says PFAS has also been found in the so-called 'tech suits' worn by Olympic swimmers. But potentially, she notes, any professional athletic gear that requires

waterproofing, as well as friction reduction or stain resistance, could contain PFAS.

Chemistry World, 19 February 2026

https://chemistryworld.com

Newly discovered material conducts heat nearly 3x faster than any metal

2026-01-27

Data center servers, powerful smartphones, and your computer's motherboard have one thing in common. When these devices get too hot, their performance takes a hit, and we can't have that. That's why copper is used to manufacture them: this metal has high thermal conductivity, which means it can efficiently carry heat and dissipate it across its surface.

Now, copper is already pretty good at what it does. With a thermal conductivity of approximately 401 W/mK at room temperature, it's second only to silver by a wee bit, while being a lot less expensive to procure. But aerospace engineers at University of California Los Angeles (UCLA) have discovered a material that blows those two out of the water with nearly thrice the thermal conductivity.

Metallic theta-phase tantalum nitride exhibits an ultrahigh thermal conductivity of 1,100 W/mK, which means it's way more efficient at transporting heat than copper and silver. Their conductivity is limited by the strong interactions between free-moving electrons and atomic vibrations called phonons.

That name just rolls off the tongue, doesn't it? It refers to a specific crystal structure of this metallic compound which has certain properties – similar to how carbon can be found in the form of soft graphite, and also as hard diamond.

Using molecular structure analysis techniques like synchrotron-based X-ray scattering and ultrafast optical spectroscopy, the researchers found unusually weak electron-phonon interactions in this specific configuration of tantalum nitride. This allows for super-efficient heat flow through the material with a lot less resistance, vastly exceeding what we see with copper and silver. The findings were published in the journal Science this month.

"As AI technologies advance rapidly, heat-dissipation demands are pushing conventional metals like copper to their performance limits,

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and the heavy global reliance on copper in chips and AI accelerators is becoming a critical concern," explained Yongjie Hu, a professor at the UCLA Samueli School of Engineering who led the study.

This metallic material could prove to be a desirable alternative to copper in heat sinks – not just for computers and AI hardware, but also for aerospace systems and quantum computers that need to constantly run cool.

New Atlas, 27 January 2026

https://newatlas.com

What 'housane' rings are and why a light-powered route may matter for drugs

2026-02-19

When developing new drugs, one thing is particularly important: finding and producing the right molecules that can be used as active ingredients. The key elements of some drugs, such as penicillin, are small, tri- or quadripartite ring molecules. A team led by Prof Frank Glorius from the Institute of Organic Chemistry of the University of Münster (Germany) has now developed a method for efficiently converting readily available basic materials into such small, high-grade ring molecules. The product has a structure reminiscent of a line drawing of a house, hence its name "housane." The reaction is triggered by a photocatalyst that transfers light energy to the molecules to enable the conversion.

The paper is published in the journal Nature Synthesis.

Small ring molecules are under strong tension similar to a bent branch. The release of tension can drive downstream reactions, thereby enabling efficient access to valuable products. However, high-tensile molecules are difficult to produce. Previous methods for producing housane often require "harsh" conditions, such as high temperatures, and they do not work with many additional atoms or atom groups, known as functional groups, on the starting molecules. However, it is precisely these functional groups that are crucial for the properties of a molecule.

The team used certain hydrocarbons (1,4-dienes) as the starting material. These normally undergo undesirable side reactions when exposed to light. However, the researchers succeeded in suppressing these deviating reaction pathways by adapting the side chains of the molecules in the starting material. This made the process more orderly and predictable. In

addition, when these side reactions are suppressed, the starting materials can "close" themselves into a ring structure to build up tension.

"This process is normally difficult to achieve because it is energetically 'uphill' and requires additional momentum. Photocatalysis provides the necessary energy," Glorius explains. Computer-aided analyses helped the team understand how the reaction works.

The new method makes it possible to produce housane easily and efficiently, and it expands the possibilities for how the high-tensile skeleton can be used to build complex molecules. The researchers expect their work to benefit both basic research and practical applications, including drug manufacturing and materials development.

Phys Org, 19 February 2026

https://phys.org

New sodium ion battery stores twice the energy and desalinates seawater

2026-02-19

Lithium-ion batteries currently dominate the market, but they depend on costly materials that can harm the environment. Sodium, by contrast, is abundant and widely accessible. Even so, matching the performance of lithium-ion technology has been a major hurdle for sodium-ion systems.

Water Boosts Sodium Vanadium Oxide Performance

In research published in the Journal of Materials Chemistry A, scientists examined sodium vanadium oxide, a well-known sodium-based compound. They discovered that allowing the material to retain its natural water content significantly enhances how it functions inside a battery.

The compound, called nanostructured sodium vanadate hydrate (NVOH), delivered far stronger results when used in its hydrated form. It stored substantially more energy, charged at a faster rate, and maintained stability for more than 400 charge cycles.

During testing, the hydrated version held nearly twice as much charge as standard sodium-ion cathode materials. This performance places it among the top cathodes reported so far for sodium-ion batteries.

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Dr. Daniel Commandeur, Research Fellow at the University of Surrey School of Chemistry and Chemical Engineering, and lead author of the paper, said:

"Our results were completely unexpected. Sodium vanadium oxide has been around for years, and people usually heat-treat it to remove the water because it's thought to cause problems. We decided to challenge that assumption, and the outcome was far better than we anticipated. The material showed much stronger performance and stability than expected and could even create exciting new possibilities for how these batteries are used in the future."

Seawater Operation and Electrochemical Desalination

The team also explored how the material performed in salt water, an especially demanding environment for battery systems. Not only did it continue operating effectively, it also removed sodium ions from the saltwater solution. At the same time, a graphite electrode extracted chloride ions in a process known as electrochemical desalination.

Dr. Commandeur added:

"Being able to use sodium vanadate hydrate in salt water is a really exciting discovery, as it shows sodium-ion batteries could do more than just store energy -- they could also help remove salt from water. In the long term, that means we might be able to design systems that use seawater as a completely safe, free and abundant electrolyte, while also producing fresh water as part of the process."

Toward Safer, Low Cost Alternatives to Lithium

This advance could speed up the adoption of sodium-ion batteries as a practical alternative to lithium-based technology. Because sodium is inexpensive and plentiful, these batteries have the potential to be safer, more affordable, and more environmentally friendly.

Possible uses include large-scale renewable energy storage for power grids as well as applications in electric vehicles. By simplifying the production of high-performance sodium-ion batteries, the Surrey team's findings move commercially viable, sustainable energy storage one step closer to reality.

Science Daily, 19 February 2026

https://sciencedaily.com

Tiny Bubbles Unlock a Powerful New Source of Blue Energy

2026-02-19

A new approach to blue energy tackles one of the field's most persistent problems: how to move ions quickly without sacrificing selectivity.

Where rivers meet the sea, nature constantly mixes freshwater and saltwater. That blending releases energy, and osmotic energy, often called blue energy, aims to turn that overlooked resource into electricity.

The basic idea is straightforward: saltwater contains lots of dissolved ions, and freshwater contains far fewer. If you place an ion-selective membrane between the two, ions naturally migrate toward the lower salt concentration, and that controlled movement generates a voltage that can be captured.

The hard part has never been getting ions to move. It has been getting the right ions to move quickly, while keeping the system stable enough to work outside the lab. In many membranes, speed and selectivity fight each other. Materials that let ions rush through often lose the ability to separate charges cleanly, and real devices also have to survive pressure, flow, and long run times without degrading. Those practical constraints are a big reason blue energy has struggled to move beyond prototypes.

Scientists at the Laboratory for Nanoscale Biology (LBEN), led by Aleksandra Radenovic at EPFL's School of Engineering, working with colleagues at the Interdisciplinary Centre for Electron Microscopy (CIME), report a potential solution in a paper published in Nature Energy.

The researchers modified tiny channels called nanopores by coating them with microscopic bubbles made of lipid molecules (liposomes). Under normal conditions, these nanopores allow ions to move through very slowly (but very precisely). After adding the lipid coating, selected ions were able to travel through the pores with far less resistance. This reduction in friction led to a marked increase in ion flow and significantly improved overall performance.

"Our work brings together the strengths of two main approaches to osmotic energy harvesting: polymer membranes, which inspire our high-porosity architecture; and nanofluidic devices, which we use to define highly charged nanopores," says Radenovic. "By combining a scalable membrane layout with precisely engineered nanofluidic channels, we

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achieve highly efficient osmotic energy conversion and open a route toward nanofluidic-based blue-energy systems."

Hydration lubrication optimization

To create the slippery coating, the team used lipid bilayers, the same type of structure that forms cell membranes. Lipid bilayers naturally assemble when two layers of fat molecules align so that their water-repelling (hydrophobic) tails face inward and their water-attracting (hydrophilic) heads face outward.

When these bilayers were applied to stalactite-shaped nanopores embedded in a silicon nitride membrane, the outward-facing hydrophilic heads drew in an extremely thin layer of water. This water film, only a few molecules thick, clings to the nanopore surface and prevents ions from directly rubbing against the pore walls. By minimizing this contact, friction drops, and ion movement becomes much more efficient.

To test the concept, the researchers produced 1,000 lipid-coated nanopores arranged in a hexagonal pattern. They then evaluated the device under conditions that mimic the natural salt levels found where seawater meets river water. The system achieved a power density of about 15 watts per square meter, which is 2-3 times higher than current polymer membrane technologies.

Computer models have long indicated that boosting both ion flow and selectivity at the same time could significantly improve osmotic energy performance. However, experimental proof has been limited. "By showing how precise control over nanopore geometry and surface properties can fundamentally reshape ion transport, our study moves blue-energy research beyond performance testing and into a true design era," says LBEN researcher Tzu-Heng Chen.

First author Yunfei Teng notes that the implications extend beyond blue energy. "The enhanced transport behavior we observe, driven by hydration lubrication, is universal, and the same principle can be extended beyond blue-energy devices," he says.

Sci Tech Daily, 19 February 2026

https://scitechdaily.com

A 'magic blueprint' for converting CO_2 into resources through atom-level catalyst design

2026-02-19

A research team led by Professor Su-Il In of the Department of Energy Science and Engineering at DGIST has uncovered the principle that the products and reaction pathways of carbon dioxide (CO2) conversion to fuel via solar energy depend on the design of atomic-level interactions in the catalyst.

The technology of converting CO2, a major greenhouse gas, into useful fuels or chemical feedstocks is a key challenge for achieving a carbon-neutral society. In particular, "artificial photosynthesis" technology, which utilizes solar energy to turn greenhouse gases into resources, is attracting attention.

However, there have been difficulties in enhancing reaction efficiency and securing selectivity toward desired products.

To address this challenge, the research team designed a "single-atom catalyst" system in which individual iron (Fe) and copper (Cu) atoms were separately dispersed on the surface of titanium dioxide (TiO2). Single-atom catalysts feature isolated metal atoms distributed individually, enabling precise control over electron dynamics at the atomic scale.

The research is published in the journal Advanced Science.

The results revealed that reaction products varied dramatically depending on the choice of metal atom. When iron (Fe) atoms were used, the production of carbon monoxide (CO) increased by 55.7 times compared to conventional systems.

In contrast, when copper (Cu) atoms were used, light irradiation facilitated the formation of sites where oxygen atoms were removed (oxygen vacancies) on the catalyst surface, and the production of hydrocarbon fuels such as methane (CH4) and ethane (C2H6) increased by up to 44.5 times.

The research team scientifically demonstrated how metal atoms modify the electronic structure within the catalyst and how these changes generate distinct reaction pathways using advanced characterization techniques (XAFS and DRIFTS) and theoretical calculations (DFT).

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In particular, they revealed that copper atoms are advantageous for involving multiple electrons in the reaction and facilitating carbon–carbon bond formation.

The study has significance in that it has provided new design guidelines for selectively obtaining desired products by tuning the electronic structure at the atomic level, going beyond conventional approaches that simply employ catalyst defects.

"This study demonstrates that carbon dioxide reduction pathways can be directly designed by precisely controlling the interactions between metal atoms and the support," stated Professor Su-Il In of the Department of Energy Science and Engineering at DGIST.

"Going forward, this approach is expected to be applied as a key strategy for addressing the climate crisis by enhancing the efficiency of solar-driven carbon utilization technologies."

Phys Org, 19 February 2026

https://phys.org

After Decades of Global Searching, Scientists Finally Create the Silicon Aromatic Once Thought Impossible

2026-02-18

A long-standing chemistry challenge has been solved with the synthesis of a five-atom silicon aromatic ring. The breakthrough validates decades of theory and points toward new industrially relevant compounds.

Major scientific advances rarely happen quickly, and this discovery is a clear example of that slow but steady progress.

After nearly fifty years of theoretical discussion and repeated experimental efforts by researchers around the world, a team at Saarland University has finally succeeded. David Scheschkewitz, Professor of General and Inorganic Chemistry, worked alongside his doctoral student Ankur and Bernd Morgenstern from the university's X-Ray Diffraction Service Center to achieve the breakthrough. Their results have now been published in the prestigious journal Science.

So what exactly did the researchers accomplish? They successfully synthesized a compound known as pentasilacyclopentadienide. While experts in the field may immediately recognize the importance of this result, many readers might reasonably ask what makes it special. At

its core, the work involved replacing the carbon atoms in an aromatic compound, a group of molecules known for their exceptional stability, with silicon atoms.

Aromatics play a prominent role in the world around us, for example, in the manufacture of plastics. 'In polyethylene and polypropylene production, for example, aromatic compounds help make the catalysts that control these industrial chemical processes more durable and more effective,' explains David Scheschkewitz. As silicon is much more metallic than carbon, it holds on to its electrons far less strongly. This shift creates opportunities for chemical systems that were previously unreachable, and the Saarland team has now demonstrated that such systems are possible.

Cracking Aromatic Stability and Opening New Chemical Frontiers

Why did it take so long to reach this point? The answer lies in the fundamental rules that govern aromatic molecules. Cyclopentadienide, the carbon-based counterpart to the newly synthesized silicon compound, is an aromatic hydrocarbon in which five carbon atoms form a flat ('planar') ring.

This geometry plays a key role in its unusual stability. (Historical side note: Aromatics were given this name because the first such compounds to be discovered in the second half of the 19th century were found to have particularly distinctive and often pleasant aromas.)

"To be classified as aromatic, a compound needs to have a particular number of shared electrons that are evenly distributed around the planar ring structure, and this number is expressed by Hückel's rule – a simple mathematical expression named after the German physicist Erich Hückel," explains David Scheschkewitz. Because these electrons are spread evenly around the ring rather than tied to individual atoms, aromatic molecules gain an extra level of stability.

Until now, silicon chemistry offered only one confirmed example of this behavior. In 1981, researchers synthesized the silicon analogue of cyclopropenium, an aromatic molecule in which a three-membered carbon ring was replaced by a three-membered silicon ring. Every attempt to extend this concept to larger silicon-based aromatic systems failed.

That situation has now changed. Ankur, Bernd Morgenstern, and David Scheschkewitz have created a five-atom silicon molecule that meets the strict criteria for aromaticity. In an unexpected coincidence, the same compound was discovered at nearly the same time in the laboratory of

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Takeaki Iwamoto at Tohoku University in Sendai, Japan. The two research groups agreed to publish their results side by side in the same issue of Science.

This work paves the way for entirely new materials and processes with potential industrial relevance. But the hardest first step has now been taken.

Sci Tech Daily, 18 February 2026

https://scitechdaily.com

Scientists Find a Hidden State Inside Liquid Metal That Shouldn't Exist

2026-01-25

Motionless atoms can trap liquid metal in a strange new state that shouldn't exist.

Scientists have discovered that a liquid does not always behave the way it seems. Even when a material is fully molten, some of its atoms can remain fixed in place, no matter how hot it gets. These stationary atoms strongly influence how a liquid turns into a solid and can even give rise to an unusual state of matter known as a corralled supercooled liquid.

Why Solidification Matters

The process of solid formation underpins many natural phenomena, including mineralization, ice growth, and the folding of protein fibrils. It is also critical for a wide range of technologies. Pharmaceuticals rely on controlled solidification, as do metal-based industries such as aviation, construction, and electronics.

Watching Metal Freeze at the Atomic Scale

To investigate how liquids solidify, researchers from the University of Nottingham and the University of Ulm in Germany used transmission electron microscopy to observe molten metal nano droplets as they cooled. Their results were published in ACS Nano.

Professor Andrei Khlobystov, who led the research, said, "When we consider matter, we typically think of three states: gas, liquid, and solid. While the behavior of atoms in gases and solids is easier to understand and describe, liquids remain more mysterious."

The Chaotic Motion of Liquid Atoms

Atoms inside a liquid move in a highly complex way, much like people pushing through a crowded space. They rush past one another while continuing to interact. Capturing this behavior is especially difficult during the moment when a liquid begins to freeze, even though this transition determines the final structure of the material and many of its practical properties.

Melting Nanoparticles on Graphene

Dr. Christopher Leist, who carried out the transmission electron microscopy experiments at Ulm using the low voltage SALVE instrument, said, "We began by melting metal nanoparticles, such as platinum, gold, and palladium, deposited on an atomically thin support—graphene. We used graphene as a sort of hob for this process to heat the particles, and as they melted, their atoms began to move rapidly, as expected. However, to our surprise, we found that some atoms remained stationary."

Further investigation revealed that these immobile atoms were tightly bound to the support at specific defect sites. This strong attachment held even at extremely high temperatures. By focusing the electron beam, the researchers could create more defects and directly control how many atoms stayed pinned within the liquid.

Electron Beams and a New Phase of Matter

Professor Ute Kaiser, who established the SALVE center at Ulm University, said, "Our experiments have surprised us as we directly observe the wave-particle duality of electrons in the electron beam. We visualize the material using electrons as waves. At the same time, electrons behave like particles, delivering discrete bursts of momentum that can either move or, surprisingly, even fix atoms at the edge of a liquid metal. This remarkable observation has allowed us to discover a new phase of matter."

The team has previously used the same approach to record films of chemical reactions involving individual molecules, including the first time a chemical bond was seen breaking and reforming in real time. This technique allows scientists to observe chemistry one atom at a time.

How Stationary Atoms Change Freezing

In the new experiments, the researchers found that pinned atoms dramatically alter the way a liquid solidifies. When only a few atoms are stationary, crystals grow normally from the liquid until the entire particle becomes solid. When many atoms are fixed in place, however, this orderly process breaks down, and crystal formation is completely blocked.

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Professor Andrei Khlobystov from the University of Nottingham said, "The effect is particularly striking when stationary atoms create a ring that surrounds the liquid. Once the liquid is trapped in this atomic corral, it can remain in a liquid state even at temperatures significantly below its freezing point, which for platinum can be as low as 350 degrees Celsius—that is more than 1,000 degrees below what is typically expected."

From Supercooled Liquid to Unstable Solid

When the temperature drops far enough, the trapped liquid eventually becomes solid. Instead of forming a crystal, it turns into an amorphous metal with no regular atomic pattern. This form is extremely unstable and exists only because the stationary atoms hold it in place. If that confinement is disturbed, the built-up tension is released, and the metal quickly rearranges into its normal crystalline structure.

Implications for Catalysts and Materials Science

Dr. Jesum Alves Fernandes, a catalysis expert at the University of Nottingham, said, "The discovery of a new hybrid state of metal is significant. Since platinum on carbon is one of the most widely used catalysts globally, finding a confined liquid state with non-classical phase behaviour could change our understanding of how catalysts work. This advancement may lead to the design of self-cleaning catalysts with improved activity and longevity."

Toward Atomically Corralled Matter

Until now, nanoscale corralling had only been demonstrated for photons and electrons. This study marks the first time atoms themselves have been corralled. Professor Andrei Khlobystov said, "Our achievement may herald a new form of matter combining characteristics of solids and liquids in the same material."

Looking ahead, the researchers aim to precisely control the placement of pinned atoms to build larger and more complex corrals. Such advances could enable more efficient use of rare metals in clean technologies, including energy conversion and storage.

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