CHEMWATCH

Bulletin Board

Contents

NOV. 14, 2025

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Changes to Workplace Exposure Limits Effective from 1 December 2026. 4

Mid-term review of the National Return to Work Strategy 2020-2030 4

Food Standards Australia New Zealand (FSANZ) has released its 2024–25 Annual Report 5

Australian Food Safety Week 6

AMERICA

EPA Extends Compliance Deadlines for Methylene Chloride Rule, Easing Challenges for Non-Federal Laboratories 7

Protection of Stratospheric Ozone: Listing of Substitutes Under the Significant New Alternatives Policy Program in Refrigeration and Air Conditioning and Fire Suppression 7

Toxic 'forever chemicals' are in B.C. Sea otters, new study finds 8

From The Campus To The Community: My wok may have cooked more than dinner-A PFAS Story 9

EUROPE

Deadly fear for animals: Will the EU reconsider its fireworks regulations? .10

Natural England's Strategy: Underpinning Evidence 10

REACH UPDATE

REACH - Publication of HSE's draft recommendation (2025) for Annex 14 (the Authorisation List) 12

JANET'S CORNER

Who am I? 13

HAZARD ALERT

Asbestos 14

GOSSIP

Traditional yoghurt recipe reveals ants' fermentation power 20

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

CHEMWATCH

Bulletin Board

Contents

NOV. 14, 2025

Baker's yeast carrier makes bee propolis a more potent medicine, study finds 24
This Common Metal Has an Unusual Power....26
Nanoparticle Treatment Combats Iron Deficiency More Effectively 28
Gas-switch reduction enables alloying in supported catalysts 29
Nanoparticles may be the secret ingredient in making ultimate plastics ..32
Sunscreen plus bleach: The surprising chemistry behind stubborn red laundry stains....33
"Really bizarre" quantum discovery defies the rules of physics....34
Bamboo dishes may leach pesticides and melamine into food....37

CURIOSITIES

Scientists Discover "Gyromorph" Materials To Enhance Light-Based Computers 38
One-pot method synthesizes blue light-responsive aryne precursors from carboxylic acids 39
Bulletproof fabric laced with carbon nanotubes is stronger than Kevlar ...41
This New CBD Formula Actually Reaches the Brain 42
Imaging method pinpoints microplastics in intact human tissue samples45
Entangled spins give diamonds a quantum advantage 46
Scientists Develop More Efficient Way To Extract Rare Earth Elements Amid Global Trade Tensions....49
Mushroom material takes on plastic packaging at Belgian start-up....52
This roof paint blocks 97% of sunlight and pulls water from the air 54
Methanol poisoning: the chemistry behind how a toxic alcohol gets into drinks 56

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ...61
CHEMICAL EFFECTS 61
ENVIRONMENTAL RESEARCH 61
PHARMACEUTICAL/TOXICOLOGY 61
OCCUPATIONAL....61

CHEMWATCH

Bulletin Board

Regulatory Update

NOV. 14, 2025

ASIA PACIFIC

Changes to Workplace Exposure Limits Effective from 1 December 2026

2025-05-29

Purpose of this document

This document provides information on the changes that will take effect from 1 December 2026.

These include:

- a decreased or increased exposure limit value
- an addition or removal of a type of exposure limit
- merging or splitting of groups of airborne contaminants
- addition or removal of an airborne contaminant listing.

This document is limited only to WEL that are new or changing on 1 December 2026. It is not a full list of all chemicals subject to a WEL. For the comprehensive lists, consult the WES (for current standards) and WEL (from 1 December 2026).

Read More

Safe Work Australia, 29 May 2025

https://www.safeworkaustralia.gov.au/sites/default/files/2025-07/changes_to_workplace_exposure_limits_-_june_2025.pdf

Mid-term review of the National Return to Work Strategy 2020-2030

2025-10-22

Safe Work Australia has released the mid-term review of the National Return to Work Strategy 2020–2030 (the Strategy), which examines the effectiveness of the Strategy in its first 5 years and identifies key challenges and opportunities requiring more focus in its remaining 5 years.

The review found that the Strategy has been effective at influencing, informing and guiding stakeholder actions to improve return to work outcomes, fostering national collaboration and focusing efforts on opportunities for change at the national level.

Stakeholders also valued the initiatives progressed under the Strategy, particularly research, and support Safe Work Australia continuing to lead their development.

While feedback on work under the Strategy was positive, return to work outcomes themselves do not appear to be improving.

The latest data shows mixed results on the Strategy's progress against strategic outcomes and towards national targets, interpreting these results is complicated by limitations in the scope of the measurement framework, the impact of COVID-19 and other external factors.

Read More

Safe Work Australia, 22-10-25

https://www.safeworkaustralia.gov.au/doc/mid-term-review-national-return-work-strategy-2020-2030

Food Standards Australia New Zealand (FSANZ) has released its 2024–25 Annual Report

2025-10-31

The report showcases our work in ensuring a safe and trusted food supply in Australia and New Zealand.

FSANZ CEO Dr Sandra Cuthbert said the year was defined by significant regulatory and scientific progress driven by collaboration with stakeholders and Food Regulation System partners.

'We finalised 20 applications and 7 proposals that advanced food standards and helped maintain trust in the safety of our food supply,' Dr Cuthbert said.

'Our work covered new and emerging areas of food regulation, including the first cell-cultured food approved for sale in Australia and New Zealand and updated definitions for genetically modified food.

'We also continued work to strengthen egg safety standards and review the Health Star Rating system and nutrition information panel to ensure labelling supports consumers to make informed food choices.'

Dr Cuthbert said FSANZ continued to deliver on its core functions, coordinating 87 food recalls and supporting the management of 10 significant food safety issues.

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 14, 2025

'We also strengthened our international partnerships, from collaborative assessments with Health Canada to new science dialogues across the Asia–Pacific region, ensuring Australia and New Zealand remain leaders in evidence-based food regulation,' she said.

'Our achievements reflect the expertise of our staff and strong partnerships across the Food Regulation System.'

Read More

FSANZ, 31-10-25

https://www.foodstandards.gov.au/publications/annual-report-2024-25

Australian Food Safety Week

2025-10-31

Food Safety Week runs from 8-15 November, shining a spotlight on the simple steps we can all take to reduce foodborne illness at home.

This year's theme - Don't swallow the myth – Food safety myth-busting - encourages everybody to separate fact from fiction when it comes to safe food handling.

Each year, foodborne illness costs the Australian economy around $3 billion. Many cases can be prevented by following evidence-based advice such as refrigerate leftovers within two hours, cook food thoroughly, prevent cross-contamination and check labels for storage and use-by information.

Food safety is based on science, not assumptions. This Food Safety Week, take a moment to check the facts and keep your food safe.

Read More

FSANZ, 31-10-25

https://www.foodstandards.gov.au/consumer/prevention-of-foodborne-illness/food-safety-basics

AMERICA

EPA Extends Compliance Deadlines for Methylene Chloride Rule, Easing Challenges for Non-Federal Laboratories

2025-11-10

Today, U.S. Environmental Protection Agency (EPA) finalized a compliance date extension for laboratories using methylene chloride to ensure long-term compliance with the requirements of the May 2024 final rule on methylene chloride issued under the Toxic Substances Control Act (TSCA). This final rule extends the Workplace Chemical Protection Program (WCPP) compliance dates for non-federal laboratories by an additional 18 months, aligning them with the dates required for federal laboratories and their contractors in the May 2024 final rule. This decision, in support of the Trump Administration's focus on reducing regulatory burdens, provides relief to non-federal laboratories facing near-term challenges in implementing the May 2024 final rule and prevents disruptions to environmental monitoring activities.

EPA received comments on the May 2025 proposed rule from various laboratories that use methylene chloride. Most commenters supported the proposed rule to extend WCPP compliance timeframes for non-federal laboratories. Many of these laboratories, which use methylene chloride in small quantities and somewhat infrequently, expressed challenges in completing the May 2024 methylene chloride rule's requirements across potentially hundreds of laboratories within the short timelines prescribed in the 2024 rule.

Read More

US EPA, 10-11-25

https://www.epa.gov/chemicals-under-tsca/epa-extends-compliance-deadlines-methylene-chloride-rule-easing-challenges-non

Protection of Stratospheric Ozone: Listing of Substitutes Under the Significant New Alternatives Policy Program in Refrigeration and Air Conditioning and Fire Suppression

2025-11-10

Proposed rule.

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 14, 2025

SUMMARY:

Pursuant to the U.S. Environmental Protection Agency's Significant New Alternatives Policy program, this action proposes to list several substitutes as acceptable, subject to use conditions, for residential and light commercial air conditioning and heat pumps, chillers, household refrigerators and freezers, motor vehicle air conditioning, and fire suppression and explosion protection. This action also proposes to update use conditions for substitutes previously listed for certain air conditioning end-uses and for water coolers.

DATES:

Comments must be received on or before December 26, 2025 unless a public hearing is held. If a public hearing is held, comments on this notice of proposed rulemaking must be received on or before date 30 days after date of public hearing. Public hearing: Any party requesting a public hearing must notify the contact listed in the FOR FURTHER INFORMATION CONTACT section, which is Emily Maruyama at email address: maruyama.emily@epa.gov by 5 p.m. Eastern Daylight Time on or before November 17, 2025. If a public hearing is held, it will take place on or around November 25, 2025. Please refer to the SUPPLEMENTARY INFORMATION section for additional information on the public hearing.

Read More

US EPA, 10-11-25

https://www.federalregister.gov/documents/2025/11/10/2025-19812/protection-of-stratospheric-ozone-listing-of-substitutes-under-the-significant-new-alternatives

Toxic 'forever chemicals' are in B.C. Sea otters, new study finds

2025-11-09

Sea otters living along B.C.'s South coast and Vancouver Island have high levels of toxic "forever chemicals" present in their bodies, a new study finds.

Researchers found elevated levels of the chemicals, commonly found in food packaging, cosmetics, electronics and other consumer products, in samples of 11 dead sea otters collected between 2016 and 2021.

University of British Columbia master's candidate Dana Price led the study, published this week in the journal Environmental Toxicology and Chemistry.

"I think the main takeaway here is that we did find these contaminants in sea otters. This gives us a baseline that we can compare things to in the future," she said, noting it was the first study of its kind in the province.

Read More

CBC, 09-11-25

https://www.cbc.ca/news/canada/british-columbia/sea-otters-forever-chemicals-9.6971949

From The Campus To The Community: My wok may have cooked more than dinner-A PFAS Story

2025-05-08

When I was a kid, I remember Mom bringing home a wok, probably in the late seventies or early eighties. We were thrilled, convinced that this single pan would transform our homemade Chinese food. Apparently, all we'd been missing was a wok. That pan had the slickest non-stick coating I'd ever seen and using it was like magic, especially when it came time to wash it. Years later, when I moved into my first college apartment, Mom sent the wok with me. Now, at nearly 50, I hate to admit I still have it. Over the years, I've heard countless warnings about the health risks of non-stick cookware, but whenever chicken teriyaki was on the menu, we reached for the wok.

Eventually, the growing concerns about PFAS made us retire it for good. Still, I can't help but wonder, did all those years of using that wok quietly shape my health in ways I'll never know? Perfluoroalkyl and polyfluoroalkyl substances are better known as PFAS. They are a group of over 9,000 synthetic chemicals that have quietly infiltrated our environment and bodies since their introduction in the 1940s. Used for their water, oil, and heat-resistant properties, PFAS are found in everything from nonstick cookware, like my wok, and food packaging to firefighting foam and cosmetics. Their durability has earned them the nickname: "forever chemicals."

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 14, 2025

Read More

Dalton Daily Citizen, 08-05-25

https://daltoncitizen.com/2025/11/08/from-the-campus-to-the-community-my-wok-may-have-cooked-more-than-dinner-a-pfas-story/

EUROPE

Deadly fear for animals: Will the EU reconsider its fireworks regulations?

2025-11-07

While Europe prepares for Halloween and pumpkin lanterns, spooky decorations, and the first fireworks herald the end of the year in many places, millions of animals are once again left out in the cold. What means festive cheer for many people becomes a nightmare for pets and wild animals, sometimes with fatal consequences.

It is increasingly being scientifically proven what pet owners have long known: fireworks trigger sheer panic in animals.

Around 80 percent of pets exhibit severe stress reactions, including trembling, attempts to flee, and hiding. In more than a third of cases, this stress persists long after the last loud noise. Veterinary practices report every year cases of injured or even deceased animals that collapse from fear or are injured while attempting to escape.

Read More

Wild, 07-11-25

https://wildbeimwild.com/en/deadly-fear-for-animals-will-make-the-eu-reconsider-its-fireworks-rules./

Natural England's Strategy: Underpinning Evidence

2025-11-06

Each of the outcomes in the Natural England strategy is grounded in evidence and responds to urgent environmental, social and economic challenges. This section summaries the key evidence that explains why we are focussing on what we are.

- **Outcome 1:** Recovering Nature
- **Outcome 2:** Building Better Places

- **Outcome 3:** Improving Health and Wellbeing
- **Outcome 4:** Delivering Security through Nature

Outcome 1: Recovering Nature

This summarises key evidence that shows why we are focussing on increasing the scale and quality of places where nature thrives.

Large places for nature are essential for biodiversity recovery and climate resilience

Nature recovery needs functioning ecosystems on land and at sea [footnote 1] [footnote 2]. This is especially necessary with accelerating climate change [footnote 2] [footnote 3].

Large sites allow natural processes to occur, support climate adaptation and deliver benefits for people, landscape and geology [footnote 4] [footnote 5]. Bigger sites can be self-sustaining, with natural dynamism creating diverse habitats that support species over the course of their lives [footnote 6]. These sites are more resilient due to species variety and larger populations [footnote 7] [footnote 8].

Read More

Gov.UK, 0611-25

https://www.gov.uk/government/publications/natural-englands-strategy-underpinning-evidence/natural-englands-strategy-underpinning-evidence

CHEMWATCH
Bulletin Board

REACH - Publication of HSE's draft recommendation (2025) for Annex 14 (the Authorisation List)

2025-11-04

Draft recommendation (2025) for inclusion of substances in Annex 14 of UK REACH

Periodically, HSE is required to recommend priority substances to be included on the authorisation list (Annex 14) of UK REACH. Before submitting this recommendation, HSE is required to make it publicly available on its website, inviting all interested parties to comment. HSE will update its recommendation, taking account of any comments received during this period

Three substances are included in the draft recommendation (2025) for inclusion into Annex 14 of UK REACH. The full list of substances included can also be accessed via the 'related documents' section below.

Interested parties are invited to submit comments on the substances included in the draft recommendation (2025) within 3 months of the publication date.

Read More

UK HSE, 04-11-25

https://consultations.hse.gov.uk/crd-reach/recommendation-annex-14-011/

Janet's Corner

NOV. 14, 2025

Who am I?

2025-11-14

I am a highly toxic, radioactive element named after a country in Eastern Europe. I was discovered by Marie Curie.

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

I am a highly toxic, radioactive element named after a country in Eastern Europe.

CHEMWATCH
Bulletin Board

Hazard Alert

NOV. 14, 2025

Asbestos

2025-11-15

Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment. One of these, namely chrysotile, belongs to the serpentine family of minerals, while all of the others belong to the amphibole family. Asbestos minerals consist of thin, separable fibres that have a parallel arrangement. Nonfibrous forms of tremolite, actinolite, and anthophyllite also are found naturally. However, because they are not fibrous, they are not classified as asbestos minerals. Amphibole asbestos fibres are generally brittle and often have a rod- or needle-like shape, whereas chrysotile asbestos fibres are flexible and curved. Chrysotile, also known as white asbestos, is the predominant commercial form of asbestos; amphiboles are of minor commercial importance. Asbestos fibres do not have any detectable odour or taste. They do not dissolve in water or evaporate and are resistant to heat, fire, chemical and biological degradation. [1,2]

USES [2,3]

Asbestos has been mined and used commercially in North America since the late 1800s. The building and construction industries have used it for strengthening cement and plastics as well as for insulation, roofing, fireproofing, and sound absorption. The shipbuilding industry has used asbestos to insulate boilers, steam pipes, and hot water pipes. The automotive industry uses asbestos in vehicle brake shoes and clutch pads. Asbestos has also been used in ceiling and floor tiles; paints, coatings, and adhesives; and plastics. In addition, asbestos has been found in vermiculite-containing garden products and some talc-containing crayons.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- Airborne exposure to asbestos may occur through the erosion of natural deposits in asbestos-bearing rocks, from a variety of asbestos-related industries, or from clutches and brakes on cars and trucks. The concentrations in outdoor air are highly variable.
- Asbestos has been detected in indoor air, where it is released from a variety of building materials such as insulation and ceiling and floor tiles. It is only released, however, when these building materials are

damaged or disintegrate. Typical concentrations in indoor air range from 1 to 200 nanograms per cubic metre (ng/m^3) (0.000001 to 0.002 milligrams per cubic meter (mg/m^3)).

- Asbestos may be released to water from a number of sources, including erosion of natural deposits, corrosion from asbestos-cement pipes, and disintegration of asbestos roofing materials with subsequent transport into sewers.

Routes of Exposure

- We are all exposed to low levels of asbestos in the air we breathe. These levels range from 0.00001 to 0.0001 fibres per millilitre of air and generally are highest in cities and industrial areas.
- People working in industries that make or use asbestos products or who are involved in asbestos mining may be exposed to high levels of asbestos.
- People living near these industries may also be exposed to high levels of asbestos in air.
- Asbestos fibres may be released into the air by the disturbance of asbestos-containing material during product use, demolition work, building or home maintenance, repair, and remodelling. In general, exposure may occur only when the asbestos-containing material is disturbed in some way to release particles and fibres into the air.
- Drinking water may contain asbestos from natural sources or from asbestos-containing cement pipes.

HEALTH EFFECTS [4]

Acute Health Effects

- No studies were located on the acute (short-term) toxicity of asbestos in animals or humans.

Carcinogenicity

- A large number of occupational studies have reported that exposure to asbestos via inhalation can cause lung cancer and mesothelioma (a rare cancer of the membranes lining the abdominal cavity and surrounding internal organs).
- Individuals who smoke and are also exposed to asbestos have a greater than additive increased risk of developing lung cancer.

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 14, 2025

- Several occupational studies have reported an increase in gastrointestinal cancer from inhalation exposure to asbestos and subsequent oral ingestion.
- Long- and intermediate-range asbestos fibres (>5 micrometers (μm)) appear to be more carcinogenic than short fibres (<5 μm).
- Several epidemiological studies have found an association between asbestos in drinking water and cancer of the oesophagus, stomach, and intestines; however confounding factors and the short follow-up time relative to the long latent period for tumour formation make it difficult to interpret the results.
- A series of large-scale lifetime feeding studies in animals reported that intermediate-range asbestos fibres increased the incidence of a benign tumour of the large intestine in male rats, while short-range asbestos fibres showed no significant increase in tumour incidence.
- EPA considers asbestos to be a human carcinogen (cancer-causing agent) and has ranked it in EPA's Group A.

Other Effects

- Chronic inhalation exposure to asbestos in humans can lead to a lung disease called asbestosis, which is a diffuse fibrous scarring of the lungs. Symptoms of asbestosis include shortness of breath, difficulty in breathing, and coughing. Asbestosis is a progressive disease, i.e., the severity of symptoms tends to increase with time, even after the exposure has stopped. In severe cases, this disease can lead to death, due to impairment of respiratory function.
- Other effects from asbestos exposure via inhalation in humans include pulmonary hypertension and immunological effects.
- Feeding studies in animals exposed to high doses of asbestos have not detected any evidence of adverse toxic effects.
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for asbestos.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

- **Skin Contact:** After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- **Ingestion:** Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling asbestos:

- Eye/Face Protection: ANSI 87.1 approved chemical safety glasses with side shield.
- Protective gloves: Rubber gloves
- Protective clothing: Wear protective clothing to prevent skin contact. Do NOT take working clothes home.
- Respiratory Protection: Wear NIOSH approved respirator in accordance with 29CFR1910.1001.

REGULATION

United States

- EPA: In 1989, the environmental protection agency banned all new uses of asbestos; uses established before this date are still allowed. EPA established regulations that require school systems to inspect for damaged asbestos and to eliminate or reduce the exposure by removing the asbestos or by covering it up. EPA regulates the release of asbestos from factories and during building demolition or renovation to prevent asbestos from getting into the environment.

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 14, 2025

- EPA has proposed a concentration limit of 7 million fibres per litre of drinking water for long fibres (lengths greater than or equal to 5 µm).

REFERENCES

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3. http://www.epa.gov/ttn/atw/hlthef/asbestos.html
4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=29&tid=4
5. http://www.2spi.com/catalog/msds/msds02701.html
6. https://www.osha.gov/dts/chemicalsampling/data/CH_219600.html

From Plastic to Pure Water: Scientists Turn Trash Into a Super Catalyst

2025-11-13

An optimized mechanochemical process produces multifunctional composite particles that remove pollutants from water.

Scientists are increasingly turning to sunlight as a powerful ally in cleaning up polluted water. Photocatalysts can harness solar energy to break down harmful contaminants, while photothermal evaporation uses that same energy to rapidly heat and vaporize dirty water, which then condenses into clean, drinkable liquid. Despite their promise, both methods often rely on expensive or difficult-to-manufacture materials that limit their large-scale use. This has sparked a global effort to create a single, affordable, and efficient material capable of performing multiple purification tasks—ideally one made from resources that would otherwise go to waste.

In a groundbreaking development, researchers at the Nagoya Institute of Technology (NITech) in Japan have found a way to turn common plastic waste into a powerful new tool for producing clean water. Led by Associate Professor Takashi Shirai, the team—consisting of Dr. Kunihiko Kato, Dr. Yunzi Xin, and Mr. Yuping Xu—has created multifunctional composite particles that can both purify and desalinate water using sunlight.

Their work was recently published in ACS Applied Materials & Interfaces.

Mechanochemical Synthesis Using a Planetary Ball Mill

To create this innovative material, the researchers used a planetary ball mill and carefully optimized the milling process. They began with a simple mixture of molybdenum trioxide (MoO_3) and polypropylene, a common plastic found in packaging and household goods.

Through precise mechanical processing, they converted this waste-derived mixture into composite particles containing hydrogen molybdenum bronze (H_xMoO_{3-y}), molybdenum dioxide (MoO_2), and activated carbon—materials that work together to capture sunlight and drive multiple purification reactions.

"The proposed mechanochemical process surpasses other current approaches in terms of both energy efficiency and cost-effectiveness," highlights Dr. Shirai.

Through extensive experimentation, the research team demonstrated the many remarkable capabilities of their composites. First, these particles

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

exhibited broad light absorption over the entire near-infrared–visible–ultraviolet range, allowing the photocatalytic degradation of a model organic pollutant. Interestingly, the composites also functioned as Brønsted acid catalysts and removed water pollutants even in the absence of light.

Harnessing Plasmonic and Photothermal Effects

Additionally, the proposed catalyst exhibited plasmonic properties leading to a marked photothermal effect that enabled rapid heating using sunlight. This could be leveraged to drive the fast evaporation of water with exceptional photothermal conversion efficiency. Finally, oxygen-containing carbons that remained as milling byproducts could adsorb and remove heavy metal ions from wastewater.

The research team plans to refine their ball milling process to produce similar all-in-one catalysts for water remediation and other applications. "Our developed technology has the potential to be applied to a wide range of oxides and plastics, and we anticipate that it will have varied applications, including enhancing the functionality of existing materials and upcycling waste plastics, to secure the availability of drinking water," concludes Dr. Shirai.

Sci Tech Daily, 13 November 2025

https://scitechdaily.com

Traditional yoghurt recipe reveals ants' fermentation power

2025-11-13

An age-old yoghurt recipe has united microbiologists, ecologists, anthropologists, food scientists and chefs in a project to uncover why ants make surprisingly good milk fermenters.

The interdisciplinary team duplicated a yoghurt recipe, once common across the Balkans and Türkiye, and discovered that ants produce formic acid, which kickstarts milk coagulation. Their mouths also carry lactic and acetic acid-producing bacteria that sour the yoghurt. On top of that, the ants contribute proteases – enzymes that give the yoghurt what the researchers call 'a pleasing mouthfeel'.

The project began about four years ago, when several parallel initiatives merged. Biologist and ecologist Robert Dunn, now senior vice provost for

interdisciplinary programmes at North Carolina State University in the US, helped bring them together.

About a year later, microbiologist Leonie Jahn joined the effort. She leads a team at the Technical University of Denmark's Novo Nordisk Foundation Center for Biosustainability. Her involvement followed conversations with Diego Prado Vásquez, then a researcher and chef at Copenhagen's Alchemist restaurant, and Nabila Rodríguez Valerón, a former scientist at Alchemist who now heads flavour fermentation at Summ Ingredients in Denmark.

'We were collaborating on several different topics, and had done really delicious and fascinating ferments, and I was interested in studying the microbiology and underlying biology that explains flavour and elucidates the underlying fermentation principles,' Jahn recounts.

Curious about ants

Jahn, whose work focuses on developing more environmentally friendly starter cultures and fermentation processes, had just finished reading Sandor Katz's book The Art of Fermentation and was intrigued by its mention of using ants to start yoghurt fermentation. 'I thought it was super-interesting that there was a link to this traditional practice and this gastronomic practice, and was really curious about the microbiology,' she states.

Knowing Dunn's expertise in ants and fermentation, Jahn shared the idea with him. He was already familiar with the tradition of using ants to make yoghurt and had spoken with anthropologist Sevgi Mutlu Sirakova about a possible collaboration. Sirakova, a PhD student at Ludwig Maximilian University in Munich in Germany, was researching fermentation practices and the migration of foodways – the cultural, social and economic practices surrounding food production, preparation and consumption.

At the time, Dunn was also part of a team that had just hired Veronica Sinotte, an assistant professor of food microbiology and fermentation at the University of Copenhagen, to study the practice of making ant yoghurt more in depth to study the practice making ant yoghurt more in depth.

Having been interested in using ants in food since he was a graduate student about a decade earlier, Dunn began to pull them all together. 'I am often just a hub that connects great people and also acts as a bit of a translator between anthropologists, chefs and microbiologists,' he tells Chemistry World.

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

Valerón, who completed a PhD last year in gastronomic science, says she and the chefs at Alchemist had been working with ants and milk to extract aroma compounds for dishes made with insects. She recalls that suddenly, after eight or 10 hours of refrigeration, the milk took on the texture of yoghurt with distinct aromas.

'When you coagulate milk with acid you get just the milk without any extra aroma, but with ants we got a very cheesy and buttery aroma that didn't come just from the acid coagulation,' Valerón explains. 'Normally the pH of yoghurt is below 4.5 but this yoghurt was above 4.5, so obviously something else is working here in the final product, and we thought maybe it had to do with microorganisms.'

Vásquez, who was head of R&D at Alchemist at the time, and Esther Merino, who worked at the restaurant producing and developing fermented drinks as well as craft spirits, went with the Copenhagen University team to the forests of Denmark to hunt for live ants that could be used in university's lab studies and eventually in Alchemist dishes.

Fieldwork in Bulgaria

After analysing the ants in the lab, Sirakova helped organise a field trip to her village of Nova Mahala in Bulgaria, in 2023. She brought with her a subset of the team, including Sinotte and David Zilber, a food scientist at Novonesis – a Danish biosolutions company that produces industrial enzymes and microorganisms.

Sirakova had lived in Nova Mahala until age nine, when her family immigrated to Türkiye. Yoghurt was a food staple in the village because most people owned cows and sheep, and it was a way to preserve milk. 'My grandmother, who passed away a few months ago, was the first person to tell me they used ants to make yoghurt,' Sirakova recounts. 'She remembered that from her childhood.'

Guided in the ancient practice by Sirakova's great uncle and members of the local community, the researchers collected red ants from local forests and dropped four whole ones into a jar of warm milk, which they buried in an ant mound to ferment overnight. By the next day, the milk had started to thicken and sour. The researchers who tasted the final product described it as having a rich flavour that was slightly tangy, herbaceous and reminiscent of 'grass-fed fat'.

Fine dining

Successfully recreating the ancient recipe – both in Bulgaria and in the Copenhagen lab – inspired Alchemist, a two-Michelin-star restaurant where dinner starts at DKK5400 (£636), to put its own spin on the results. The team created menu items like yoghurt ice-cream sandwiches, mascarpone-style cheeses with a pungent tang and cocktails clarified with a milk wash.

Such traditional ferments are much more microbially diverse and can contain up to 20 different microbial strains, according to Jahn. By comparison, modern industrially-produced yoghurt is usually made with just two bacterial strains. This makes it easily reproducible but means there is a much narrower flavour profile.

Natural microbial communities are also much more resilient. For example, phage infections can kill a starter culture. But having many different strains makes it is more stable and also produces richer flavours, Jahn says. Consuming more complex microbial foods may also be advantageous from a health perspective, she adds.

The study's coauthors have different takeaways from the project and various ideas about next steps. Dunn, for example, wants to better understand how many of these lactic acid bacteria are present in the mouths of different ant species and how they could be useful for culinary purposes.

'We are humans that know and like each other so this group will stay connected,' Dunn states. He notes that those involved in the study regularly meet virtually and with other scientists from around the world who are interested in food fermentation, and suggests this forum, and these connections, will spawn new and innovative research projects.

The success of such global, interdisciplinary studies depends on collaborators with very different expertise and goals building trust among one another, says Dunn. 'It is harder to be a human than to be a scientist, and in a project like this there is a lot of being human involved since it takes longer and has many different objectives,' he concludes.

Chemistry World, 14 November 2025

https://chemistrywworld.com

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

Baker's yeast carrier makes bee propolis a more potent medicine, study finds

2025-11-13

A team of researchers from the University of Chemistry and Technology in Prague has developed a novel method to enhance the natural healing properties of bee propolis, a potent remedy known for its antibacterial, antioxidant, and anti-inflammatory effects.

By encapsulating propolis extract within porous particles derived from common baker's yeast, the scientists have successfully overcome propolis's main limitation—poor water solubility. This new composite material was shown to be significantly more powerful at fighting inflammation and microbes than propolis alone.

The findings, published in the Journal of Drug Delivery Science and Technology, detail research that could lead to a new generation of highly effective, naturally-based therapies.

Propolis is a resinous substance that honeybees produce to protect their hives from diseases. It is a complex mixture of hundreds of beneficial compounds, including flavonoids and phenols, which have well-documented health benefits.

Propolis's limitations and the new solution

"For centuries, humans have used propolis as a powerful natural medicine," said Adéla Brejchová and Eva Králová, the lead authors on the study.

"However, its effectiveness has always been limited because it's waxy and doesn't dissolve in water, meaning our bodies can't easily absorb it. Most of its healing potential is locked away," added Dr. Denisa Lizoňvá, a co-author of the study.

The research team's innovative solution was to find a natural "carrier" to deliver the propolis. They turned to an inexpensive and safe source: baker's yeast (Saccharomyces cerevisiae). Through a multi-step process, they extracted the yeast's tough outer cell wall, creating hollow, porous "glucan particles" (GPs) that act like microscopic sponges.

They then used an advanced spray-drying technique—patented by UCT Prague—to successfully load the propolis extract directly into these particles.

Enhanced bioactivity and wound healing results

The study confirmed that this method was highly efficient, creating a stable, amorphous powder where the propolis was ready to be released. When tested, the new propolis-loaded glucan particles (GPs/PP) far outperformed pure propolis extract.

The GPs/PP composite released propolis rapidly, creating a "supersaturated solution" that delivered a much higher concentration of propolis's active compounds than pure extract ever could in water.

The encapsulated propolis effectively reduced key inflammatory markers (like NO and IL-6) at levels comparable to propolis dissolved in harsh organic solvents. This demonstrates a significant increase in usable bioactivity.

The new composite showed a vastly improved ability to kill the yeast Candida albicans and the "superbug"-related bacterium Staphylococcus aureus compared to propolis alone.

In a lab model simulating a wound, the GPs/PP 3 composite promoted 100% wound closure within 48 hours. In contrast, propolis extract dissolved in ethanol (the base for many commercial tinctures) failed to fully close the wound even after 72 hours.

Implications for future therapies

Such advanced bioactivity tests were possible thanks to state-of-the-art facilities at the Department of Biochemistry and Microbiology, operated by Prof. Jitka Viktorová who collaborated on the research.

"We've essentially created a delivery system that tricks propolis into dissolving in water, making it much more bioactive at lower concentrations," explained Professor František Štěpánek, a lead researcher on the project.

"The glucan particle itself is also beneficial, as it can interact with the immune system. This combination creates a synergistic effect where the whole is greater than the sum of its parts. By solving the solubility problem, we've made propolis a much more effective and viable therapeutic."

Phys Org, 13 November 2025

https://phys.org

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

This Common Metal Has an Unusual Power

2025-11-09

A new manganese(I) complex sets a record for the longest excited-state lifetime, opening the door to future large-scale applications in photochemistry.

Chemical reactions are often powered by heat, but scientists have increasingly turned to light as an energy source because it allows reactions to be guided with remarkable precision. This light-based process is called photochemistry.

Until recently, photochemical reactions depended on rare and costly metals such as ruthenium, osmium, or iridium, which also pose environmental challenges during extraction. Now, researchers at Johannes Gutenberg University Mainz (JGU) have created a groundbreaking metal complex that uses manganese—an element that is both abundant and inexpensive.

"This metal complex sets a new standard in photochemistry: it combines a record-breaking excited-state lifetime with simple synthesis," stated Professor Katja Heinze from the JGU Department of Chemistry. "It thus offers a powerful and sustainable alternative to the noble metal complexes that have long dominated light-driven chemistry."

Their findings were recently published in Nature Communications.

Single-step synthesis and strong absorption

Although manganese is more than 100,000 times more common on Earth than ruthenium, its use in photochemistry has long been limited. This was largely due to the complex, multi-step synthesis process, often requiring nine or ten stages, and the very short lifetime of its excited state.

"The newly developed manganese complex overcomes both challenges," explained Dr. Nathan East, a former doctoral student in the Heinze group who carried out the original synthesis. The new material is synthesized directly from commercially available starting materials – in just a single synthesis step.

In addition to manganese, the researchers use a ligand, which allows the properties of the complex to be tuned.

"The combination of a colorless manganese salt and the colorless ligand in solution immediately produces a deep purple color, just like ink. This is a very unusual color for a manganese complex, which showed us that

something unique was happening," added Sandra Kronenberger, who further investigated this novel manganese complex as a doctoral student in the Heinze group at the Max Planck Graduate Center (MPGC).

The resulting manganese complex not only looks impressive, it also exhibits remarkable properties: "Its light absorption is exceptionally strong, meaning the probability of capturing a light particle is very high – the complex thus uses light very efficiently," explained Dr. Christoph Förster, who supported the project with quantum chemical calculations.

Excited state lifetime exceeds the 190-nanosecond mark

"The lifetime of the complex of 190 nanoseconds is also remarkable. This is two orders of magnitude longer than any previously known complexes containing common metals such as iron or manganese," said lead scientist and spectroscopist Dr. Robert Naumann, who characterized the dynamics of the excited state of the complex using luminescence spectroscopy.

In photochemistry, the catalyst, in this case the manganese complex, is excited by light. When it encounters another molecule through diffusion, it transfers an electron to it. Since it can take nanoseconds for the particles to find each other, the excited state must last as long as possible.

But does the complex actually do what the researchers hope it will, i.e., transfer an electron to another molecule? "We were able to detect the initial product of the photoreaction – the electron transfer that occurred – and thus prove that the complex reacts as desired," summarized Professor Katja Heinze.

This discovery expands the boundaries of sustainable photochemistry. Thanks to its scalable one-step synthesis, efficient light absorption, robust photophysical behavior, and long-lasting excited state, the new manganese-containing material paves the way for future large-scale applications of photoreactions. This could be important for future applications, for example, for sustainable hydrogen production.

Sci Tech Daily, 9 November 2025

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

Nanoparticle Treatment Combats Iron Deficiency More Effectively

2025-11-13

Iron deficiency is globally widespread. Women are particularly affected, with one in five in Europe suffering from iron deficiency. The consequences are anaemia, constant fatigue, chronic headaches and a weakened immune system.

Researchers led by ETH professor Raffaele Mezzenga have now developed a new dietary supplement that could efficiently treat iron deficiency and anaemia. This development is being co-led by Michael B. Zimmermann, professor emeritus at ETH Zurich. The preparation consists of edible oat protein nanofibrils coated with iron nanoparticles. The corresponding study has just been published in the journal Nature Food.

The new iron compound is not only easy to produce but also extremely effective: the iron it contains is absorbed by the body almost twice as well as iron administered from iron sulphate – the currently most widely used standard for iron supplementation. This is shown by a rigorous clinical study conducted by Mezzenga's project partners in Thailand. They administered the compound to 52 women aged 18 to 45 who were suffering from anaemia due to iron deficiency.

Vegans could benefit

The novel preparation has several advantages. Being based on plant proteins means that it is suitable for vegetarians and vegans. "This is important because they are more likely to suffer from iron deficiency than meat-eaters: the body absorbs iron from animal foods better than iron from plant-based foods," says ETH professor Mezzenga. The new compound has further advantages: it is tasteless and colourless, meaning it does not substantially alter a food's taste or appearance. Iron sulphate, in contrast, gives food a metallic aftertaste.

"Sensory properties play a major role in consumer acceptance of food additives," says Jiangtao Zhou, the first author of the study and Mezzenga's former postdoctoral researcher and currently an assistant professor at the National University of Singapore. The oat protein iron supplement is also very easy to take: it can either be dissolved in water or juice, or added to food in powder form – muesli, for instance. "However, the clinical study shows that the supplement is best absorbed when it is dissolved in water," says Mezzenga.

Those with an iron deficiency often take iron in the wrong form

Iron occurs naturally in red meat, lentils and whole grains. Premenopausal women have a particularly high iron requirement of 18 milligrams per day. The daily requirement for men is lower, at 11 milligrams. Nevertheless, around 15 percent of men also suffer from iron deficiency. To combat this, people resort to iron supplements that the body is often unable to absorb sufficiently and require iron infusions in the case of severe iron deficiency.

Patented technology and potential for further products

The researchers originally used animal proteins to develop their iron supplement process a few years ago; however, the same patent covers all food protein sources, including those that are plant based. It has by now been granted in Europe and the USA.

Mezzenga and his colleagues now hope that the iron-enriched oat protein fibres will soon be able to be used in a variety of ways. "The hurdles for launching a dietary supplement are lower than those for a pharmacological product," explains the ETH professor, who aims to further develop the technology to combat other deficiencies, such as zinc and selenium.

Technology Networks, 13 November 2025

https://technologynetworks.com

Gas-switch reduction enables alloying in supported catalysts

2025-11-13

Supported catalysts are systems in which the active catalytic materials, such as metals, are dispersed on a solid support material, such as alumina, silica, etc. These catalysts are widely used in various chemical processes. Several methods are available for preparing supported catalysts.

Among these, the simple impregnation method is particularly suited for industrial settings. In this method, metal precursors and oxide supports are mixed, dried, and crystallized via heat treatment under certain gases. Various high-performance supported catalysts have been prepared using impregnation.

However, this method has mostly been used to synthesize conventional monometallic catalysts, which perform well only for specific chemical reactions. Given the limited number of metal catalyst and oxide support

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

materials and the growing demand for advanced catalytic reactions, there is a need to explore new methods that enhance the diversity and performance of supported catalysts.

Metal alloying as a new approach

Metal alloying is a promising method for achieving this. Random alloying can dramatically change both the structure and catalytic behavior of metals by combining their divergent properties. Yet, alloying metals is challenging, especially for immiscible metals, requiring complex methods. For industrial processes, simpler and more scalable methods are desirable.

In a breakthrough, a Japanese research team led by Assistant Professor Yoshihide Nishida from the Advanced Ceramics Research Center at Nagoya Institute of Technology successfully demonstrated simple impregnation-based alloying of an immiscible ternary rhodium–palladium–platinum (Rh–Pd–Pt) system on non-reducible alumina (Al2O3) via an innovative gas-switch-triggered reduction method.

"A key idea in our research is that oxide supports, like alumina, have exceptional heat resistance," explains Nishida. "This means that metal precursors can be stably held on the support at high temperatures. A simple gas switch can then trigger the simultaneous reduction of all metals, instantly alloying them despite their immiscibility."

The team included Takaaki Toriyama and Tomokazu Yamamoto from Kyushu University, and Katsutoshi Sato and Katsutoshi Nagaoka from Nagoya University, and Masaaki Haneda from Nagoya Institute of Technology. Their study was published in Catalysis Science & Technology on August 15, 2025.

How the gas-switch-triggered method works

The core principle of alloying immiscible metals, according to previous studies, involves simultaneous co-reduction of all metal cations. To streamline this process for supported catalysts, the researchers integrated it into the impregnation process via a gas-switch-triggered reduction method.

In conventional impregnation, only hydrogen (H2) is supplied during heat treatment to reduce the metal cations. However, this results in sequential reduction, limiting alloying. In contrast, the new method begins with an inert gas, like argon (Ar), during the initial temperature increase. Then, at a sufficiently high temperature, around 600°C, where Rh, Pd, and Pt can all

be reduced, the gas is switched to H2, triggering simultaneous reduction and alloying.

Using this method, the researchers successfully prepared an alloyed RhPdPt/Al2O3 supported catalyst, with metal precursors in an equimolar ratio.

Results, validation and industrial potential

Through X-ray absorption spectroscopy (XAS), the researchers confirmed the alloying of the metals in the prepared catalyst. In contrast, in the samples prepared using conventional impregnation, the metals retained their individual characteristics, indicating insufficient alloying.

To validate the generalizability of the method, the researchers also prepared additional catalysts: bimetallic PdPt/Al2O3, trimetallic RhPdPt/SiO2, as well as RhPdPt/Al2O3 with varied metal compositions. The results confirmed general applicability, while also highlighting potential limitations under certain support and metal compositions, which the researchers explained can be overcome by optimizing process parameters.

Notably, they also observed that the metals alloyed using the gas-switch-triggered reduction method were prone to oxidation when exposed to air, which can restructure the particles. To prevent this, the researchers recommend merging it into the pretreatment process before catalyst evaluation, allowing in situ alloy formation without oxidation.

The prepared RhPdPt/Al2O3 supported catalyst demonstrated an impressive 18 times higher catalytic performance in nitrile hydrogenation compared to monometallic catalysts. Furthermore, the proposed method does not require any specialized equipment or procedure, making it highly suitable for industrial processes.

"This proposed gas-switch-triggered reduction method is simple, scalable and has the potential to significantly reduce energy consumption in chemical manufacturing," says Nishida. "This will lead to more sustainable production of chemicals, pharmaceuticals, and fuels essential in our daily lives."

We hope this method becomes commonplace in industry, accelerating the shift toward greener and more efficient chemical synthesis.

Phys Org, 13 November 2025

https://Phys.Org

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

Nanoparticles may be the secret ingredient in making ultimate plastics

2025-09-25

A sprinkling of nanoparticles could be the solution to a problem that has long plagued plastics manufacturers – namely, how do you make a material that is both strong, tough and easy to work with?

Hu-Jun Qian at Jilin University in China and his colleagues call this the plastics trilemma: making a polymer stronger, or harder to deform, tends to make it more brittle, or less tough, while attempting to improve both of these properties at once normally makes the material more viscous and harder to work with.

To get around this, the researchers mixed nanoparticles made from polystyrene with several commonly used plastic materials. For example, they added the nanoparticles to PEMA, a polymer that is used to make hearing aids and artificial nails, acrylic glass used in aquariums and eyeglasses, and PVC, which is used in construction and packaging.

The team put the resulting materials through a series of tests to see, for example, how much they could elongate before breaking. In general, the new materials showed better-than-usual performance across different tests, sometimes dramatically – they found that PEMA was about 50 per cent stronger when fortified with nanoparticles. "This offers a general design principle for next-generation polymers with previously unattainable combinations of properties," says Qian.

To better understand why adding nanoparticles was so helpful, the researchers also carried out computer simulations of the new materials. For the case of plastics under stress, these simulations showed that nanoparticles can move and redistribute within the material, thus allowing it to deform more slowly and smoothly instead of failing. Their ability to move was similarly beneficial for plastics flowing more easily when melted. So they were stronger, tougher and workable.

Qian says that his team's approach is compatible with existing industrial processes and could be scaled up to large quantities. "This strategy could revolutionise applications requiring lightweight, strong, tough and easily processable materials—such as automotive and aerospace composites,

sustainable packaging, biomedical devices and advanced recyclable plastics," he says.

New Scientist, 25 September 2025

Sunscreen plus bleach: The surprising chemistry behind stubborn red laundry stains

2025-11-12

Have you ever tried bleaching sunscreen stains on clothing, only to be left with bright red results? Professor Clare Mahon, from the Durham University Department of Chemistry, did just this and the scarlet staining instantly intrigued her.

Determined to uncover what was happening, she joined forces with colleagues to dig into the chemistry behind the reaction.

What came next was a fascinating dive into the interaction between two common household products—one that could just save summer wardrobes the world over.

The study is published in the journal Chemical Communications.

More than meets the eye

Durham's Chemistry Department is home to the ANTENNA project—an innovative collaboration with P&G and Imperial College London developing advanced cleaning and detergent formulations. So, we're the perfect place to investigate such a surprising chemical reaction.

Clare led a team of our chemists in a detailed study of how commercial sunscreens reacted to bleach.

Of the 11 sunscreens the team tested, seven of them produced the red coloration when exposed to bleach. All seven of these contained the ingredient diethylaminohydroxybenzoyl hexyl benzoate (or DHHB for short).

Previous studies had found that parts of the DHHB molecule could be changed by adding chlorine (such as bleach). However, this change did not result in a strong coloration, making the cause of the red stains a mystery. Clare and her team suspected there was more at play.

Seeing red

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

They turned to nuclear magnetic resonance experiments to fully understand the structure of the molecules at play. Working with Professor Andy Beeby, Dr. Alan Kenwright and Dr. Eric Hughes the team found a molecular structure at odds with what standard chemistry rules would have predicted.

An unusual chemical change in the DHHB molecule was observed, where two chlorine atoms ended up in the same spot on one of its ring structures—a process called ipso-dichlorination.

Computational simulations, performed by Professor Mark Wilson showed that this new molecule would absorb most of the shorter and medium-range wavelengths of visible light, allowing only the longer red wavelengths to pass through.

The result—bright red colorization, just like on the clothes that sparked the study.

Future formulations

To confirm their findings, the team developed an ipso-dichlorination resistant version of DHHB. In this version, there was very little change in its UV absorption—suggesting it could offer a formula to avoid sunscreen staining.

Any new formulations would require further research and testing. However, there is hope on the horizon for banishing these stains for good.

Phys Org, 12 November 2025

https://phys.org

"Really bizarre" quantum discovery defies the rules of physics

2025-11-09

Lu Li, a physicist who studies advanced materials, knows that people often want to hear how his research could lead to new technologies or practical breakthroughs. But sometimes, what he uncovers is so unusual that its value lies purely in revealing how strange the universe can be.

Working with an international team of scientists, Li has made one of those discoveries, recently described in Physical Review Letters.

"I would love to claim that there's a great application, but my work keeps pushing that dream further away," said Li, a professor of physics at the

University of Michigan. "But what we've found is still really bizarre and exciting."

Quantum Oscillations: When Electrons Act Like Springs

Supported by the U.S. National Science Foundation and the U.S. Department of Energy, the research focuses on a puzzling effect called quantum oscillations. In metals, these oscillations occur when electrons behave like tiny springs, vibrating in response to magnetic fields. By changing the magnetic field's strength, scientists can alter how quickly these "electron springs" move.

In recent years, however, researchers have discovered the same quantum oscillations in insulators -- materials that should not conduct electricity or heat. That revelation has left scientists debating whether the effect originates only on the surface of these materials or deep within their interior (known as the bulk).

Searching for Answers Inside the Material

If the oscillations came from the surface, that would be particularly exciting for potential technologies. Materials called topological insulators, which conduct electricity on their surfaces while remaining insulating inside, are already being studied for new kinds of electronic, optical, and quantum devices.

To explore the mystery, Li and his collaborators turned to the National Magnetic Field Laboratory, home to the most powerful magnets in the world. Their experiments revealed that the oscillations were not just a surface effect. Instead, they came from the bulk of the material itself.

"I wish I knew what to do with that, but at this stage we have no idea," Li admitted. "What we have right now is experimental evidence of a remarkable phenomenon, we've recorded it and, hopefully, at some point, we'll realize how to use it."

A Global Collaboration and a Clear Result

The study involved more than a dozen scientists from six institutions in the United States and Japan, including research fellow Kuan-Wen Chen and graduate students Yuan Zhu, Guoxin Zheng, Dechen Zhang, Aaron Chan, and Kaila Jenkins from the University of Michigan.

"For years, scientists have pursued the answer to a fundamental question about the carrier origin in this exotic insulator: Is it from the bulk or the

CHEMWATCH
Bulletin Board
Gossip
NOV. 14, 2025

surface, intrinsic or extrinsic?" said Chen. "We are excited to provide clear evidence that it is bulk and intrinsic."

A "New Duality" in Physics

Li describes the finding as part of what he calls a "new duality." The original, or "old," duality in physics emerged more than a century ago when scientists realized that light and matter can act as both waves and particles. That discovery transformed physics and led to technologies such as solar cells and electron microscopes.

The new duality, Li says, involves materials that can behave as both conductors and insulators. His team explored this idea using a compound called ytterbium boride (YbB_{12}) inside a magnetic field so powerful that it reached 35 Tesla -- about 35 times stronger than the field inside a hospital MRI machine.

"Effectively, we're showing that this naive picture where we envisioned a surface with good conduction that's feasible to use in electronics is completely wrong," Li explained. "It's the whole compound that behaves like a metal even though it's an insulator."

Unlocking the Mystery of a "Crazy Metal"

Although this "metal-like" behavior only appears under extreme magnetic conditions, the finding raises new questions about how materials behave at the quantum level.

"Confirming that the oscillations are bulk and intrinsic is exciting," said Zhu. "We don't yet know what kind of neutral particles are responsible for the observation. We hope our findings motivate further experiments and theoretical work."

The project received additional support from the Institute for Complex Adaptive Matter, the Gordon and Betty Moore Foundation, the Japan Society for the Promotion of Science, and the Japan Science and Technology Agency.

Science Daily, 9 November 2025

https://sciencedaily.com

Bamboo dishes may leach pesticides and melamine into food

2025-11-11

So-called "eco-friendly" bamboo and other bio-based dishes, often marketed as natural and safe alternatives to plastic, may release potentially harmful chemicals into food, according to a new study led by researchers at the University of Chemistry and Technology, Prague (UCT Prague).

The investigation, published in the journal Food Control, found that a significant portion of tested tableware contained the industrial chemical melamine, which migrated into food simulants at levels exceeding legal limits.

Melamine found in bamboo-based tableware

The comprehensive study analyzed 33 bio-based dishes—including bowls, cups, and dining sets—purchased from markets in the Czech Republic, the United Kingdom, and China. Using advanced analytical techniques (UHPLC-HRMS/MS), the scientists discovered that melamine was present in 32% of the tested products, almost exclusively in those containing bamboo.

The research team performed migration tests to simulate real-world use. The results were concerning: six of the bamboo-based products were found to be non-compliant with European Union regulations, releasing melamine above the specific migration limit (SML) of 2.5 mg/kg. The study further documented that melamine leached into common beverages, including hot lemon tea and orange juice, highlighting a direct route of consumer exposure.

Misleading labels and regulatory gaps

"Our findings are a critical warning for consumers who choose bio-based tableware believing it is a safer, more sustainable option," said Professor Jana Hajslova, the corresponding author of the study and a leading researcher at UCT Prague's Department of Food Analysis and Nutrition.

"The 'natural' label can be dangerously misleading. Many of these products are essentially plastic dishes made from melamine-formaldehyde resin containing bamboo filler. Our research shows this combination can accelerate the polymer's degradation and increase the migration of harmful substances like melamine, especially into hot or acidic foods and drinks."

CHEMWATCH
Bulletin Board

Scientists Discover "Gyromorph" Materials To Enhance Light-Based Computers

2025-11-10

Researchers have been developing computers that deploy light, or photons, rather than electricity to power storage and calculations. These light-based computers have the potential to be more energy efficient than traditional computers while also running calculations at greater speeds.

However, a major challenge in the production of light-based computers—still in their infancy—is successfully rerouting microscopic light signals on a computer chip with minimal loss in signal strength. This is fundamentally a materials-design problem. These computers require a lightweight material to block additional light from all incoming directions—what's known as an "isotropic bandgap material"—in order to maintain signal strength.

Scientists at New York University report the discovery of "gyromorphs"—a material that combines the seemingly incompatible properties of liquids and crystals and that performs better than any other known structure in blocking light from all incoming angles. The breakthrough, described in the journal Physical Review Letters, marks an innovative way to control optical properties and to potentially advance the capabilities of light-based computers.

"Gyromorphs are unlike any known structure in that their unique makeup gives rise to better isotropic bandgap materials than is possible with current approaches," says Stefano Martiniani, an assistant professor of physics, chemistry, mathematics and neural science, and the paper's senior author.

In designing isotropic bandgap materials, scientists have frequently turned to quasicrystals—first conceived by physicists Paul Steinhardt and Dov Levine in the 1980s and simultaneously observed in experiments by Dan Schechtman, who received the Nobel Prize in Chemistry in 2011. Quasicrystals have a mathematical order to their structure, but, unlike a crystal, one that does not repeat.

However, there is an unfortunate trade-off in quasicrystals, the NYU researchers note: either they block out light completely, but only from a few directions, or they attenuate light from all directions, but do not quite block it. That is why scientists have continued to seek alternative materials that can block out signal-sapping light.

In the Physical Review Letters work, the NYU researchers created "metamaterials," which are engineered materials with properties stemming from their structure rather than their chemical nature. However, a challenge in creating metamaterials is first understanding how their structure gives rise to physical properties of interest.

To address these challenges, the scientists developed an algorithm to design disordered structures that were functional. In doing so, they discovered a novel form of "correlated disorder"—materials that are neither fully disordered nor fully ordered.

"Think of trees in a forest—they grow at random positions, but not completely random because they're usually a certain distance from one another," explains Martiniani. "This new pattern, gyromorphs, combines properties that we believed to be incompatible and displays a function that outperforms all ordered alternatives, including quasicrystals."

The researchers noticed that every single isotropic bandgap material had a structural signature in common.

"We wanted to make this structural signature as pronounced as possible," adds Mathias Casiulis, a postdoctoral fellow in NYU's Department of Physics and the paper's lead author. "The result was a new class of materials—gyromorphs—that reconcile seemingly incompatible features.

"This is because gyromorphs don't have a fixed, repeating structure like a crystal, which gives them a liquid-like disorder, but, at the same time, if you look at them from a distance they form regular patterns. These properties work together to create bandgaps that lightwaves can't penetrate from any direction."

Technology Networks

https://technologynetworks.com

One-pot method synthesizes blue light-responsive aryne precursors from carboxylic acids

2025-11-11

Arynes are highly reactive organic intermediates featuring a triple bond within an aromatic ring. Their strong reactivity enables them to form bonds with a wide range of functional groups, making them valuable tools for the synthesis of complex aromatic molecules in drug discovery and agricultural chemistry.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

These versatile intermediates, however, are not the first choice of synthetic chemists when designing aromatic molecules. The path to designing arynes is quite difficult.

A team of researchers from the University of Minnesota, U.S., has developed an effective method for deriving aryne precursors from commercially available carboxylic acids—in a single step. These precursors can then be triggered by blue light or mild heat.

By applying this method, the team created dozens of previously unreported aminated arynes and 20 entirely new aryne precursors in one step via nucleophilic aromatic substitution (SNAr). The findings are published in Nature.

Unpopular despite potential

Building aromatic compounds with multiple substitutions is a core and challenging task in synthetic chemistry. One intermediate that can make this process significantly easier is arynes, as these highly strained intermediates have two reactive ends that allow diverse chemical transformations.

Over the years, scientists have sought ways to make arynes more accessible for organic reactions, but progress has been limited, preventing their widespread use.

Traditional methods of deriving arynes rely on harsh bases to strip protons from strong C–H bonds, followed by halide elimination. The second step makes the process unsuitable for molecules with sensitive functional groups. Scientists have also experimented with thermally activated precursors, which turned out to be highly explosive, and the UV-light methods led to more unwanted reactions than the desired ones.

This created a vacuum for a simple, mild method that can generate diverse aryne derivatives from readily available starting materials.

Jumping over the synthesis barrier

The researchers of this study believed that the answer to this long-standing problem was hidden in a simple reagent. So they decided to explore if o-iodoniobenzoates could be transformed into aryne precursors that are easy to synthesize and can be activated by visible light or mild heat. They devised a one-pot synthesis of o-iodoniobenzoate precursors from carboxylic acids.

Unfortunately, o-iodoniobenzoates are poorly soluble and prone to unwanted side reactions. After some trial and error, the researcher discovered that introducing isopropoxy groups to o-iodoniobenzoates not only increased the moiety's solubility but also suppressed unwanted reactions.

Finally, adding a substituent adjacent to the carboxylate group produced aryne precursors that can be activated by either blue light or heating to 100 °C.

Further investigations revealed that heat activation is largely driven by a field effect, where chemical groups added near the carboxylate on the aromatic ring create an electronic field that promotes decarboxylation.

In contrast, blue light (398 nm) activation excites the molecule to a triplet state. This causes the aromatic ring to break from the iodine, and the molecule loses CO2, ultimately leading to aryne formation.

The researchers highlight that this new one-pot approach unlocks access to a vast array of aryne precursors starting from common carboxylic acids. It is compatible with many functional groups and can greatly simplify the synthesis of complex aromatic compounds for pharmaceuticals and agrochemicals, opening the door to previously unexplored chemical space.

Phys Org, 11 November 2025

https://phys.org

Bulletproof fabric laced with carbon nanotubes is stronger than Kevlar

2025-10-31

A new material is so strong that just a 1.8-millimetre-thick sheet of it could stop a bullet, making it far stronger than Kevlar and possibly the strongest fabric ever made.

Bulletproof vests work by spreading the energy of a projectile through a network of connected fibres. In the case of Kevlar, these fibres are made from aramids, a group of polymer chain chemicals known for having extreme strength. However, under extreme stress, these polymer chains can slip, limiting the protection they offer.

For the past six years, Jin Zhang at Peking University, China, and his colleagues have been trying to develop even stronger materials than

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

Kevlar or Dyneema, which is a different kind of polyethylene fibre and often cited as the world's strongest fabric.

"Ultra-high dynamic strength and toughness are crucial for fibrous materials in impact-protective applications," Zhang says. "These include bullet-proofing armours, vehicles, and aircraft."

Now his team has worked out a method of aligning carbon nanotubes with aramid polymer chains to prevent the molecules from slipping. "Our new fibre significantly surpasses all reported macroscopic high-performance polymer fibres," says Zhang. "Our fabric outperforms Kevlar entirely."

The new material is a "fabricated carbon nanotube/heterocyclic aramid composite", says Zhang, but he hopes to come up with a snappier name along the lines of Kevlar "at a later date".

Because the material is stronger than Kevlar, the same bulletproof effect can be achieved with much less material. A single layer of fabric is approximately 0.6 millimetres thick and can reduce the velocity of a bullet travelling at 300 metres per second to 220 m/s, says Zhang. "Based on energy-absorption calculations, roughly three layers of fabric are sufficient to stop the bullet," making a total thickness of 1.8 mm. By comparison, Kevlar must be at least 4 mm thick to stop that same bullet.

Julie Cairney at the University of Sydney, Australia, says the combination of aramid fibres and oriented carbon nanotubes is innovative.

"This approach could potentially be used to produce other new composites," Cairney says. She also says the manufacturing strategy is compatible with existing industrial processes, making it promising for scalable production and real-world adoption.

"For personal and military protection, these materials could be used for lighter, more effective bulletproof vests and armour, enhancing safety without sacrificing mobility," she says.

New Scientist, 31 October 2025

https://newscientist.com

This New CBD Formula Actually Reaches the Brain

2025-11-07

CBD (cannabidiol) is everywhere, but how much actually reaches the brain when you take it?

A research team at the University of Rochester and Harvard Medical School has developed a novel nano-micelle formulation of CBD that reached high brain concentrations and relieved neuropathic pain in mice within 30 minutes.

Their results suggest that improving the delivery of CBD into the nervous system may unlock its therapeutic potential for chronic pain.

Why CBD hasn't delivered for chronic pain yet?

CBD, a non-psychoactive compound from cannabis, has become widely marketed for pain relief. Yet despite its popularity, CBD's actual effects on the nervous system remain poorly understood.

Currently, the only Food and Drug Administration-approved CBD product is for specific forms of epilepsy. Its efficacy for chronic or neuropathic pain is inconsistent and often unclear. Prior animal studies have shown mixed results; while CBD can prevent pain onset in some models, it has largely failed to reverse established neuropathic pain.

A key barrier is its poor water solubility and low capacity to cross the blood–brain barrier, which limits delivery of CBD to the brain and spinal cord.

"We need to understand more about this compound, what mechanisms it interacts with in the brain, its impact on the body and whether it is a potentially safer solution for treating the chronic pain epidemic," said corresponding author Dr. Kuan Hong Wang, a professor at the University of Rochester Medical Center.

Chronic neuropathic pain is particularly difficult to treat, and current options such as gabapentin or opioids often have significant side effects and may only deliver partial relief.

Wang and the team aimed to develop a formulation that delivers CBD effectively to the brain and investigate its effects on pain-related pathways.

How the new CBD-IN nano delivery system works?

To solve the problem of poor brain delivery, the researchers created a new formulation called CBD-IN, which suspends CBD inside tiny water-friendly spheres. These nano-micelles are small enough to move efficiently through the bloodstream and cross the blood–brain barrier.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

When tested in mice with spared nerve injury, a widely used model for neuropathic pain, a single dose of CBD-IN, delivered either by injection or by mouth, produced measurable pain relief within 30 minutes.

The treated mice regained normal touch sensitivity and showed no loss of coordination, balance or memory.

Mass-spectrometry analysis confirmed that CBD-IN delivered significantly higher CBD concentrations to the brain than the standard oil-based or single-solvent formulations.

It also cleared from the liver more quickly, which could reduce the risk of liver toxicity seen with some CBD products.

"The pain relief also lasted through repeated use," said first author Dr. Jingyu Feng, staff scientist in Wang's lab at the University of Rochester Medical Center. "We did not see its effect wear off over time."

Behavioral testing showed that CBD-IN reduced pain from light touch and lowered exaggerated response to painful stimuli, while sparing normal sensory and motor function – an advantage over gabapentin and opioids, which often dull movement and cognition.

Further experiments using genetic activity mapping and calcium imaging revealed that CBD-IN calmed overactive neurons in pain-processing regions, including the spinal cord, the thalamus and the somatosensory cortex, without altering activity in healthy circuits.

Pain relief also did not rely on the classical CB1 or CB2 cannabinoid receptors, pointing to a novel mechanism of action.

"Instead, CBD-IN seems to influence broader electrical and calcium signaling in nerve cells, offering a new way to control nerve hyperactivity without triggering the 'high' or dependency risks associated with traditional cannabinoids or opioids," Feng said.

What this means for pain treatment?

By improving its bioavailability and allowing it to act only where nerve circuits are overactive, the findings suggest a higher degree of selectivity than many existing pain treatments.

"The broader implication of this research is that nanotechnology can make natural compounds like CBD more effective and precise," said Wang.

"By enhancing brain delivery and targeting only disease-related neural overactivity, this strategy could open new doors for treating chronic pain and possibly other neurological disorders, such as epilepsy or neurodegenerative diseases, where abnormal nerve activity plays a central role," he added.

A targeted, fast-acting mechanism could make cannabinoid-based therapies safer and more reliable. However, several questions remain. The precise molecular targets of CBD-IN are still uncertain, and the study only involved mice. Human trials will be needed to confirm safety, optimal dosing and long-term effects.

By addressing the long-standing delivery barrier that has limited CBD's medical use, this study provides a clear framework for using nanotechnology to refine natural therapeutics for neurological disorders.

Technology Networks, 7 November 2025

https://technologynetworks.com

Imaging method pinpoints microplastics in intact human tissue samples

2025-11-13

While microplastic pollution continues to advance, research into its possible effects on health remains hampered by technical hurdles. To date, there are no suitable methods for precisely identifying the particles in the body without destroying tissue. As part of two research projects, a team of scientists from MedUni Vienna, together with partner institutions, has now established a new method that locates microplastics in tissue in a non-destructive and spatially resolved manner—i.e., in such a way that the exact location of the particles within the intact tissue structure remains visible.

The study results, published in Analytical Chemistry and posted to the medRxiv preprint server, could advance research and help clarify possible links between microplastic exposure and chronic diseases.

The studies were conducted in cooperation with RECENDT GmbH—Research Center for Non-Destructive Testing in Linz, where the method known as OPTIR is already being used in other contexts. OPTIR stands for Optical Photothermal Infrared Spectroscopy and was originally developed to visualize chemical structures in complex materials with high spatial resolution.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

As part of the recently published research, the scientific team led by Lukas Kenner from the Clinical Department of Pathology at MedUni Vienna has demonstrated for the first time how the method can be applied to human tissue samples.

Infrared fingerprinting for precise identification

OPTIR utilizes the reaction of different materials to infrared laser light. This light heats the samples locally, whereby plastics such as polyethylene (PE), polystyrene (PS) or polyethylene terephthalate (PET) behave in a manner characteristic of their chemical structure. These specific signals are detected by a second light source, creating a so-called infrared fingerprint that allows unique chemical identification—without damaging the tissue.

What makes the newly developed testing concept so special is that the method has been successfully applied for the first time to FFPE samples (formalin-fixed and paraffin-embedded)—the type of tissue that is routinely examined and archived in clinical pathology. The tissue structure remains completely intact, making it possible to combine chemical analysis directly with subsequent histological (microscopic) or genetic assessments.

This means that microplastic particles can not only be detected, but also examined in connection with tissue changes. "In the recently published study, we were able to identify various microplastic particles in human colon tissue, including PE, PS and PET. These were found to be conspicuously frequent in areas with inflammatory changes," reports Kenner.

Additional experiments with mice and three-dimensional cell cultures also showed that even extremely small particles with a diameter of only 250 nanometers—equivalent to 0.00025 millimeters—can be reliably detected. PE, PS and PET are particularly widespread plastics that can be found in many everyday objects such as cling film, plastic bags, drinking bottles and food packaging.

Phys Org, 13 November 2025

https://phys.org

Entangled spins give diamonds a quantum advantage

2025-11-11

Working at the intersection of quantum physics and materials science, Jayich and her team study how precise atomic-scale imperfections in

diamond -- known as spin qubits -- can be engineered for advanced quantum sensing. Among the group's standout researchers, Lillian Hughes, who recently completed her Ph.D. and is heading to Caltech for postdoctoral work, made a major breakthrough in this field.

Through three co-authored papers -- one in PRX in March and two in Nature in October -- Hughes demonstrated for the first time that not just individual qubits but two-dimensional ensembles of many quantum defects can be organized and entangled inside diamond. This achievement marks a milestone toward solid-state systems that deliver a measurable quantum advantage in sensing, opening a new path for the next generation of quantum devices.

Engineering Quantum Defects in Diamond

"We can create a configuration of nitrogen-vacancy (NV) center spins in the diamonds with control over their density and dimensionality, such that they are densely packed and depth-confined into a 2D layer," Hughes explained. "And because we can design how the defects are oriented, we can engineer them to exhibit non-zero dipolar interactions." This accomplishment formed the basis of the PRX study, "A strongly interacting, two-dimensional, dipolar spin ensemble in (111)-oriented diamond."

An NV center consists of a nitrogen atom replacing a carbon atom and an adjacent vacancy where a carbon atom is missing. "The NV center defect has a few properties, one of which is a degree of freedom called a spin -- a fundamentally quantum mechanical concept. In the case of the NV center, the spin is very long lived," said Jayich. "These long-lived spin states make NV centers useful for quantum sensing. The spin couples to the magnetic field that we're trying to sense."

From MRI to Quantum Sensing

The concept of using spin as a sensor dates back to the development of magnetic resonance imaging (MRI) in the 1970s. Jayich explained that MRI works by controlling the alignment and energy states of protons and detecting the signals they emit as they relax, forming an image of internal structures.

"Previous quantum-sensing experiments conducted in a solid-state system have all made use of single spins or non-interacting spin ensembles," Jayich said. "What's new here is that, because Lillian was able to grow and engineer these very strongly interacting dense spin ensembles, we can actually leverage the collective behavior, which provides an extra

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

quantum advantage, allowing us to use the phenomena of quantum entanglement to get improved signal-to-noise ratios, providing greater sensitivity and making a better measurement possible."

Why Diamond Matters for Quantum Sensors

The type of entanglement-assisted sensing demonstrated by Hughes has been shown before, but only in gas-phase atomic systems. "Ideally, for many target applications, your sensor should be easy to integrate and to bring close to the system under study," Jayich said. "It is much easier to do that with a solid-state material, like diamond, than with gas-phase atomic sensors on which, for instance, GPS is based. Furthermore, atomic sensors require significant auxiliary hardware to confine and control, such as vacuum chambers and numerous lasers, making it hard to bring an atomic sensor within nanometer-scale proximity to a protein, for instance, prohibiting high-spatial-resolution imaging."

Jayich's team is especially focused on using diamond-based quantum sensors to study electronic properties of materials. "You can place material targets into nanometer-scale proximity of a diamond surface, thus bringing them really close to sub-surface NV centers," Jayich explained. "So it's very easy to integrate this type of diamond quantum sensor with a variety of interesting target systems. That's a big reason why this platform is so exciting."

Probing Materials and Biology with Quantum Precision

"A solid-state magnetic sensor of this kind could be very useful for probing, for instance, biological systems," Jayich said. "Nuclear magnetic resonance [NMR] is based on detecting very small magnetic fields coming from the constituent atoms in, for example, biological systems. Such an approach is also useful if you want to understand new materials, whether electronic materials, superconducting materials, or magnetic materials that could be useful for a variety of applications."

Overcoming Quantum Noise

Every measurement has a limit set by noise, which restricts precision. A fundamental form of this noise, called quantum projection noise, sets what's known as the standard quantum limit -- the point beyond which unentangled sensors cannot improve. If scientists can engineer specific interactions between sensors, they can surpass this boundary. One way to do this is through spin squeezing, which correlates quantum states to reduce uncertainty.

"It's as if you were trying to measure something with a meter stick having gradations a centimeter apart; those centimeter-spaced gradations are effectively the amplitude of the noise in your measurement. You would not use such a meter stick to measure the size of an amoeba, which is much smaller than a centimeter," Jayich said. "By squeezing -- silencing the noise -- you effectively use quantum mechanical interactions to 'squish' that meter stick, effectively creating finer gradations and allowing you to measure smaller things more precisely."

Amplifying Quantum Signals

The team's second Nature paper details another strategy for improving measurement: signal amplification. This approach strengthens the signal without increasing noise. In the meter stick analogy, amplifying the signal makes the amoeba appear larger so that even coarse measurement markings can capture it accurately.

Looking ahead, Jayich is confident about applying these principles in real-world systems. "I don't think the foreseen technical challenges will prevent demonstrating a quantum advantage in a useful sensing experiment in the near future," she said. "It's mostly about making the signal amplification stronger or increasing the amount of squeezing. One way to do that is to control the position of the spins in the 2Dxy plane, forming a regular array."

"There's a materials challenge here, in that, because we can't dictate exactly where the spins will incorporate, they incorporate in somewhat random fashion within a plane," Jayich added. "That's something we're working on now, so that eventually we can have a grid of these spins, each placed a specific distance from each other. That would address an outstanding challenge to realizing practical quantum advantage in sensing."

Science Daily, 11 November 2025

https://sciencedaily.com

Scientists Develop More Efficient Way To Extract Rare Earth Elements Amid Global Trade Tensions

2025-11-13

Researchers at UT Austin have created artificial membrane channels that mimic nature's precision to selectively extract key rare earth elements.

A team of scientists at The University of Texas at Austin has created a cleaner and more efficient way to extract rare earth elements, which are

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

vital for technologies such as electric vehicle batteries and smartphones. The technique could strengthen domestic production and lessen dependence on expensive imports.

The new process makes it possible to separate and collect rare earth elements from sources that were previously too difficult or inefficient to use, offering a potential solution to supply challenges heightened by global trade tensions.

"Rare earth elements are the backbone of advanced technologies, but their extraction and purification are energy intensive and extremely difficult to implement at the scales required," said Manish Kumar, professor in the Cockrell School of Engineering's Fariborz Maseeh Department of Civil, Architectural and Environmental Engineering and the McKetta Department of Chemical Engineering. "Our work aims to change that, inspired by the natural world."

The study, recently published in ACS Nano, describes how the team engineered artificial membrane channels, tiny pores within membranes, that imitate the highly selective transport systems of natural proteins in living organisms. In biology, such channels guide ions as they move between cells.

Each channel has unique properties that allow only ions with specific traits to pass through while blocking others. This fine-tuned selectivity is essential for many biological functions, including the way the human brain processes information.

Designing Artificial Gatekeepers

The researchers' artificial channels use a modified version of a structure called pillararene to enhance their ability to bind and block specific common ions while transporting specific rare earth ions. The result is a system that can selectively transport middle rare earth elements, such as europium (Eu^3) and terbium (Tb^3), while excluding other ions like potassium, sodium, and calcium.

"Nature has perfected the art of selective transport through biological membranes," said Venkat Ganesan, professor in the McKetta Department of Chemical Engineering and one of the research leaders. "These artificial channels are like tiny gatekeepers, allowing only the desired ions to pass through."

Rare earth elements are split into several classes (light, middle and heavy), each with different properties that make them ideal for specific

applications. Middle elements are used in lighting and displays, including TVs, and as magnets in green energy technologies, such as wind turbines and electric vehicle batteries.

The U.S. Department of Energy and the European Commission have identified several middle elements, including europium and terbium, as critical materials at risk of supply disruption. With demand for these elements expected to grow by over 2,600% by 2035, finding sustainable ways to extract and recycle them is more urgent than ever.

Remarkable Selectivity and Efficiency

In experiments, the artificial channels showed a 40-fold preference for europium over lanthanum (a light rare earth element) and a 30-fold preference for europium over ytterbium (a heavy rare earth element). These selectivity levels are significantly higher than those achieved by traditional solvent-based methods that require dozens of stages to achieve similar results.

Using advanced computer simulations, they discovered that the channels' selectivity is driven by unique water-mediated interactions between the rare earth ions and the channel. These interactions allow the channels to differentiate between ions based on their hydration dynamics—how water molecules surround and interact with ions.

Kumar and his team have been working on this research for more than five years. He is an expert in membrane-based separations, applying that knowledge to clean water generation as well.

The researchers envision their technology being integrated into scalable membrane systems for industrial use. The goal is to make it easier to conduct ion separations in the U.S., using clean energy.

They're working on a platform for these channels that allows users to select a variety of ions to gather. This could include other critical minerals like lithium, cobalt, gallium, and nickel.

This is a first step towards translating nature's sophisticated molecular recognition and transport strategies into robust industrial processes, thus bringing high selectivity to settings where current methods fall short," said Harekrushna Behera, a research associate in Kumar's lab who worked on the project.

Sci Tech Daily, 13 November 2025

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

Mushroom material takes on plastic packaging at Belgian start-up

2025-11-13

On a gleaming new production line in Brussels, Julien Jacquet shows off a row of milky-white soap bar wrappers—made by what is billed as Europe's first factory for mushroom-based packaging.

Jacquet's start-up company, Permafungi, pitches its fully biodegradable "myco-material" as a sustainable alternative to polystyrene and other polluting plastics.

"These ones are designed for hotels," he explained to visitors on a recent tour of the site.

Profitability remains a distant goal: so far Permafungi operates in a niche market, crafting custom packaging for high-end soap makers.

But the 12-person company has built a reputation on the green economy scene in Brussels by recycling grounds from local coffee shops to grow edible mushrooms over the past decade.

Now, it is looking to shift up a gear—opening a new factory to break into the fiercely competitive packaging sector.

Jacquet is highly critical of conventional packaging, often made from petroleum-based materials and shipped from far-flung corners of the globe.

His vision is to "bring the user closer to the packaging"—using mushrooms sourced from the Sonian forest on the southern rim of the Belgian capital as his starting point.

The process begins with Permafungi recovering waste materials such as sawdust that are discarded by traditional industries.

These are placed into molds, where mycelium, the root-like structure of fungi, takes over.

Feeding on the waste, the mycelium grows into the desired shape. The result—a spongy, tofu-textured mass—is dried, turned out and delivered.

Scale-up challenge

"No more petrochemicals to heat and press," said Jacquet. "Here, we just watch the mushrooms grow—with help from recycled rainwater and machines that speed up production."

Solar panels line the roof, and a wooden bike shed adds to the eco-friendly appeal of the project—which aligns with upcoming EU legislation requiring all packaging to be recyclable by 2030.

Permafungi has received two million euros in EU funding, along with regional support.

It also secured one million euros from the Swiss private equity fund Apres-Demain, led by pharmaceutical billionaire Thierry Mauvernay.

"The fund wants to support impact-driven companies that use local resources in environmentally respectful ways," said Sebastien Beth, one of its managers.

But Beth acknowledged that Permafungi "needs to be profitable within two to five years" if it wants to keep going.

As it stands, the company is expanding, with new collaborations announced with two wineries, a watch brand and a candle maker. Jacquet is aiming for three million euros in turnover within three years.

Across Europe and the United States, environmental projects using mushrooms have been popping up since the mid-2000s.

"A lot of promises have been made" around alternatives to petroleum-based materials, said Luc Vernet of Farm Europe, a think tank focused on agriculture and food. "The challenge is scaling up and managing costs."

The main obstacle, he said, remains "competition from fossil-based products, especially when oil prices are low."

The EU is expected to unveil a bioeconomy strategy later this month, which will include support for biomaterials.

The stakes are high, with packaging waste a growing source of pollution.

According to EU data, each European citizen generated nearly 190 kilograms of packaging waste in 2021—a figure projected to rise to 209 kg by 2030 without further action.

Jacquet also sees his project as a way to reindustrialize an urban area—with many parts of Europe feeling the strain from decades of factory closures.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

Permafungi's new site sits just a few hundred meters from a former Audi car plant, which shut down in February leaving around 3,000 Brussels workers jobless.

Phys Org, 13 November 2025

https://phys.org

This roof paint blocks 97% of sunlight and pulls water from the air

2025-11-03

A roof paint that can cool your home and pull fresh water straight out of the air? It's within reach, as scientists scale up production of a new kind of paint-like coating that shields roofing from the sun's rays and harvests dew from its surface.

Researchers at the University of Sydney and commercial start-up Dewpoint Innovations have created a nano-engineered polymer coating that not only reflects up to 97% of the sun's rays, but also passively collects water. In tests, it was able to keep indoors up to 6 °C (~11 °F) cooler than the air outside.

That temperature differential results in water vapor condensing on the surface – like the fogging on a cold mirror – producing a steady trickle of droplets.

In trials on the roof of the Sydney Nanoscience Hub, the coating captured dew more than 30% of the year, generating as much as 390 mL of water per square meter (roughly 13 fluid ounces per 10.8 square feet) daily. This might not sound like a lot, but a 12-sq-m (about 129-sq-ft) section of treated roof could produce around 4.7 L (around 1.25 US gallons) of water per day under optimal conditions.

Most houses have a lot more roof than that. "Over an average residential roof," reads the Dewpoint website, "you can expect enough water per day to cover your basic water needs." That's in addition, mind you, to the rainwater you'd be collecting as well, since you do need to have a typical rainwater collection system installed to capture the dew. In Sydney for example, assuming an average annual rainfall around 1 m (3.3 ft), The Tank Factory tells us we could expect to collect somewhere around 6 times more rainwater than condensation - but that equation would certainly look very different in drier areas.

"This technology not only advances the science of cool roof coatings but also opens the door to sustainable, low-cost and decentralized sources of fresh water – a critical need in the face of climate change and growing water scarcity," said research lead Chiara Neto, a professor at the University of Sydney's Nano Institute and School of Chemistry.

The team has recently finished up a six-month outdoor trial, with panels featuring the polymer paint-like coating set up on the roof of the Sydney Nanoscience Hub building. During this period, minute-by-minute data was collected on the coating's cooling and water collection abilities, and found that dew could be collected over 32% of the year, suggesting water could be harvested from the air during periods without rain. What's more, the coating withstood the challenging test of the harsh Australian sun, and showed no signs of degradation over the six months.

Most commercial white paints – especially those designed for exterior walls and roofs – use titanium dioxide as the primary pigment, which reflects UV light. However, while this novel coating may look like white paint on the surface, it gets its sun-shielding power through structure. The porous coating is made of polyvinylidene fluoride-co-hexafluoropropene (PVDF-HFP), so reflects the sun through microscopic pores. Those tiny air pockets scatter sunlight in all directions without glare and without the need of UV-absorbing chemicals that can degrade over time. The result is a self-cooling, weather-resistant film that was able to sustain its high performance throughout the lengthy testing phase.

"Our design achieves high reflectivity through its internal porous structure, delivering durability without the environmental drawbacks of pigment-based coatings," said study lead author Dr Ming Chiu, Chief Technology Officer of Dewpoint Innovations. "By removing UV-absorbing materials, we overcome the traditional limit in solar reflectivity while avoiding glare through diffuse reflection. This balance between performance and visual comfort makes it easier to integrate and is more appealing for real-world applications."

The water droplets form on the surface of the coating and, thanks to its smooth topcoat, roll off to a collection point. The team believes that large collection areas could provide water for horticulture, misting systems for cooling or even use in hydrogen production.

"While humid conditions are ideal, dew can form even in arid and semi-arid regions where night-time humidity rises," said Neto. "It's not about replacing rainfall but supplementing it – providing water where and when other sources become limited."

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

And unlike many materials that stay stuck in the purgatory of development stage, this innovation is already being scaled. Dewpoint Innovations is currently developing a water-based paint formulation that can be applied with common rollers or sprayers.

"At Dewpoint, we're proud to partner with the University of Sydney to bring this breakthrough in passive atmospheric water harvesting to life through advanced paint-based coatings," said Perzaan Mehta, CEO of Dewpoint Innovations. "It's a scalable, energy-free solution that transforms rooftops and remote infrastructure into reliable sources of clean water, helping address an urgent challenge of our time."

While still in its early stages, the team is confident it'll see a commercial release before long.

"Imagine roofs that not only stay cooler but also make their own fresh water – that's the promise of this technology," Neto added.

The research was published in the journal Advanced Functional Materials.

New Atlas, 3 November 2025

https://newatlas.com

Methanol poisoning: the chemistry behind how a toxic alcohol gets into drinks

2025-11-13

Methanol poisoning can occur when contaminated alcoholic drinks are consumed. This is a global problem, with several hundred outbreaks affecting numerous people each year. In severe cases, methanol exposure can lead to blindness, respiratory issues and even death.

Poisoning events involving methanol are rarely out of the news. More than 160 people are reported to have died from methanol poisoning in Turkey at the start of this year with dozens more hospitalised. Another nine people died in Jordan in July following consumption of alcoholic drinks contaminated with methanol. In August, tainted alcohol killed 13 people in Kuwait, and blinded another 21. And last month, UK prime minister Keir Starmer was urged to raise the methanol poisoning deaths of two British citizens in Vietnam, Greta Otteson and Arno Quinton, with the country's leader.

A lack of awareness of methanol poisoning's symptoms can contribute to misdiagnosis and delayed treatment. However, a new sensor developed in

Australia can detect methanol up to parts per billion and could potentially prevent numerous cases of methanol poisoning if simple devices like these can be rolled out to consumers.

But how is methanol ending up in alcoholic drinks in the first place?

What is methanol?

Methanol (CH_3OH) is the simplest alcohol. It is structurally similar to its more well known relative, ethanol (C_2H_5OH), which is the ingredient that gives alcoholic beverages their intoxicating effects.

Around 138 billion litres of methanol are produced each year and this is predominantly used as an industrial feedstock to synthesise other chemicals such as formaldehyde. Industry also uses methanol to produce antifreezes, perfumes, fuels and solvents.

So how does methanol end up in drinks?

Fermenting fruit or grain with yeast is the usual way of making alcoholic drinks, with alcoholic content reaching between 12–16% before fermentation efficiency decreases. Distillation can then raise the alcohol content by evaporating and condensing the alcohol, leaving behind excess water.

This distillation process is useful for removing any methanol that is produced as a side product of fermentation. Methanol has a lower boiling point (64°C) than ethanol (78°C), meaning distillation of methanol occurs first. Discarding the first few distillates, known as foreshots, removes methanol and unpleasant-tasting compounds from the final product. Poorly managed distillation, which usually occurs during small scale fermentation, can lead to the presence of unwanted methanol.

Unintentional methanol contamination is more likely to occur in traditionally fermented alcoholic beverages. Here, alcoholic drinks are made using fruits – such as grapes and berries – that are high in pectin, a naturally occurring sugar found in the cell wall of most plants. Certain yeasts, bacteria and fungi can metabolise pectin into pectic acid and methanol, thanks to the enzyme pectin esterase. Improper sterilisation of equipment or the deliberate use of wild yeast can introduce these esterase-producing microbes into the brewing process. Such fruits are frequently fermented to produce higher percentage alcohols, such as palm or plum wine, further increasing the risk of a higher methanol percentage.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

Bootleg brewers also sometimes add enough methanol to informally produced spirits to cause serious health effects. In countries where the production and selling of alcoholic drinks is illegal, these brewers do this as a cheap way of raising the alcohol content.

What happens when you consume a drink containing methanol?

Despite methanol's bad press, the compound itself is not intrinsically toxic. The metabolism of methanol is where the real issue lies.

Methanol is first oxidised by alcohol dehydrogenase to form formaldehyde. Aldehyde dehydrogenase further oxidises formaldehyde to create formic acid, the toxic chemical behind methanol poisoning. These enzymes are also responsible for metabolising ethanol, forming acetaldehyde and subsequently acetic acid. Alcohol dehydrogenase is 20 times more selective for ethanol than methanol, meaning in alcoholic drinks containing trace amounts of methanol, metabolism of methanol is limited. However, in drinks that contain more methanol, the ethanol is metabolised quickly, which then allows for methanol metabolism to occur, generating formic acid. This formic acid can be removed from the body by being broken down into carbon dioxide in a pathway involving folate, though this process is slow, allowing formic acid to build-up.

An excess of formic acid lowers blood pH and inhibits mitochondrial enzymes. Methanol poisoning can lead to blindness in severe cases, as retinal cells are rich in mitochondria as constant conversion of photons into electrical signals is an energy-intensive process. This means that the retina is particularly sensitive to high levels of formic acid, with as little as 4ml of ingested methanol leading to permanent eye damage. Formic acid also severely depresses the central nervous system, which can lead to hyperventilation and cardiac arrest, resulting in death.

A normal blood methanol concentration is less than 0.5mg/l. The World Health Organization associates levels above 500mg/l with severe toxicity, whilst concentrations in the range of 1500–2000mg/l are fatal, if left untreated.

Can methanol poisoning be treated?

Poisoning is treatable if diagnosed within 10–30 hours. However, this is often difficult as ethanol and methanol produce similar initial symptoms, such as dizziness, nausea and lack of coordination. Later, more severe symptoms can develop due to methanol ingestion, such as abdominal

pain, blurred vision or difficulty breathing. These symptoms may not show until as late as 48 hours after ingestion, making diagnosis difficult.

Administering patients with controlled doses of either ethanol or fomepizole is standard practice. These compounds are competitive inhibitors for alcohol dehydrogenase, reducing the amount of methanol converted into toxic formic acid. The kidneys can then slowly excrete the methanol from the body, with external dialysis often administered to aid and speed up this process. However, fomepizole's current price rises as high as thousands of dollars per dose, making it too expensive for those in countries most affected, despite the World Health Organization listing fomepizole as an essential drug.

Other treatments include administering sodium bicarbonate to neutralise formic acid and correct pH levels of blood and other bodily fluids, and physical support for patients such as mechanical ventilation and intubation.

Where are you most likely to get methanol poisoning?

Methanol poisoning can be challenging to diagnose, with symptoms often disguised or delayed. This can hide the true number of poisonings around the world. Statistics from Medecins Sans Frontieres show that the issue is global and has affected over 40,000 people and killed 14,000 over the past 25 years. However, Iran, India and Indonesia make up half of all recorded cases. In 2023, fomepizole was used in 3000 cases of methanol poisoning in the US, according to the United States Poison Centre.

Last month, the UK's Foreign Office added methanol poisoning advice to the advisory information on eight countries, including Japan, Mexico and Nigeria, bringing the total number of countries with such warnings to 16.

How can you reduce your risk of methanol poisoning?

The World Health Organization and the Foreign Office have listed some ways that individuals can protect themselves against methanol poisoning:

- Be wary of alcoholic drinks being sold in informal settings or at very low prices.
- Check that labelling is authentic, properly printed and that bottles have unbroken seals.
- Know the symptoms of methanol poisoning and seek medical attention as soon as possible.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 14, 2025

- For those brewing their own alcoholic drinks, ensure that commercially available yeast is used and that equipment is thoroughly sterilised. This will prevent unwanted contamination with microorganisms that could lead to a higher methanol content.

Chemistry World, 13 November 2025

https://chemistryworld.com

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Technical Notes

NOV. 14, 2025

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

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