CHEMWATCH

Bulletin Board

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ASIA PACIFIC

ACCC proposes to authorise new scheme for soft plastics recycling

2025-08-11

The ACCC has issued a draft determination proposing to grant authorisation to establish a voluntary, industry-led scheme to collect and recycle soft plastic packaging from consumers.

The scheme will be run by Soft Plastics Stewardship Australia (SPSA) and aims to increase the collection and recycling of soft plastic packaging from consumers, such as shopping bags and food wrappers. Initial members of the scheme are Woolworths, Coles, Aldi, Nestlé, Mars and McCormick Foods.

"It is clear that many Australians are concerned about the environmental impacts of soft plastic packaging and want to recycle it," ACCC Deputy Chair Mick Keogh said.

The ACCC has previously authorised the major supermarkets to engage in conduct as part of the Soft Plastics Taskforce to process the stockpile left over from REDcycle and to restart instore collection pilots until July 2026.

"We believe the proposed scheme will result in an environmental benefit as it aims to take over and expand the current in-store collection and kerbside pilots for recycling soft plastic packaging, meaning some soft plastics are likely to be diverted from landfill," Mr Keogh said.

"While we know that soft plastic recycling has faced many challenges in Australia, we consider that the SPSA scheme is an important stepping stone to expanding collections and recycling."

The ACCC considers that these public environmental benefits outweigh any potential detriment to competition that results from the collaboration through SPSA's scheme.

The ACCC is proposing to grant authorisation for eight years and to include a reporting condition to ensure transparency of the performance of the scheme. An additional condition is proposed to ensure that there is no exclusive contracts with processors.

The ACCC has also granted interim authorisation to SPSA to allow it to engage in part of the conduct now including the sharing of operational

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information and data to allow for existing arrangements of the Soft Plastics Taskforce to be transferred to SPSA.

Submissions on the ACCC's draft determination are due by 25 August 2025

Read More

ACCC, 11-08-25

https://www.accc.gov.au/media-release/accc-proposes-to-authorise-new-scheme-for-soft-plastics-recycling

More types of PFAS 'forever chemicals' in Sydney tap water than previously thought

2025-08-12

A UNSW analysis of Sydney water has found at least 31 PFAS chemicals, including 21 not previously recorded in Australian tap water, and one detected in tap water globally for the first time.

Researchers from UNSW Sydney have identified 21 new PFAS chemicals in Sydney's tap water, bringing the known total to 31 types.

While official health guidance, opens in a new window says there is currently limited evidence of human disease or other clinically significant harm resulting from PFAS exposure, the scientists say their findings reinforce the need for broader monitoring.

In a study published today in the journal Chemosphere, opens in a new window, the researchers flag two of the new PFAS chemicals as being of interest. One compound, 6:2 diPAP, has previously been found in bottled water and other consumer environments but not in tap water. The other (3:3 FTCA) has, until now, never been found in Australian tap water, and has only once before been reported in a drinking water supply worldwide.

PFAS compounds – or per- and polyfluoroalkyl substances – are often dubbed 'forever chemicals' because they don't break down naturally and persist in the environment and human body for decades.

Read More

UNSW Media, 12-08-25

https://www.unsw.edu.au/newsroom/news/2025/08/more-pfas-forever-chemicals-sydney-tap-water-previously-thought

AMERICA

Now Available: Latest Update to the TSCA Inventory

2025-08-14

The U.S. Environmental Protection Agency (EPA) has released the latest Toxic Substances Control Act (TSCA) Inventory, with the public portion available on EPA's website.

The TSCA Inventory is a list of all existing chemical substances manufactured, processed or imported in the U.S. under TSCA that do not otherwise qualify for an exemption or exclusion. This biannual update to the TSCA Inventory includes EPA's regular posting of non-confidential TSCA Inventory data. The next regular update of the TSCA Inventory is planned for winter 2026.

EPA is also updating the TSCA Master Inventory File, which includes the full, specific chemical identities claimed as confidential. The TSCA Master Inventory File now contains 86,862 chemicals of which 42,578 are active (currently known to be in use) in U.S. commerce. Other updates to the TSCA Inventory include updates to commercial activity data, unique identifier data and to regulatory flags (e.g., Significant New Use Rules and test orders).

EPA continues to perform ongoing CBI reviews resulting in a number of chemicals that no longer have confidential claims to the chemical name and have been moved to the non-confidential portion of the Inventory.

For more information on the TSCA Inventory, please visit EPA's website

Read More

US EPA, 14-08-25

https://www.epa.gov/tsca-inventory/about-tsca-chemical-substance-inventory

EPA's New Chemicals Program Could Improve Safety If Better Managed

2025-08-14

Chemicals are everywhere. From the laundry detergents and cleaning supplies we use at home to the pesticides used on crops. Some of the chemicals used in industrial, agricultural, or other sectors pose risks to the environment and human health.

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A federal program run by the Environmental Protection Agency aims to help manage the potential risks from chemicals before they enter the marketplace. Today's WatchBlog post looks at our recent report on this program.

How does EPA screen new chemicals for safety and potential hazards?

The Environmental Protection Agency is tasked with assessing and regulating chemicals for safety. Last fiscal year, EPA's New Chemicals program received more than 2,600 applications (known as notices) for new chemicals that needed review.

New chemicals are assessed through a 13-step process that includes an eco hazard review, a human health hazard review, and several other risks assessments. These include assessments about accidental releases in different settings—such as a workplace or among the general population.

For our recent report, we reviewed EPA's efforts and interviewed some chemical manufacturers that had submitted notices for new chemicals. Many of the manufacturers cited strengths in the program. For example, some said that EPA provided useful information on the process and what's expected from applicants.

Read More

US GAO, 14-08-25

https://www.gao.gov/blog/epas-new-chemicals-program-could-improve-safety-if-better-managed

EPA Seeks Small Business Input on Formaldehyde Regulation

2025-08-14

The U.S. Environmental Protection Agency (EPA) is preparing for the risk management phase of its formaldehyde regulation under the Toxic Substances Control Act (TSCA). The final risk evaluation for formaldehyde that EPA is relying on unjustifiably puts many critical industries in jeopardy that rely on this essential building block chemistry.

As part of this process, EPA will convene a Small Business Advocacy Review (SBAR) Panel to gather input from small businesses that may be impacted.

If your organization or members use formaldehyde in manufacturing, agriculture, construction, coatings, adhesives, healthcare, or other industries, your voice is needed.

The deadline for self-nominations is August 22,2025.

Submit a nomination for the formaldehyde SBAR panel

Read the formaldehyde final risk evaluation

Learn more about the SBAR process on the EPA website

What's Involved:

- Meetings with EPA this Fall
- Review of proposed regulatory options
- Opportunity to provide feedback and industry data

Who Can Participate:

- Small business owners/operators
- Trade associations representing small businesses

How to Get Involved:

- Submit a nomination for the formaldehyde SBAR panel
- Review SBA size standards by NAICS code
- Learn more about the SBAR process on the EPA website
- Read the formaldehyde final risk evaluation

Learn more at: https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2025/epa-seeks-small-business-input-on-formaldehyde-regulation

Read More

American Chemistry Council, 14-08-25

https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2025/epa-seeks-small-business-input-on-formaldehyde-regulation

Get Forever Chemicals Out of Our Food Chain

2025-08-13

To accomplish its mission, the recently created Make America Healthy Again (MAHA) Commission must stem human exposure to toxic "forever chemicals" in our foods, according to a petition from public health groups

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led by Public Employees for Environmental Responsibility (PEER). Per- and polyfluoroalkyl substances (PFAS) are called "forever chemicals" since they do not readily break down in the environment and bioaccumulate within us.

Human exposure to PFAS is associated with cancer, birth defects, and impaired functioning of the liver, kidneys, and immune system, among other adverse effects. The U.S. Environmental Protection Agency (EPA) has determined that there is no safe level of exposure for PFOA and PFOS, two legacy PFAS, in drinking water at any concentration above zero.

Besides drinking water, PFAS are ingested from contaminated foods. The petition highlights three human exposure pathways it asks the MAHA Commission to address:

- Biosolid fertilizers made from sewage sludge contain high levels of PFAS. Nearly 20% of U.S. agricultural land is estimated to use sludge-based fertilizers and as many as 70 million acres of farmland may be contaminated. PFAS from the sewage sludge are taken up by plants, and accumulate in fruits, vegetables, meat, eggs, and dairy.
- The fluorination process used by a large manufacturer of plastic containers creates PFAS in their linings which leach into their contents, including into edible oils and flavorings. An estimated 200 million containers a year are made this way.
- Pesticides containing PFAS are used throughout the country on staple foods such as corn, wheat, kale, spinach, apples and strawberries. They are also widely used in people's homes in flea and tick treatments for pets and insect-killing sprays

Read More

PEER, 13-08-25

https://peer.org/get-forever-chemicals-out-of-food-chain/

EPA Releases New Mobile Tool to Help Farmers Implement Recommended Ecological Pesticide Mitigation Measures

2025-08-14

Today, the Environmental Protection Agency (EPA) is announcing the release of the Pesticide App for Label Mitigations (PALM), an easy-to-use, mobile-friendly tool to serve as a one-stop shop that helps farmers and applicators use EPA's mitigation menu to reduce pesticide exposure to

nontarget species from agricultural crop uses. Quickly accessible in the field, at users' fingertips, PALM will make mitigation information from the final Insecticide Strategy, Herbicide Strategy and other strategies readily available in an intuitive, user-friendly format. This action supports Administrator Zeldin's Powering the Great American Comeback Initiative Pillar 1: Clean Air, Land and Water for Every American.

EPA has released multiple resources to assist applicators in determining what mitigation options are available to them, including the spray drift and runoff calculators. PALM now saves time for farmers and applicators by combining the functionality of both of these calculators in a mobile-friendly and easy-to-use web interface. This nimble application incorporates information from the Ecological Mitigation Support Document to Support Endangered Species Strategies Version 2.0 (published in April 2025), as well as the Insecticide Strategy and Herbicide Strategy. PALM also provides a useful summary to show how users can calculate their runoff and erosion mitigation points or ecological spray drift buffer reductions and what field characteristics or application parameters are applicable to their individual applications. As an on-the-go solution, the tool will help pesticide users understand available mitigation measures without the need for redundant data entry or any additional software or models.

Read More

US EPA, 14-08-25

https://www.epa.gov/pesticides/pesticide-app-label-mitigations

Kids in Pennsylvania Are Breathing (Much) Easier After a Coal Plant Shuttered

2025-08-05

In 2015, when Karen Grzywinski heard that the Shenango Coke Works near Pittsburgh was closing after 54 years in operation, she didn't believe it. Neither did her neighbors, some of whom had joined her in fighting a long battle for the plant to better control its pollution. "A number of us thought it was a joke," she said. "We were really, really surprised."

Shenango, which produced coke, a concentrated form of coal used to manufacture steel, was then a major source of air pollution in the region. After years of suffering from respiratory symptoms triggered by bad air days, Grzywinski said she noticed a change soon after the closure. "You

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could look across the river and not see this perpetual haze," she said. "It was astounding, the difference."

Since Shenango closed in 2016, researchers at New York University, the University of Pittsburgh and the Allegheny County Health Department have tracked respiratory and cardiovascular emergency room visits and hospitalizations before and after the shutdown, each time finding dramatic evidence of improvement. Two weeks ago, the authors of one of those studies published an analysis focused only on respiratory health.

Read More

Inside Climate News, 05-08-25

https://insideclimatenews.org/news/05082025/pittsburgh-asthma-cases-drop-after-coal-plant-closure/

EUROPE

NI PPP authorisations affected by upcoming EU MRL amendments

2025-07-01

Check that your PPP authorisations in NI containing the active substances propamocarb and ethephon comply with the relevant EU maximum residue levels (MRLs).

The EU MRL review programme can result in EU MRLs being lowered. PPPs authorised in NI may be affected.

Find out the status of ongoing and upcoming EU MRL reviews.

Future EU MRL amendments: publication expected late early 2025 to early 2026

In June 2025, the EU SCoPAFF (Standing Committee on Plants, Animals, Food and Feed) agreed to changes to EU MRLs for active substances under Regulation (EC) No 396/2005.

If these pass scrutiny by the European Parliament and Council, we can expect the publication of EU Implementing Regulations for the revised MRLs in the next 4 to 6 months. The MRLs are likely to come into force 6 months following publication.

It is expected that EU MRLs will be amended for the active substances:

- Dimoxystrobin
- Ethephon
- Propamocarb
- Benfluralin
- Benthiavalicarb
- Penflufen

Find out which commodities are affected by searching for the active substance in the EU MRL database. Related changes proposed to EU MRLs will shortly appear in the 'not yet applicable' column.

The list of active substances does not include the results from applications to raise EU MRLs. For example, to support new PPP uses, or proposals to list active substances on Annex IV of Regulation (EC) No 396/2005 (actives not subject to MRLs).

What HSE will do?

HSE will aim to identify NI PPP authorisations that require amending or withdrawing because of new EU MRLs coming into force and contact authorisation holders that are affected.

What NI PPP authorisation holders are advised to do?

As there are no NI authorisations for dimoxystrobin, benfluralin, benthiavalicarb, or penflufen on any crop, no amendment or withdrawal action is required because of the new EU MRLs for these active substances.

Authorisation holders for PPPs containing propamocarb and ethephon only are advised to check that their NI PPP authorisations comply with the amended EU MRLs.

Authorisation holders who identify any NI PPP authorisations that will not comply with the amended EU MRLs are advised to contact us.

Authorisation holders should review the European Food Safety Authority's reasoned opinionswhich identify data or information that is unavailable but is required to retain MRLs following EU MRL reviews.

These appear as footnotes in the EU MRL database. Authorisation holders wishing to retain EU MRLs should submit the data or information by the deadline in an application to an EU Member State.

Find guidance on submitting data to confirm EU MRLs

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Read More

EFSA, 01-07-25

https://www.efsa.europa.eu/sites/default/files/pesticides-MRL-review-progress-report.pdf

The Court of Justice upholds the annulment of the classification of titanium dioxide in certain powder forms as a carcinogenic substance

2025-08-01

Titanium dioxide is used, inter alia, in the form of a white pigment, in various products, including paints, medicinal products, foodstuffs and toys. In 2016, the Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (National Agency for Food, Environmental and Occupational Health and Safety (ANSES), France) submitted to the European Chemicals Agency (ECHA) a proposal for classification of titanium dioxide as a carcinogen by inhalation. 1 The following year, the ECHA Committee for Risk Assessment (RAC) adopted an opinion stating that the classification of that substance was justified. 2 On the basis of that opinion, in 2019, the European Commission adopted a regulation, 3 proceeding with the classification and labelling of titanium dioxide. 4 More specifically, according to the Commission, that substance was suspected of being carcinogenic to humans, by inhalation, in powder form containing 1% or more of particles of a diameter equal to or below 10 µm.

Read More

Court of Justice of the European Union, 01-08-25

https://curia.europa.eu/jcms/upload/docs/application/pdf/2025-08/cp250099en.pdf

INTERNATIONAL

Talks stall on world's first plastic pollution treaty one day before deadline

2025-08-14

Almost 100 countries reject draft treaty as 'unambitious' and 'inadequate'

Talks on the world's first legally binding treaty to end plastic pollution have stalled just one day before the negotiations are due to end.

Some of the countries calling for an ambitious treaty to include targets to reduce plastic production, including Colombia, the EU and the UK, have rejected as "unacceptable" and "unambitious" a draft treaty text that does not include production caps, nor address chemicals used in plastic products.

Almost 100 countries, including Australia, Canada, Mexico and many African and Pacific nations, have called for the adoption of legally binding measures to limit plastic production in order to address plastic at source. Many have said toxic chemicals in plastics need to be controlled.

The main sticking point at the talks, now in their third year, has been whether to cap plastic production or to focus on issues such as better design, recycling and reuse.

Read More

The Guardian, 14-08-25

https://www.theguardian.com/environment/2025/aug/13/plastic-pollution-treaty-talks-stall-one-day-before-deadline

The EEC Council approved the procedure for the formation and maintenance of the register of chemical substances and mixtures of the EAEU and the procedure for notification of new chemical substances

2025-08-01

On August 1, 2025, at a meeting of the Council of the Eurasian Economic Commission, two "second-level" documents were adopted to the Union's technical regulation "On the safety of chemical products" (EAEU TR 041/2017) – this is the procedure for the formation and maintenance of the register of chemical substances and mixtures of the Union and the procedure for notification of new chemical substances developed by the EEC jointly with the EAEU member states.

The purpose of the decision of the EEC Council to approve the Procedures is to ensure compliance with the provisions of the EAEU Technical Regulations "On the Safety of Chemical Products" (EAEU TR 041/2017). They are based on the unification of procedures for creating a single register of chemical products circulated in the EAEU, as well as notification of new chemicals. This is necessary so that market participants can receive up-to-date information on chemical products. In addition, this approach will help reduce both financial and time costs, including the process of

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preparing documents for assessing compliance with the requirements of the regulation, for example, chemical product safety data sheets.

In turn, the approval of the Procedures is one of the conditions for the entry into force of the EAEU technical regulation "On the safety of chemical products" (EAEU TR 041/2017).

The formation and maintenance of the Unified Register is planned to be carried out by means of the integrated information system of the EAEU, which in turn will require the implementation of a corresponding general process within the EAEU.

Read More

EEC Council, 01-08-25

https://eec.eaeunion.org/news/sovet-eek-utverdil-poryadok-formirovaniya-i-vedeniya-reestra-khimicheskikh-veshchestv-i-smesey-eaes-/

REACH Update

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Consultations on applications for authorisation

2025-08-13

We have launched consultations on nine applications for authorisation covering 12 uses of Chromium trioxide (EC 215-607-8) used for:

- functional chrome plating
- hard chrome plating
- etching of plastic substrates
- electroplating of plastic and metal components in personal grooming products

More details about the uses applied for and all sectors affected are available on our website.

Submit your comments through our web form by 8 October 2025.

Read More

ECHA, 13-08-25

https://echa.europa.eu/harmonised-classification-and-labelling-consultation

EU guidance for transitioning to fluorine-free firefighting foams

2025-08-13

This guidance supports stakeholders in the transition from PFAS-containing firefighting foams to fluorine-free alternatives, in line with regulatory requirements under the Persistent Organic Pollutants (POPs) and REACH regulations.

It consolidates best practice, technical and regulatory insights, and feasible solutions to help operators and regulators in the transition while maintaining high fire safety and environmental protection standards.

The guidance also addresses the requirements of the upcoming REACH restriction on PFAS in firefighting foams, which was agreed by the European Commission's REACH Committee in April 2025 and is expected to be formally adopted by the Commission later this year.

Read More

ECHA, 13-08-25

https://echa.europa.eu/understanding-pops

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Janet's Corner

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Who Am I?

2025-08-22

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

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

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

Antimony

2025-08-22

Antimony is a chemical element with symbol Sb and atomic number 51. It is semimetallic chemical element, which can exist in two forms: the metallic form is bright, silvery, hard and brittle; the non-metallic form is a grey powder. Antimony is a poor conductor of heat and electricity; it is stable in dry air and is not attacked by dilute acids or alkalis. Antimony and some of its alloys expand on cooling.[1,2]

USES [2,3]

Antimony is mixed into alloys and used in lead storage batteries, solder, sheet and pipe metal, motor bearings, castings, semiconductors, and pewter. Antimony oxide is added to textiles, plastics, rubber, adhesives, pigments and paper to prevent them from catching fire. It is also used in paints, ceramics, ammunition and fireworks, and as enamels for plastics, metal, and glass. Antimony compounds also find medical uses.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- **Industry sources:** Antimony oxides can be released as a by-product of smelting lead and other metals (emissions to air, land or water), and coal-fired power plants (emissions to air and land).
- **Diffuse sources:** Refuse incinerators, small industrial facilities involving lead casting etc, and burning of fossil fuels, e.g. for home heating (emissions to air and land).
- **Natural sources:** Antimony ores occur naturally in the earth's crust. Volcanoes can release antimony oxides into the environment. Antimony is a common component of coal and petroleum.
- **Transport sources:** Emissions result from vehicle exhaust.
- **Consumer products:** Products such as plastics, textiles, rubber, adhesives, pigments and paper. Antimony alloys are found in solder, sheet, pipe, bearing and type metals, and castings.

Antimony is a chemical element with symbol Sb and atomic number 51. [1,2]

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Routes of Exposure

- As antimony is found naturally in the environment, the general population is exposed to low levels of it every day, primarily in food, drinking water, and air.
- It may be found in air near industries that process or release it, such as smelters, coal-fired plants, and refuse incinerators.
- In polluted areas containing high levels of antimony, it may be found in the air, water, and soil.
- Workers in industries that process it or use antimony ore may be exposed to higher levels.

HEALTH EFFECTS [4]

Acute Health Effects

- The only effects reported from acute exposure to antimony by inhalation in humans are effects on the skin and eyes. Skin effects consist of a condition known as antimony spots, which is a rash consisting of pustules around sweat and sebaceous glands, while effects on the eye include ocular conjunctivitis.
- Oral exposure to antimony in humans has resulted in gastrointestinal effects.
- Animal studies have reported effects on the lungs, cardiovascular system, and liver from acute exposure to high levels of antimony by inhalation.
- Antimony is considered to have high acute toxicity based on short-term oral tests in rats, mice, and guinea pigs.

Carcinogenicity

- In one human study, inhalation exposure to antimony did not affect the incidence of cancer in workers employed for 9 to 31 years.
- Lung tumours have been observed in rats exposed to antimony trioxide by inhalation.
- EPA has not classified antimony for carcinogenicity.

Other Effects

- The primary effects from chronic exposure to antimony in humans are respiratory effects that include antimony pneumoconiosis (inflammation of the lungs due to irritation caused by the inhalation

of dust), alterations in pulmonary function, chronic bronchitis, chronic emphysema, inactive tuberculosis, pleural adhesions, and irritation.

- Other effects noted in humans chronically exposed to antimony by inhalation are cardiovascular effects (increased blood pressure, altered EKG readings and heart muscle damage) and gastrointestinal disorders.
- Animal studies have reported effects on the respiratory and cardiovascular systems and kidney from chronic inhalation exposure. Oral animal studies have reported effects on the blood, liver, central nervous system (CNS), and gastrointestinal effects.
- A National Toxicology Program (NTP) 14-day drinking water study of potassium antimony tartrate reported an increase in relative liver and kidney weights in the high dose group (females only).
- A 13-week intraperitoneal injection study, also by the NTP, reported inflammation and/or fibrosis of the liver in mice dosed with potassium antimony tartrate.
- EPA has not established a Reference Concentration (RfC) for antimony. However, EPA has established an RfC of 0.0002 milligrams per cubic metre (mg/m3) for antimony trioxide based on respiratory effects in rats.
- The Reference Dose (RfD) for antimony is 0.0004 milligrams per kilogram body weight per day (mg/kg/d) based on longevity, blood glucose, and cholesterol in rats.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

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- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Workplace Controls & Practices [4]

- Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits.
- If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling antimony:

- Splash goggles;
- Lab coat;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves.

Personal Protective Equipment in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL) - General Industry See29 CFR 1910.1000 Table Z-1	0.5 mg/m3 TWA	HE3	Chronic poisoning, functional disorders of the heart, degeneration of the heart muscle
OSHA PEL -Construction Industry See 29 CFR 1926.55 Appendix A	0.5 mg/m3 TWA	HE3	Chronic poisoning, functional disorders of the heart, degeneration of the heart muscle
OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	0.5 mg/m3 TWA	HE3	Chronic poisoning, functional disorders of the heart, degeneration of the heart muscle
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	0.5 mg/m3 TWA	HE3	Heart muscle changes, heart disease
		HE5	Spontaneous late abortion, premature birth, gynaecologic problems
		HE10	Pneumoconiosis
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2001)	0.5 mg/m3 TWA	HE15	Skin and upper respiratory tract irritation

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Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
CAL/OSHA PEL	0.5 mg/m3 TWA	HE15	Upper respiratory tract irritation

References

1. https://en.wikipedia.org/wiki/Antimony
2. http://www.lenntech.com/periodic/elements/sb.htm
3. http://www.npi.gov.au/resource/antimony-and-compounds
4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=331&tid=58
5. http://www3.epa.gov/airtoxics/hlthef/antimony.html
6. http://www.sciencelab.com/msds.php?msdsId=9927438
7. https://www.osha.gov/dts/chemicalsampling/data/CH_219100.html

Amylin Discovery Could Pave the Way for New Weight Loss Drugs

2025-08-20

Amylin, a hormone that controls appetite and blood sugar by activating three different receptors in the brain, could be the basis for the next blockbuster obesity drugs. A University of Oklahoma study published today in the journal Science Signaling reveals a new understanding of how amylin receptors react upon being activated, an advancement that will be crucial to the field of drug development.

"This paper shows the new biochemical and pharmacological methods we developed that will enable the field, for the first time, to understand exactly what drugs in development do at each of the three amylin receptors," said the paper's senior author, Augen Pioszak, Ph.D., an associate professor of biochemistry and physiology at the University of Oklahoma College of Medicine. "Amylin receptors are very complicated, and each has very different and unique properties. What we have discovered has eluded researchers for many years, and we believe our findings will advance drug development."

Amylin is secreted from the pancreas, along with insulin, after a person eats. Amylin receptors in the brain are in the same family as GLP-1 receptors, which are targeted by pioneering drugs like semaglutide (Ozempic and Wegovy).

"There has been a lot of interest in the pharmaceutical industry for developing new obesity drugs," said Sandra Gostynska, a doctoral student in Pioszak's lab who is the lead author of the paper and made the seminal findings. "What we have done is given the field new tools for understanding how a drug can affect amylin receptors."

Their findings are two-fold:

- The three amylin receptors share a core component but have differing accessory subunits, as if they wear common attire but dress it up with different accessories to make each a distinct fashion. Understanding how to target that distinctiveness may be important for creating a drug that best controls appetite and brings about the most weight loss with the fewest side effects. Gostynska developed a laboratory procedure to arrive at that understanding.
- Drugs have the potential to pull the subunits together or push them apart. This, too, could be important for drug development because the drugs may act differently depending on whether they push or pull.

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Pharmaceutical companies are already developing drugs based on amylin. Pioszak said his lab's research provides clarity for what occurs when a drug targets a complicated set of receptors.

"We believe our findings will further the study of drugs because what pharmaceutical and biotech companies want to know is what their drug does at each amylin receptor," Pioszak said. "Now we have a method of answering those questions that were previously unanswerable."

Technology Networks, 20 August 2025

https://technologynetworks.com

Alternating pulses enhance copper's role in converting CO_2 to valuable fuels

2025-08-21

Scientists from the Interface Science Department at the Fritz Haber Institute have studied how applying pulsed electric potential treatments to copper single crystal surfaces as model catalysts can improve their ability to convert carbon dioxide (CO2) into fuels like ethylene and ethanol. The key to achieving selectivity tunability relies on the control of the pulsed-induced structural and chemical catalyst transformations. This research offers insights which could help to reduce CO2 emissions and produce renewable energy sources.

The study is published in the journal Nature Catalysis.

The rapid industrialization and deforestation worldwide have led to a significant increase in carbon dioxide (CO2) emissions, a major contributor to global climate change. Addressing this issue requires innovative solutions to reduce emissions as well as to convert the still irremediably produced CO2 into useful products. Copper has emerged as a promising catalyst for this conversion, particularly in forming valuable chemical compounds like ethylene and ethanol.

The team led by Dr. Thomas Schmidt and Prof. Beatriz Roldán Cuenya has applied a recently developed method using pulsed potentials in electrochemical treatments combined with in-depth spectro-microscopy characterization methods (LEEM/XPEEM) to understand and ultimately tune the electro-catalytic properties of well-defined copper surfaces.

By applying alternating anodic (oxidizing) and cathodic (reducing) pulses, they observed that copper surfaces undergo changes in their structure (formation of specific crystalline facets) and oxidation state (generation

and stabilization of Cu(I) species) that result in a more efficient conversion of CO2 into hydrocarbons and alcohols.

Understanding the science

The study employed advanced spectro-microscopy techniques to observe these changes at a microscopic level. The researchers found that the pulsed treatments create two kinds of unique surface structures on copper. During the anodic pulse, inverted pyramid like structures with specific side facets are formed by site-selective dissolution of copper into the electrolyte. Furthermore, at this anodic pulse (+0.6 V), the copper surface is oxidized, resulting in an about 1 nm thick film of Cu(I).

Interestingly, at the following cathodic pulse (-1 V) only the topmost part of this film is reduced to metallic Cu, giving rise to a sandwich-like structure of a ~0.5 nm thick metallic copper film on a ~0.5 nm thick Cu(I) subsurface layer on the metallic copper bulk crystal. Both structures, the facets and the subsurface oxide are important for the enhanced production of ethylene and ethanol.

In particular, the coexistence of metallic and Cu2O species appears to enhance ethanol production, while stepped mainly metallic surfaces lead to enhanced ethylene yields. This insight provides valuable feedback for theoretical models and helps refine the understanding of copper's catalytic behavior.

This research offers a promising avenue for developing sustainable energy solutions. By improving the efficiency of CO2 conversion, the findings could lead to more effective ways of reutilizing "climate-killer" greenhouse gases such as carbon dioxide for the production of renewable fuels. The innovative use of pulsed electric potential treatments on copper surfaces represents a step forward in the quest for cleaner energy technologies.

Phys Org, 21 August 2025

https://phys.org

New plastic dissolves in the ocean overnight, leaving no microplastics

2025-03-27

Plastics are durable and strong, which is great while they're being used but frustrating when they end up in the environment. Scientists at RIKEN in Japan have developed a new type of plastic that's just as stable in everyday use but dissolves quickly in saltwater, leaving behind safe compounds.

The benefit of plastics is that they're made with strong covalent bonds that hold their molecules together, meaning they take a lot of energy to break. This is why they're so sturdy, long-lasting and perfect for everything from packaging to toys.

But those same strong bonds become a problem after the useful life of a plastic product is over. That cup you used once and threw away will sit in landfill for decades, even centuries, before it fully breaks down. And when it does, it forms microplastic pieces that are turning up in all corners of the natural world, including our own bodies, where they wreak havoc on our health in ways we're only just beginning to understand.

RIKEN researchers have now developed a new type of plastic that can work just as well as the regular stuff when it's needed, and break down readily into safe compounds when it's not. It's made of what are known as supramolecular polymers, which have reversible bonds that function like sticky notes that can be attached, removed and reattached, according to the team.

The team wanted to make a specific type of supramolecular polymer that would be strong enough for the usual uses of plastic, but could also be made to break down quickly when required, under mild conditions and leaving only non-toxic compounds.

After screening a range of molecules, the researchers identified a particular combination that seemed to have the right properties – sodium hexametaphosphate, which is a common food additive, and monomers based on guanidinium ions, which are used in fertilizers. When these two compounds are mixed together in water, they form a viscous material that can be dried to form plastics.

A reaction between the two ingredients forms "salt bridges" between the molecules that make the material strong and flexible, like conventional plastic. However, when they're soaked in saltwater, the electrolytes unlock those bonds, and the material dissolves.

In practice, the team found that the material was just as strong as normal plastic during use, and was non-flammable, colorless and transparent. Immersed in saltwater though, the plastic completely dissolved in about eight and a half hours.

There's one major hurdle with any degradable plastic material of course: what if it comes into contact with the catalyst for its destruction before you want it to? A plastic cup is no good if certain liquids can dissolve it, after all.

In this case, the team found that applying hydrophobic coatings prevented any early breaking down of the material. When you eventually want to dispose of it, a simple scratch on the surface was enough to let the saltwater back in, allowing the material to dissolve just as quickly as the non-coated sheets.

While some biodegradable plastics can still leave behind harmful microplastics, this material breaks down into nitrogen and phosphorus, which are useful nutrients for plants and microbes. That said, too much of these can be disruptive to the environment as well, so the team suggests the best process might be to do the bulk of the recycling in specialized plants, where the resulting elements can be retrieved for future use.

But if some of it does end up in the ocean, it will be far less harmful, and possibly even beneficial, compared to current plastic waste.

New Atlas, 27 March 2025

https://newatlas.com

Molecule Found in Guava Plants Could Help Fight Liver Cancers

2025-08-20

The team have invented a pathway that uses widely available chemicals to create molecules found in a guava plant that are known to fight deadly cancers.

You may not be aware that most of the medicines that have been approved for treatment are rooted in nature.

For example, the bark of willow trees has been called nature's aspirin because it contains a chemical called salicin. The human body converts salicin into salicylic acid, which relieves pain and fights fevers.

New research by William Chain, associate professor in the University of Delaware's Department of Chemistry and Biochemistry, and his lab, uses a molecule found in a tropical fruit to offer hope in the fight against liver-related cancers, one of the world's top causes of cancer deaths.

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Using a process called natural product total synthesis, Chain and his lab group have invented a pathway that uses widely available chemicals to create molecules found in a guava plant that are known to fight these deadly cancers. The work was published in one of the leading chemistry publications, the international journal Angewandte Chemie.

The research provides scientists around the world with an easy and low cost method to create large amounts of the naturally-occurring molecules, and opens doors to more effective and cheaper treatments.

"The majority of clinically approved medicines are either made from a natural product or are based on one," Chain said. "But there aren't enough natural resources to make enough treatments. Now chemists will be able to take our manuscripts and basically follow our 'recipe' and they can make it themselves."

The discovery invites collaboration with scientists around the world.

"We are the first ones to pave that road, and other people can repave it any which way. Find the shortcuts if they have to. But since we entered into that unknown territory, I think we helped shed light on this unknown pathway that can get us there. And I think that's the cool part," said Liam O'Grady, doctoral student in Chain's lab and the article's first author.

The potential impact is enormous. The number of liver and bile duct cancer cases has grown dramatically in recent years, with one in 125 men and women globally projected to be diagnosed with hepatocellular cancer over the course of their lives.

In the United States, chemotherapies for liver cancers are a multi-billion-dollar health burden and the current five-year survival rates for late-stage liver cancers are under 15%. In 2025 in the US alone, more than 42,000 people will be diagnosed and over 30,000 will lose their battle.

The team is working with the National Cancer Institute on the next steps for the process, and whether the guava molecule may be effective in fighting other types of cancers.

Technology Networks, 20 August 2025

https://technologynetworks.com

Heat-Based Hair Care Routines May Expose You to More Than 10 Billion Nanoparticles

2025-08-21

A typical morning hair care routine can expose you to as much immediate nanoparticle pollution as standing in dense highway traffic, report Purdue University engineers.

A Purdue research team led by Nusrat Jung, an assistant professor in the Lyles School of Civil and Construction Engineering, and her PhD student Jianghui Liu found that a 10-20 minute heat-based hair care routine exposes a person to upward of 10 billion nanoparticles that are directly deposited into their lungs. These particles can lead to serious health risks such as respiratory stress, lung inflammation and cognitive decline. The team's findings were recently published in Environmental Science & Technology.

"This is really quite concerning," Jung said. "The number of nanoparticles inhaled from using typical, store-bought hair care products was far greater than we ever anticipated."

Until this study, Jung said, no real-time measurements on nanoparticle formation during heat-based hair styling had been conducted in full-scale residential settings. Their research addresses this gap by examining temporal changes in indoor nanoparticle number concentrations and size distributions during realistic heat-based hair styling routines.

"By providing a detailed characterization of indoor nanoparticle emissions during these personal care routines, our research lays the groundwork for future investigations into their impact on indoor atmospheric chemistry and inhalation toxicity," Jung said. "Studies of this kind have not been done before, so until now, the public has had little understanding of the potential health risks posed by their everyday hair care routines."

What makes these hair care products so harmful, Liu said, is when they are combined with large amounts of heat from styling appliances such as curling irons and straighteners. When combined with heat exceeding 300 degrees Fahrenheit, the chemicals not only rapidly release into the air but also lead to the formation of substantial numbers of new airborne nanoparticles.

"Atmospheric nanoparticle formation was especially responsive to these heat applications," Liu said. "Heat is the main driver — cyclic siloxanes and

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other low-volatility ingredients volatilize, nucleate and grow into new nanoparticles, most of them smaller than 100 nanometers."

In a study Jung published in 2023, her team found that heat significantly increased emissions of volatile chemicals such as decamethylcyclopentasiloxane (aka D5 siloxane) from hair care routines. D5 siloxane in particular was identified as a compound of concern when inhaled.

"When we first studied the emissions from hair care products during heat surges, we focused on the volatile chemicals that were released, and what we found was already quite concerning," Jung said. "But when we took an even closer look with aerosol instrumentation typically used to measure tailpipe exhaust, we discovered that these chemicals were generating bursts of anywhere from 10,000 to 100,000 nanoparticles per cubic centimeter."

Jung said that D5 siloxane is an organosilicon compound and is often listed first or second in the ingredient lists of many hair care products, indicating it can be among the most abundant ingredients. It has become a common ingredient over the past few decades in many personal care products due to its low surface tension, inertness, high thermal stability and smooth texture.

According to the European Chemicals Agency, D5 siloxane is classified as "very persistent, very bioaccumulative." And while the test results on laboratory animals are already concerning, Jung said, there is little information on its human impact. The chemical in wash-off cosmetic products has already been restricted in the European Union because of this.

"D5 siloxane has been found to lead to adverse effects on the respiratory tract, liver and nervous system of laboratory animals," Jung said previously. However, under high heat, cyclic siloxanes and other hair care product ingredients can volatilize and contribute to the formation of large numbers of airborne nanoparticles that deposit efficiently throughout the respiratory system. These secondary emissions and exposures remain far less characterized than the primary chemical emissions.

"And now it appears that the airborne hazards of these products — particularly 'leave-on' formulations designed to be heat-resistant, such as hair sprays, creams and gels — are even greater than we expected," Liu said.

According to the report, respiratory tract deposition modeling indicated that more than 10 billion nanoparticles could deposit in the respiratory system during a single hair styling session, with the highest dose occurring in the pulmonary region — the deepest part of the lungs. Their findings identified heat-based hair styling as a significant indoor source of airborne nanoparticles and highlight previously underestimated inhalation exposure risks.

As for how to avoid putting oneself at risk of inhaling mixtures of airborne nanoparticles and volatile chemicals, Jung and Liu said the best course of action is simply to avoid using such products — particularly in combination with heating devices. If that is not possible, Jung recommends reducing exposure by using bathroom exhaust fans for better room ventilation.

"If you must use hair care products, limit their use and ensure the space is well ventilated," Liu said. "Even without heating appliances, better ventilation can reduce exposure to volatile chemicals, such as D5 siloxane, in these products."

To more fully capture the complete nanoparticle formation and growth process, Jung said future studies should integrate nano mobility particle sizing instruments capable of detecting particles down to a single nanometer. The chemical composition of these particles should also be evaluated.

"By addressing these research gaps, future studies can provide a more holistic understanding of the emissions and exposures associated with heat-based hair styling, contributing to improved indoor air pollution assessments and mitigation strategies," Jung said.

Gathering the data

Jung and Liu's experimental research was conducted in a residential architectural engineering laboratory that Jung designed: the Purdue zero Energy Design Guidance for Engineers (zEDGE) tiny house.

The zEDGE lab is a mechanically ventilated, single-zone residential building with a conditioned interior. A state-of-the-art high-resolution electrical low-pressure impactor (HR-ELPI+) from Jung's laboratory was used to measure airborne nanoparticles in indoor air in real time, second by second. In parallel, a proton transfer reaction time-of-flight mass spectrometer (PTR-TOF-MS) was used to monitor volatile chemicals in real time.

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The hair care routine emission experiments were conducted during a measurement campaign in zEDGE over a period of several months, including three experiment types: realistic hair care experiments that replicate actual hair care routines in the home environment, hot plate emission experiments that explore the relationship between the temperature of the hair care tools and nanoparticle formation, and surface area emission experiments that investigate how hair surface area impacts nanoparticle emissions during hair care events.

For the realistic hair care routine emission experiments, participants were asked to bring their own hair care products and hair styling tools to replicate their routines in zEDGE. Prior to each experiment, the participants were instructed to separate their hair into four sections. The hair length of each participant was categorized as long hair (below the shoulder) or short hair (above the shoulder). The sequence of each experiment consisted of four periods, to replicate a real-life routine.

After hair styling, the participants had two minutes to collect the tools and leave zEDGE; this was followed by a 60-minute concentration decay period in which zEDGE was unoccupied, and the HR-ELPI+ monitored the decay in indoor nanoparticle concentrations. The experiments and subsequent analysis focused on the formation of nanoparticles and resulting exposure during and after active hair care routine periods.

Technology Networks, 21 August 2025

https://technologynetworks.com

Scientists Discover a New Crystal That Breathes Oxygen

2025-08-18

A team of scientists from Korea and Japan has discovered a new type of crystal that can "breathe"—releasing and absorbing oxygen repeatedly at relatively low temperatures. This unique ability could transform the way we develop clean energy technologies, including fuel cells, energy-saving windows, and smart thermal devices.

The newly developed material is a special kind of metal oxide made of strontium, iron, and cobalt. What makes it extraordinary is that it can release oxygen when heated in a simple gas environment and then take it back in, all without falling apart. This process can be repeated many times, making it ideal for real-world applications.

This remarkable study has been led by Professor Hyoungjeen Jeen from the Department of Physics, Pusan National University, Korea, and co-

authored by Professor Hiromichi Ohta from the Research Institute for Electronic Science, Hokkaido University, Japan. Their findings have been published in the journal Nature Communications osn August 15, 2025.

"It is like giving the crystal lungs and it can inhale and exhale oxygen on command," says Prof. Jeen. Controlling oxygen in materials is crucial for technologies like solid oxide fuel cells, which produce electricity from hydrogen with minimal emissions. It also plays a role in thermal transistors—devices that can direct heat like electrical switches—and in smart windows that adjust their heat flow depending on the weather.

Until now, most materials that could do this kind of oxygen control were too fragile or operated only at the harsh conditions like extremely high temperatures. This new material works under milder conditions and remains stable.

"This finding is striking in two ways: only cobalt ions are reduced, and the process leads to the formation of an entirely new but stable crystal structure," explains Prof. Jeen.

They also showed that the material could return to its original form when oxygen was reintroduced, proving that the process is fully reversible. "This is a major step towards the realization of smart materials that can adjust themselves in real time," says Prof. Ohta. "The potential applications range from clean energy to electronics and even eco-friendly building materials."

Technology Networks, 18 August 2025

https://technologynetworks.com

New formula improves accuracy of particle concentration measurements in diverse samples

2025-08-21

Researchers can use a metric called the particle number concentration (PNC) to calculate the number of particles in a sample, such as the number of marbles in a jar.

Researchers at the National Institute of Standards and Technology (NIST) have developed a new mathematical formula to calculate the concentration of particles suspended in a solution. The new approach, which yields more accurate results than current methods, can be used to deliver the correct drug dosage to patients, measure the amount of nanoplastics in ocean water, and help ensure the correct level of additives in food products, among other applications.

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The researchers have published their findings in Analytical Chemistry.

"This new formula has the potential to help advance nanotechnology applications, such as food packing and preservation, and the fabrication of microchips and electronic devices," said NIST engineer Elijah Petersen, who helped test the new formula. "It improves upon current methods by correcting for a common bias that assumes that particles are uniform in size."

The particle number concentration measures how many particles are present in a given volume of gas or liquid. It is usually expressed in particles per cubic centimeter.

One way to find the concentration of particles suspended in a solution is to use two variables: the total mass of particles in solution and their size. However, the particles' size can vary. This is referred to as their size distribution.

Current mathematical approaches work well when the particles are nearly uniform in size. However, they can produce inaccurate results when the particles vary significantly in size.

To understand why size distribution is important, imagine a contest where you have to estimate how many candies are in a jar. If the candies are all the same size, say a bunch of M&Ms, then you can use quick calculations to estimate the total number of candies in the jar. But what if the candies are different sizes? Let's say there are full-size Kit Kats and Reese's peanut butter cups mixed in. In that case, you would be better off with a different approach.

The new formula, which was derived by former NIST researcher Natalia Farkas, accounts for the variation in particle size to give a more accurate result.

To test the new formula, researchers applied it to samples of gold nanoparticles in water. NIST scientists had previously characterized these samples using multiple laboratory methods, providing highly accurate measurements of their actual particle number concentrations. The results showed that while the previous formulas overestimated the particle number concentration by about 6%, the new formula was accurate to within 1% of the directly measured value.

Researchers then applied the new formula to a more practical example: an anti-caking agent used in food production. Unlike gold nanoparticles, which have a relatively narrow size distribution, the particles in this

material varied widely in size. In this case, the estimates from the new and old formulas differed by as much as 36%.

"There are different ways to calculate the particle number concentration," Petersen said. "Choosing the right formula can make a big difference."

Phys Org, 21 August 2025

https://phys.org

Chinese Scientists Develop Breakthrough Catalyst for Clean Propane Conversion

2025-07-29

Propane dehydrogenation (PDH) is a chemical process that requires a large input of heat, typically needing temperatures above 600°C when carried out using traditional thermo-catalytic methods. These high temperatures pose several issues, including high energy usage, degradation of the catalyst through sintering, and the buildup of carbon deposits known as coke. Scientists have long sought ways to overcome these limitations and carry out PDH at or near room temperature, which remains a key challenge in the field of catalysis.

A new study published in Nature Chemistry offers a promising solution. Led by Prof. Tao Zhang and Prof. Aiqin Wang from the Dalian Institute of Chemical Physics at the Chinese Academy of Sciences (CAS), in collaboration with Prof. Yi Gao's team at the Shanghai Advanced Research Institute of CAS, the researchers introduced a novel approach.

They developed a water-assisted PDH process that uses a copper single-atom catalyst (SAC) and is driven by a combination of light and heat, known as photo-thermo catalysis. This method enables efficient conversion of propane into propylene at much lower temperatures than previously possible.

Efficient Reaction at Near-Room Temperature

By using a Cu1/TiO2 SAC, researchers achieved PDH under near-ambient conditions in a water vapor atmosphere. In a continuous-flow fixed-bed reactor, the reaction temperature was reduced to just 50–80 °C, achieving a maximum reaction rate of 1201 μmol gcat-1 h-1.

Researchers revealed that Cu single atoms, water vapor, and light illumination all played essential roles in the propane-to-propylene conversion.

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Through photocatalytic water splitting on the Cu1/TiO2 SAC, hydrogen and hydroxyl species were generated. Hydroxyl radicals subsequently adsorbed on the catalyst surface, abstracting hydrogen atoms from propane to form propylene and water. Water acted catalytically without being consumed. This mechanism fundamentally differs from traditional PDH and oxidative dehydrogenation of propane.

Furthermore, researchers demonstrated that the developed route could be extended to the dehydrogenation of other light alkanes, including ethane and butane. The reaction could even be directly driven by sunlight using the Cu1/TiO2 SAC.

"Our study not only provides a new way for PDH but also establishes a paradigm for conducting high-temperature reactions driven by solar energy," said Prof. Xiaoyan Liu, one of the corresponding authors of the study.

Sci Tech Daily, 29 July 2025

https://scitechdaily.com

A Sprinkle of Iron Microparticles on Your Food Could Fight Malnutrition

2025-08-14

Around the world, about 2 billion people suffer from iron deficiency, which can lead to anemia, impaired brain development in children, and increased infant mortality.

To combat that problem, MIT researchers have come up with a new way to fortify foods and beverages with iron, using small crystalline particles. These particles, known as metal-organic frameworks, could be sprinkled on food, added to staple foods such as bread, or incorporated into drinks like coffee and tea.

"We're creating a solution that can be seamlessly added to staple foods across different regions," says Ana Jaklenec, a principal investigator at MIT's Koch Institute for Integrative Cancer Research. "What's considered a staple in Senegal isn't the same as in India or the U.S., so our goal was to develop something that doesn't react with the food itself. That way, we don't have to reformulate for every context — it can be incorporated into a wide range of foods and beverages without compromise."

The particles designed in this study can also carry iodine, another critical nutrient. The particles could also be adapted to carry important minerals such as zinc, calcium, or magnesium.

"We are very excited about this new approach and what we believe is a novel application of metal-organic frameworks to potentially advance nutrition, particularly in the developing world," says Robert Langer, the David H. Koch Institute Professor at MIT and a member of the Koch Institute.

Jaklenec and Langer are the senior authors of the study, which appears today in the journal Matter. MIT postdoc Xin Yang and Linzixuan (Rhoda) Zhang PhD '24 are the lead authors of the paper.

Iron stabilization

Food fortification can be a successful way to combat nutrient deficiencies, but this approach is often challenging because many nutrients are fragile and break down during storage or cooking. When iron is added to foods, it can react with other molecules in the food, giving the food a metallic taste.

In previous work, Jaklenec's lab has shown that encapsulating nutrients in polymers can protect them from breaking down or reacting with other molecules. In a small clinical trial, the researchers found that women who ate bread fortified with encapsulated iron were able to absorb the iron from the food.

However, one drawback to this approach is that the polymer adds a lot of bulk to the material, limiting the amount of iron or other nutrients that end up in the food.

"Encapsulating iron in polymers significantly improves its stability and reactivity, making it easier to add to food," Jaklenec says. "But to be effective, it requires a substantial amount of polymer. That limits how much iron you can deliver in a typical serving, making it difficult to meet daily nutritional targets through fortified foods alone."

To overcome that challenge, Yang came up with a new idea: Instead of encapsulating iron in a polymer, they could use iron itself as a building block for a crystalline particle known as a metal-organic framework, or MOF (pronounced "moff").

MOFs consist of metal atoms joined by organic molecules called ligands to create a rigid, cage-like structure. Depending on the combination

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of metals and ligands chosen, they can be used for a wide variety of applications.

"We thought maybe we could synthesize a metal-organic framework with food-grade ligands and food-grade micronutrients," Yang says. "Metal-organic frameworks have very high porosity, so they can load a lot of cargo. That's why we thought we could leverage this platform to make a new metal-organic framework that could be used in the food industry."

In this case, the researchers designed a MOF consisting of iron bound to a ligand called fumaric acid, which is often used as a food additive to enhance flavor or help preserve food.

This structure prevents iron from reacting with polyphenols — compounds commonly found in foods such as whole grains and nuts, as well as coffee and tea. When iron does react with those compounds, it forms a metal polyphenol complex that cannot be absorbed by the body.

The MOFs' structure also allows them to remain stable until they reach an acidic environment, such as the stomach, where they break down and release their iron payload.

Double-fortified salts

The researchers also decided to include iodine in their MOF particle, which they call NuMOF. Iodized salt has been very successful at preventing iodine deficiency, and many efforts are now underway to create "double-fortified salts" that would also contain iron.

Delivering these nutrients together has proven difficult because iron and iodine can react with each other, making each one less likely to be absorbed by the body. In this study, the MIT team showed that once they formed their iron-containing MOF particles, they could load them with iodine, in a way that the iron and iodine do not react with each other.

In tests of the particles' stability, the researchers found that the NuMOFs could withstand long-term storage, high heat and humidity, and boiling water.

Throughout these tests, the particles maintained their structure. When the researchers then fed the particles to mice, they found that both iron and iodine became available in the bloodstream within several hours of the NuMOF consumption.

The researchers are now working on launching a company that is developing coffee and other beverages fortified with iron and iodine. They

also hope to continue working toward a double-fortified salt that could be consumed on its own or incorporated into staple food products.

The research was partially supported by J-WAFS Fellowships for Water and Food Solutions.

Technology Networks, 14 August 2025

https://technologynetworks.com

One catalyst, two reactions: Multiple reaction steps now possible in one vessel using inexpensive cerium

2025-08-21

Most of the drugs, plastics, and industrial materials widely used today are produced through chemical reactions. In general, most high-performance and sophisticated substances have complex structures, and their assembly involves multiple chemical reaction steps carried out one after another. This creates significant overhead, as each step requires specific conditions, reagents, and catalysts, as well as considerable energy and labor.

Tandem reactions offer a promising solution to this issue. The core idea is to carry out multiple reactions in sequence within the same container without needing to isolate intermediate products or change catalysts. While repeating the same type of reaction is relatively straightforward, a major challenge has been developing a single catalyst that can facilitate completely different types of reactions.

Now, a research team led by Associate Professor Shinji Harada from the Graduate School of Pharmaceutical Sciences, Chiba University, Japan, has developed a solution to this problem. Their new method, known as "redox-adaptive auto-tandem catalysis," uses a single catalyst to enable two different chemical reactions in a single container. Their study, which was co-authored by Professor Tetsuhiro Nemoto and Ms. Nanami Tsuji from Chiba University, was published online in the journal ACS Catalysis on August 3, 2025.

The researchers achieved this by leveraging the unique catalytic properties of cerium, a widely used rare-earth element. By sheer accident, a member of the team left a reaction flask exposed to air when studying a reaction involving cerium. To their surprise, they found a new, completely unexpected product as a result of this exposure. This fortunate event caught the team's attention and ultimately led them to a key discovery useful for tandem reactions.

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Unlike other rare-earth elements, cerium can easily interconvert between two oxidation states, adopting two configurations that promote different chemical transformations. Inspired by the unexpected results of their previous experiment, the researchers explored ways to leverage this property.

After screening and testing with various inexpensive cerium-based catalysts, they succeeded in linking two different reactions. The first reaction is a ring-forming step, which acts on the initial reactants to produce an intermediate compound with a five-membered ring structure. The second reaction is an oxidation reaction, which adds oxygen to the intermediate compound to produce the final compound.

Each reaction is catalyzed by a different oxidation state of cerium, and the act of catalyzing either reaction "flips" cerium to the other oxidation state. In this way, as Dr. Harada puts it, "Cerium acts like a chameleon, dynamically changing its function to perform completely different types of reactions sequentially in a single vessel."

Using this method, the researchers synthesized various α-hydroxylated cyclopentenones, compounds valuable for pharmaceutical synthesis, in high yields under mild conditions. The fact that a single cerium catalyst can change roles autonomously without external intervention between two different reactions could help make chemical manufacturing much simpler and energy efficient.

"Our findings may lead to lower costs and reduced chemical waste, contributing to greener and more sustainable synthetic processes," says Dr. Harada. Notably, this technique requires no hazardous reagents and can be performed with standard laboratory equipment without the need for special devices.

The team will focus on expanding their newfound redox-adaptive auto-tandem catalysis method to a broader range of chemical reactions, especially those relevant in pharmaceuticals and functional material manufacturing. This would not only accelerate drug development and innovations in next-generation materials, but also contribute to creating new manufacturing technologies with a lower environmental impact.

Phys Org, 21 August 2025

https://phys.org

Don't throw away those cannabis leaves—they're packed with rare compounds

2025-08-13

Analytical chemists from Stellenbosch University (SU) have provided the first evidence of a rare class of phenolics, called flavoalkaloids, in cannabis leaves.

Phenolic compounds, especially flavonoids, are well-known and sought after in the pharmaceutical industry because of their antioxidant, anti-inflammatory, and anti-carcinogenic properties.

The researchers identified 79 phenolic compounds in three strains of cannabis grown commercially in South Africa, of which 25 were reported for the first time in cannabis. Sixteen of these compounds were tentatively identified as flavoalkaloids. Interestingly, the flavoalkaloids were mainly found in the leaves of only one of the strains. The results were published in the Journal of Chromatography A recently.

Dr. Magriet Muller, an analytical chemist in the LC-MS laboratory of the Central Analytical Facility (CAF) at Stellenbosch University and first author on the paper, says the analysis of plant phenolics is challenging due to their low concentration and extreme structural diversity.

"Most plants contain highly complex mixtures of phenolic compounds, and while flavonoids occur widely in the plant kingdom, the flavoalkaloids are very rare in nature," she explains.

"We know that cannabis is extremely complex—it contains more than 750 metabolites—but we did not expect such high variation in phenolic profiles between only three strains, nor to detect so many compounds for the first time in the species. In particular, the first evidence of flavoalkaloids in cannabis was very exciting."

For her postgraduate studies in SU's Department of Chemistry and Polymer Science, she developed powerful analytical methods combining comprehensive two-dimensional liquid chromatography and high-resolution mass spectrometry for the detailed characterization of phenolic compounds.

"We were looking for a new application for the methods that I developed, after successfully testing them on rooibos tea, grapes and wine. I then decided to apply the methods to cannabis because I knew it was a complex sample, and that cannabis phenolics have not been well characterized," she explains.

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According to Prof. André de Villiers, her study leader and main author on the paper, he was blown away by the chromatographic results that Muller obtained: "The excellent performance of two-dimensional liquid chromatography allowed separation of the flavoalkaloids from the much more abundant flavonoids, which is why we were able to detect these rare compounds for the first time in cannabis." He leads the analytical chemistry research group in SU's Department of Chemistry and Polymer Science.

Prof. De Villiers says it is obvious there is still much to gain from studying cannabis, as the bulk of research in this field to date has been focused on the pharmacological properties of the mood-effecting cannabinoids.

"Our analysis again highlights the medicinal potential of cannabis plant material, currently regarded as waste. Cannabis exhibits a rich and unique non-cannabinoid phenolic profile, which could be relevant from a biomedical research perspective," he concludes.

Phys Org, 13 August 2025

https://phys.org

Prenatal Painkiller Use Associated With Autism, ADHD in Children

2025-08-14

Researchers at the Icahn School of Medicine at Mount Sinai have found that prenatal exposure to acetaminophen may increase the risk of neurodevelopmental disorders, including autism spectrum disorder and attention-deficit/hyperactivity disorder (ADHD), in children. The study, published today in BMC Environmental Health, is the first to apply the rigorous Navigation Guide methodology to systematically evaluate the rigor and quality of the scientific literature.

Acetaminophen (often sold under the brand name Tylenol®, and known as paracetamol outside the United States and Canada) is the most commonly used over-the-counter pain and fever medication during pregnancy and is used by more than half of pregnant women worldwide. Until now, acetaminophen has been considered the safest option for managing headache, fever, and other pain. Analysis by the Mount Sinai-led team of 46 studies incorporating data from more than 100,000 participants across multiple countries challenges this perception and underscores the need for both caution and further study.

The Navigation Guide Systematic Review methodology is a gold-standard framework for synthesizing and evaluating environmental health data. This approach allows researchers to assess and rate each study's risk of bias, such as selective reporting of the outcomes or incomplete data, as well as the strength of the evidence and the quality of the studies individually and collectively.

"Our findings show that higher-quality studies are more likely to show a link between prenatal acetaminophen exposure and increased risks of autism and ADHD," said Diddier Prada, MD, PhD, Assistant Professor of Population Health Science and Policy, and Environmental Medicine and Climate Science, at the Icahn School of Medicine at Mount Sinai. "Given the widespread use of this medication, even a small increase in risk could have major public health implications."

The paper also explores biological mechanisms that could explain the association between acetaminophen use and these disorders. Acetaminophen is known to cross the placental barrier and may trigger oxidative stress, disrupt hormones, and cause epigenetic changes that interfere with fetal brain development.

While the study does not show that acetaminophen directly causes neurodevelopmental disorders, the research team's findings strengthen the evidence for a connection and raise concerns about current clinical practices.

The researchers call for cautious, time-limited use of acetaminophen during pregnancy under medical supervision; updated clinical guidelines to better balance the benefits and risks; and further research to confirm these findings and identify safer alternatives for managing pain and fever in expectant mothers.

"Pregnant women should not stop taking medication without consulting their doctors," Dr. Prada emphasized. "Untreated pain or fever can also harm the baby. Our study highlights the importance of discussing the safest approach with health care providers and considering non-drug options whenever possible."

With diagnoses of autism and ADHD increasing worldwide, these findings have significant implications for public health policy, clinical guidelines, and patient education. The study also highlights the urgent need for

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pharmaceutical innovation to provide safer alternatives for pregnant women.

Technology Networks, 14 August 2025

https://technologynetworks.com

Why recycling 'dead' batteries could save billions and slash pollution

2025-08-19

Increased demand for electric vehicles, portable electronics, and renewable energy storage has resulted in lithium becoming a truly critical mineral. As the world races toward a clean energy future, the recycling of lithium batteries has become crucial.

New research from Edith Cowan University (ECU) has highlighted that tapping into used batteries as a secondary source of lithium not only helps reduce environmental impact but also secures access to this valuable resource, supporting a circular economy and ensuring long-term sustainability in the energy sector.

PhD student Ms Sadia Afrin has pointed out that the global lithium-ion battery market size is projected to expand at a compound annual growth rate of 13 per cent, reaching $87.5 billion by 2027, with lithium consumption forecast to increase from 390 kilotons in 2020 to approximately 1,600 kilotons by 2026.

However, only around 20 per cent of a lithium-ion battery's capacity is used before the battery is no longer fit for use in electric vehicles, meaning those batteries ending up in storage or on the landfill retain nearly 80 per cent of their lithium capacity.

The Australian Department of Industry, Science and Resources has previously estimated that by 2035, Australia could be generating 137,000 t of lithium battery waste annually.

For the end-of-life batteries, the obvious answer is recycling, said first author Mr Asad Ali quoting figures from the government which estimates that the recycling industry could be worth between $603 million and $3.1 billion annually in just over a decade.

"By recycling these batteries, you can access not only the remaining lithium - which already purified to near 99 per cent - but you can also retrieve the nickel and the cobalt from these batteries."

While the lithium retrieved through the recycling process is unlikely to impact the lithium extraction or downstream sectors, Mr Ali noted that the recycling process offered significant environmental benefits when compared with the mining industry.

"Recycling processes can significantly reduce the extensive use of land, soil contamination, ecological footprint, water footprint, carbon footprint and harmful chemical release into the environment, thereby lowering greenhouse gas emissions and minimising waste.

"Mining emits up to 37% tons of CO2 per ton of lithium. Recycling processes produce up to 61 per cent less carbon emissions compared with mining and uses 83 per cent less energy and 79 per cent less water as compared to mining. Hydrometallurgical recycling can generate profit up to $27.70 per kilogram of lithium recovered. And again, the lithium produced through the recycling process is already purified to 99 per cent, which means all of the energy, water and emissions are saved from the downstream process."

ECU lecturer and corresponding author Dr Muhammad Azhar said that while Australia holds one of the largest hard rock lithium reserves in the world, the recovery of lithium from end-of-life batteries could provide socio-economic benefits and fulfils environmental sustainability.

"The mining industry actually offers another source of retired and potentially end-of-life batteries, as the electrification of the mining industry gains momentum. ECU is exploring the second life of these retired lithium batteries," he added.

While the benefits of lithium-ion battery recycling seem obvious, Ms Afrin noted that there were still some challenges to be addressed.

"The rate of innovation significantly outstrips policy development, and the chemical make-up of the batteries also continuously evolve, which makes the recycling of these batteries more complicated," she said.

"There is a definite need for investment into the right infrastructure in order to create this circular economy, but there are several Australian companies that are looking at the best ways to approach this."

Science Daily, 19 August 2025

https://sciencedaily.com

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Atomic-scale copper arrangements steer reactions to produce hydrogen or methane

2025-08-20

Scientists have discovered a way to control chemical reactions by carefully arranging copper atoms on a carbon-based material. With just tiny changes at the atomic scale, the same material can be switched to produce either hydrogen or methane from simple starting ingredients.

In a study published in Advanced Functional Materials, a collaborative team from the National Synchrotron Radiation Research Center in Taiwan (experimental group) and the Center for Condensed Matter Sciences, National Taiwan University (theoretical/computational group), demonstrated how atomic-scale engineering of copper on graphitic carbon nitride (g-C_3N_4) can control chemical reactions.

The researchers found that copper atoms placed individually or in clusters on g-C_3N_4 predominantly catalyze hydrogen evolution. In contrast, pairs of copper atoms embedded within g-C_3N_4 selectively convert carbon dioxide into methane, achieving an efficiency of 88%. This high selectivity not only makes methane production practical but also highlights a promising route for clean energy applications.

The findings reveal that even subtle differences in atomic arrangement can dramatically alter catalytic behavior. By precisely tuning the positions of copper atoms, it becomes possible to direct the reaction toward desired products, illustrating the power of atom-level control in material design.

"This study shows the potential of atomic design," says Michitoshi Hayashi, the study's corresponding author. "By simply changing where the copper atoms are positioned, we can guide the reaction along the pathway we want, enabling precise control over chemical transformations."

The work emphasizes the broader implications of atom-by-atom engineering, providing insights that could accelerate the development of next-generation catalysts and materials for sustainable energy. By leveraging such precise structural control, researchers aim to design catalysts that efficiently produce fuels and chemicals, ultimately reducing dependence on fossil resources while advancing clean energy technologies.

Phys Org, 20 August 2025

https://phys.org

India introduces new rules to tackle chemical contamination sites

2025-08-20

The Indian government has introduced new legislation – the Environment Protection (Management of Contaminated Sites) Rules, 2025 – to tackle chemically contaminated sites across the country. The rules sit under the Environment Protection Act and provide a legal framework to address various issues related to sites contaminated by chemicals – from fixing liabilities and outlining remediation requirements to establishing roles and responsibilities of various private and public authorities.

The Central Pollution Control Board defines contaminated sites as those where hazardous and other wastes have been dumped historically, resulting in contamination of ground and surface water, soil etc that threatens human health and the environment. They include landfills, dumps, waste storage and treatment sites, spill sites and chemical waste handling and storage sites. Several such sites are long-abandoned and were contaminated when there were no regulations to tackle hazardous wastes. In others, the polluters have either shut their operations for good or remediation may be beyond their financial or technical capacity.

Under the new rules the district authorities would regularly prepare reports on suspected contaminated sites. An expert board would initiate preliminary assessment within 90 days and a detailed survey would follow, if found contaminated. They would also identify and calibrate levels of chemical contamination with 189 hazardous chemicals listed in the existing Hazardous and Other Wastes (Management and Transboundary Movement) Rules of 2016. If safety levels are exceeded, then the sites would be publicly identified and restrictions placed on their access. Although the rules define some timelines for assessments, they do not set out timelines for completing any necessary remediation.

The board would also identify individuals or agencies responsible for any contamination and fix financial and criminal liabilities. If the costs are beyond the liable parties' means, then the central and state authorities would share clean-up costs.

To avoid duplication, the new rules do not cover radioactive waste, mining operations, marine pollution by oil or oily substances or solid waste dump sites, as these are already covered under other legislation.

'The new rules present very progressive legislation, which is progress in the right direction,' says environmental lawyer Gopal Krishna, founder

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of non-profit Toxics Watch. 'The rules were long due, but their scope is limited to only 189 hazardous chemicals. It has missed the opportunity to provide an inventory of all the hazardous chemicals and minerals which are used, emitted and transported in the country,' he says. In October 2003, the supreme court had ordered the preparation of a national inventory of hazardous waste generation and dump sites, as well as creation of a policy on hazardous waste landfills, shipbreaking and related activities, but this has not been complied with, he says.

The authorities have so far identified 196 potentially contaminated sites across India – of which 103 are confirmed, while investigations are ongoing for the other 93. Remediation measures have only been initiated for 7 sites, although ten more have completed project reports for action.

Beyond these numbers, no more details are available for these sites in the public domain. One of the most notable and persistent chemically contaminated sites is the contentious Union Carbide factory site and surrounding areas in Bhopal – where remediation liability wranglings have been mired in controversy for 40 years. Incineration of 337 tonnes of toxic waste from the site was completed at Pithampur in June – but the latest challenge will be heard in Madhya Pradesh high court in mid- September. Citizen groups have complained to the state government about unsafe incineration practices and accused it of clearing only a minuscule fraction of the contaminated site in Bhopal while the final fate of the incinerated waste – now amounting to 900 tonnes – is still not clear.

Chemistry World, 20 August 2025

https://chemistryworld.com

Hydrogen could unlock greener, faster metal production

2025-08-20

Most metals found in nature are actually in their oxide forms. To extract those metals for use in critical applications—ranging from infrastructure such as bridges and buildings to advanced technologies like airplanes, semiconductors or even quantum materials—those oxides must be reduced with gases.

A new study illuminating how different gases can affect oxide reduction, however, has the potential to revamp scientific understandings and current industrial practices.

Hydrogen or carbon monoxide are typically used as reductants, presumed to get the job done similarly enough. This research highlights, for the first time, distinct variations between the two that affect the critical chemical reactions fueling metal production.

Published in Nature, the new paper was a collaboration between Binghamton University and Brookhaven National Laboratory, as well as Stony Brook University and Columbia University.

"For metal production, the key challenge is efficiently removing atomic oxygen from metal oxides to yield pure metals," said Guangwen Zhou, a SUNY distinguished professor at the Thomas J. Watson College of Engineering and Applied Science and deputy director of Binghamton University's Materials Science and Engineering program.

"The goal is to drive this reduction process using less energy, at lower temperatures, and with minimal carbon dioxide emissions. Our study offers insights that can help guide the choice of gases or reductants to accelerate reaction kinetics, making metal extraction faster, cleaner and more energy efficient."

Carbon monoxides have raised concerns for their role in releasing harmful greenhouse gases during manufacturing. The findings of this study point to hydrogen as a greener alternative for metal production, capable of speeding up the process in a more sustainable manner. All this happens while generating benign water vapor as a much more benign chemical consequence.

Members of Zhou's research group have been working on oxides for a long time, according to Binghamton doctoral student and first author Xiaobo Chen, but they gradually began noticing discrepancies in reduction reactions when using one gas versus another.

After prying into the mechanisms of each reducing agent, they found that carbon monoxide and hydrogen reductants aren't actually so similar. When carbon monoxide was used to reduce nickel oxide, the oxide's surface gradually grew coated with a thin layer of metal—essentially stopping any more catalytic reactions from occurring as oxygen depleted from the top.

Trapped and unable to migrate into the bulk, those pockets lacking oxygen accumulated at the surface and drove the local conversion of nickel oxide into metallic nickel.

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This newly formed metallic "crust" further blocked oxygen from being removed deeper within the oxide, slowing the overall reduction process. In addition to carbon dioxide emissions, continuing to wring any reactions out of a now inactive oxide would be even more costly and time-consuming.

"If we look at CO—because it's mostly used as a method for metal production—if metal forms on the surface, it can block active sites and slow down the reaction kinetics," Zhou said. "That makes the extraction process more difficult, which means you need to use more energy and higher temperatures."

In contrast, when hydrogen was used, oxygen vacancies formed at the surface could migrate into the bulk of the oxide, enabling metal formation throughout the interior. Importantly, the surface remained largely intact with hydrogen, still capable of the catalytic reactions that are crucial for jumpstarting chemical reactions.

"All this difference is related to the difference in the fundamental mechanisms," Zhou said. "I think that's the reason the community has a strong interest in this work, because we've provided this fundamental insight to understand these two basic reductant gases in controlling reactions—in both kinetics and reaction products."

And because hydrogen protons help oxygen vacancies more easily migrate away from the surface, that also raises the possibility of replenishing them through counterdiffusion of atomic oxygen from the oxide's interior to its surface—a self-healing behavioral quirk that oxides exhibit.

Zhou has also studied this mechanism in a paper published, in the Proceedings of the National Academy of Sciences.

"If we use hydrogen, we can facilitate this process. For industrial applications, we can have that catalyst regeneration, without interrupting the catalytic process," Zhou said. "The reaction itself may actually build or provide some self-healing capabilities to make the catalyst last longer."

A longtime collaboration

More than its potential to improve industrial practices, this study also recontextualizes how scientists can understand the very basic principles of oxide reduction, according to Judith Yang, a scientist at the Brookhaven National Laboratory's Center for Functional Nanomaterials (CFN).

The previous belief held that reductions are more influenced by the partial pressure of oxygen, rather than the reductants themselves. You might wonder, for example, what's better for baking a good dessert: the temperature of the oven or the foundational ingredients.

"With these new tools and scientific insights, like from Professor Zhou, we're really seeing a great richness in these systems, which have a classical and standard description that is still taught in the classroom," Yang said. "We are now developing a new paradigm."

Zhou and his students conducted their research using instruments, coupled with staff scientific support, at the shared user facilities housed in Brookhaven National Laboratory, which is sponsored by the U.S. Department of Energy's Basic Energy Sciences program. First, they used CFN's environmental transmission electron microscope (TEM) to observe in situ reactions in real time, atom by atom.

"There are only a few [of these tools] with such a capability in the entire country," Zhou said. "That's why we are lucky to have this opportunity to access this tool."

They complemented this with synchrotron X-ray diffraction (XRD) to study reactions on a larger scale.

"The combination of these techniques provides a comprehensive, multi-scale understanding of the reaction," explained Lu Ma, lead beamline scientist at the Quick X-ray Absorption and Scattering beamline at Brookhaven National Lab's National Synchrotron Light Source II (NSLS-II).

"While in-situ TEM reveals whether nucleation initiates on the surface or within the interior at the nanoscale, it cannot probe larger-scale samples. Conversely, ensemble XRD offers bulk-scale insights. Together, these methods deliver consistent and complementary evidence of the reaction dynamics across different length scales."

A project like this required many hands and heads, Zhou said, but the partnership between Binghamton and Brookhaven has extended across multiple studies. Moreover, the CFN and NSLS-II are both shared-user facilities with cutting-edge instrumentation and scientific expertise that are free for use by the wider research community.

"I've been collaborating with people from Brookhaven National Lab since I started my faculty position here in Binghamton, so it's probably closer to 20 years," he said. "CFN at Brookhaven National Lab has been really instrumental to my career and research."

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Many of Zhou's students also work on-site at Brookhaven, gaining crucial hands-on experience navigating complicated instruments and experiments while establishing rapport with seasoned scientists.

"We cannot guarantee, every time, to successfully perform the experiments. Sometimes, we need a lot of chances to try," Chen said. "We cannot guarantee we can get a result every time, but CFN and NSLS-II are a fundamentally friendly environment. We can have a lot of chances to try those kinds of things."

Studies like these don't just benefit industries, Yang said, but also scientists like herself who get to work with ever-advancing technologies for a living.

"It's the science that Xiaobo and Professor Zhou are doing that motivates the next generation of infrastructure development," she said. "This interest in getting the chemistry and structure in real time, at the atomic scale, in a controlled environment, motivated our next instrument."

In this case, it's a first-in-the-world specialized environmental scanning transmission electron microscope capable of handling angstrom-level resolution, exceptional energy and temporal resolution, and gases ranging from ultra-high vacuum pressures to only a few torr.

Zhou and his team now plan to expand their experimental materials, from copper to iron oxides—reminiscent of the same Bronze and Iron Ages that once characterized much of ancient history, Yang added.

"It's just really fascinating that Guangwen's work ties into the history of humankind," she said. "We're finding new fascination in what's defined the material ages of human history."

Phys Org, 20 August 2025

https://phys.org

Fluoride and Your Health: The Good and the Bad

2025-06-30

The debate around fluoride never seems to go away. Is the mineral good for us? Bad for us? Is adding it to drinking water a sensible public health policy? Or oppressive, forced medication?

The current White House administration seems to side with the more dubious of these opinions. In April, Robert F. Kennedy Jr., the US's Secretary of Health and Human Services, announced that he will direct

the US Centers for Disease Control and Prevention (CDC) to recommend against fluoridating water.

With a fluoride skeptic now steering US health policy, let's take a closer look at the facts on fluoride.

A brief history of fluoride

Fluoride is a mineral, naturally present in soil and rocks.

Its dental benefits were discovered in the early 1900s by a particularly investigative dentist called Dr. Frederick McKay. Upon opening his practice in Colorado Springs, he was astonished to find that most of the town's children had discolored brown teeth (dental fluorosis) but no signs of dental decay (caries).

Driven by a suspicion of the town's water supply, McKay began to gather water samples across the nearby Colorado communities and document the prevalence of tooth discoloration in the children living there.

By 1931, with the help of colleagues and testing carried out by the aluminum manufacturer Alcoa, McKay proved that the drinking water of affected towns was naturally high in fluoride.

It was thus deduced that fluoride could a) turn children's teeth brown and b) protect the teeth from decay. It seemed an invaluable asset to dental hygiene had just been uncovered.

To learn more, the fluoride-research baton was passed into the hands of one Dr. H. Trendley Dean, head of the Dental Hygiene Unit at the National Institute of Health , who began running studies to find the ideal amount of fluoride in water that would protect against caries but not lead to brown discoloration.

"Dean conducted research in 21 cities and identified a level of 1 ppm [parts per million] of fluoride as a balance of benefits of protection against dental decay and acceptable levels of dental fluorosis," Loc Do, a professor in dental public health and director of research at the University of Queensland's School of Dentistry School, told Technology Networks.

With this ideal level set, work gradually got underway to introduce fluoride into US public water sources that were naturally low in the mineral. Finally, in 1945, Grand Rapids, Michigan, became the first city in the country – and the world – to implement water fluoridation.

And that's when people started to object.

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A brief history of fluoride opposition

"Forced medication" was un-American, according to some pundits. Other critics went further, likening the public health policy to a communist plot.

It wasn't long before this kind of rhetoric spread to other countries.

In Ireland, one plaintiff argued that water fluoridation infringed on their right to bodily integrity. The country's Supreme Court ultimately held in 1965 that fluoridation did no such infringing. Over in the Netherlands, however, the Dutch Supreme Court declared fluoridation of drinking water unauthorized in 1973.

Fast forward to 2025 and the same libertarian arguments (and occasional conspiracy theory) are still being made, and gaining sway. Utah recently became the first US state to ban fluoride in drinking water, with Florida following as a close second.

Outlining the state's new stance against the mineral, Florida Governor Ron DeSantis said his local government was prioritizing individual liberty.

"Yes, use fluoride for your teeth, that's fine, but forcing it in the water supply is basically forced medication on people," he said in May during a news conference on the state ban.

And yet most other US states and many other countries still champion water fluoridation and its public health benefits.

So, whose argument wins out? Let's take a look at the research.

Is fluoride good for us?

As demonstrated all those years ago in Colorado Springs, fluoride can reverse the progression of dental caries and stimulate new bone formation.

This quality makes the mineral valuable in preventing and treating caries in children, whose bones and teeth are more vulnerable as they grow.

This, say many experts, is why public water fluoridation is so vital: it can help prevent children getting caries in the first place.

Research largely supports this argument.

Published in JDR Clinical & Translational Research in 2019, one review of 32 studies found that children who lived in areas with fluoridated water tended to have lower levels of caries than those who didn't.

"It protects against dental decay just by drinking water, a physiological act," Do told Technology Networks.

Crucially, these dental benefits don't appear to come at any health cost during childhood. Published in Public Health in 2023, one meta-analysis on the cognitive effects of fluoride exposure on children found the mineral was not associated with lower IQ scores.

"The current evidence is clear that water fluoridation is safe," Do stressed.

"This passive delivery mode [water fluoridation] ensures that everyone in the population benefits from dental decay protection, regardless of their socioeconomic status and abilities."

This last point is a salient one, as children growing up in deprived areas can have a three-times higher risk of developing caries than children from less deprived areas.

Is fluoride, in any way, bad for us?

Clearly, though, the mineral still has at least one downside: a risk of causing dental fluorosis.

Is this effect anything to be concerned about? Not according to Do.

"The only confirmed risk of fluoride at this level is dental fluorosis," he said, "which is developed when young children consume fluoride from different sources."

Cases of dental fluorosis have gone up in the US since the introduction of water fluoridation and fluoride-containing toothpaste. The CDC has estimated that, between 1999 and 2004, the condition affected a significant proportion of teenagers (41%) and a minority of older adults (8.7% of those aged 40–49).

Most of these cases, however, were deemed mild (white spots on tooth enamel) and far from the severe cases (brown spots) first witnessed by McKay in Colorado Springs.

"The levels of dental fluorosis in populations with fluoridated water are mostly very mild to mild, and do not negatively impact health and quality of life," Do added.

The future of fluoride

Seemingly, though, those that decry fluoridated water aren't even interested in its potential cosmetic drawbacks. Instead, opponents like

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Governor Desantis and Stephanie Gricius – the Utah representative who introduced the bill to ban fluoridated water in the state – argue that individual liberty should always override any policy of "forced medication".

But, as outlined by the relevant research and experts, this highly libertarian sentiment comes at the risk of children's dental health.

"The developments in the US are examples of when health decision-making processes are politicized," Lo told Technology Networks.

"A simulation study estimated that cessation of public water fluoridation in the US would increase dental decay and health system costs. Such increases will more likely impact those populations at higher risk of having dental diseases."

This scenario has already played out in other jurisdictions, notably Calgary, Canada.

Back in 2011, the city's council voted to remove fluoride from its drinking water. Since then, the rate of caries in children has significantly increased. Published in Community Dentistry and Oral Epidemiology in 2021, one study found that 64.8% of children sampled in the city had carries, compared to 55.1% of children sampled in the city of Edmonton (which still fluoridated its water).

In light of research like this, Calgary City Council reintroduced fluoride into the city's drinking water on June 30, 2025.

Whether Utah and Florida mirror this Canadian case study remains to be seen.

Technology Networks, 30 June 2025

https://technologynetworks.com

Bye-Bye Teflon? This Slick New Material Could Change Cookware Forever

2025-08-11

Engineers have crafted a new non-stick coating that could finally give Teflon some competition—without the dangerous "forever chemicals" that have raised health alarms.

By bonding silicone-based bristles with the tiniest PFAS molecule possible, the team created a surface that resists both water and grease as effectively as traditional coatings.

Safer Non-Stick Alternative Emerges

Researchers at the University of Toronto's Faculty of Applied Science & Engineering have created a new type of material that could provide a safer option for the non-stick coatings widely used in cookware and other everyday products.

This innovation repels both water and grease as effectively as many standard non-stick surfaces, but contains much smaller amounts of per- and polyfluoroalkyl substances (PFAS). PFAS are a group of chemicals linked to environmental and health concerns.

"The research community has been trying to develop safer alternatives to PFAS for a long time," says Professor Kevin Golovin (MIE), who heads the Durable Repellent Engineered Advanced Materials (DREAM) Laboratory at U of T Engineering.

"The challenge is that while it's easy to create a substance that will repel water, it's hard to make one that will also repel oil and grease to the same degree. Scientists had hit an upper limit to the performance of these alternative materials."

The Science Behind Teflon and PFAS

First introduced in the late 1930s, Teflon (polytetrafluoroethylene or PTFE) became famous for its ability to keep water, oil, and grease from sticking. Teflon is part of the larger PFAS family.

PFAS molecules are made of carbon atoms bonded to multiple fluorine atoms. These carbon-fluorine bonds are extremely stable, which is what gives PFAS their strong non-stick properties.

That same chemical stability also makes PFAS resistant to natural breakdown processes. This persistence in the environment has earned them the nickname "forever chemicals."

Health Concerns and Ubiquity of PFAS

In addition to their persistence, PFAS are known to accumulate in biological tissues, and their concentrations can become amplified as they travel up the food chain.

Various studies have linked exposure to high levels of PFAS to certain types of cancer, birth defects, and other health problems, with the longer chain PFAS generally considered more harmful than the shorter ones.

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Despite the risks, the lack of alternatives means that PFAS remain ubiquitous in consumer products: they are widely used not only in cookware, but also in rain-resistant fabrics, food packaging, and even in makeup.

Searching for a Safer Substitute

"The material we've been working with as an alternative to PFAS is called polydimethylsiloxane or PDMS," says Golovin.

"PDMS is often sold under the name silicone, and depending on how it's formulated, it can be very biocompatible — in fact it's often used in devices that are meant to be implanted into the body. But until now, we couldn't get PDMS to perform quite as well as PFAS."

To overcome this problem, MIE PhD student Samuel Au developed a new chemistry technique that the team is calling nanoscale fletching. The technique is described in a paper published in Nature Communications.

Mimicking Feathered Arrows at the Nanoscale

"Unlike typical silicone, we bond short chains of PDMS to a base material — you can think of them like bristles on a brush," says Au.

"To improve their ability to repel oil, we have now added in the shortest possible PFAS molecule, consisting of a single carbon with three fluorines on it. We were able to bond about seven of those to the end of each PDMS bristle.

"If you were able to shrink down to the nanometre scale, it would look a bit like the feathers that you see around the back end of an arrow, where it notches to the bow. That's called fletching, so this is nanoscale fletching."

Matching PFAS Performance with Minimal Risk

Au and the team coated their new material on a piece of fabric, then placed drops of various oils on it to see how well it could repel them. On a scale developed by the American Association of Textile Chemists and Colorists, the new coating achieved a grade of 6, placing it on par with many standard PFAS-based coatings.

"While we did use a PFAS molecule in this process, it is the shortest possible one and therefore does not bioaccumulate," says Golovin.

"What we've seen in the literature, and even in the regulations, is that it's the longest-chain PFAS that are getting banned first, with the shorter ones

considered much less harmful. Our hybrid material provides the same performance as what had been achieved with long-chain PFAS, but with greatly reduced risk."

Toward a PFAS-Free Future

Golovin says that the team is open to collaborating with manufacturers of non-stick coatings who might wish to scale up and commercialize the process. In the meantime, they will continue working on even more alternatives.

"The holy grail of this field would be a substance that outperforms Teflon, but with no PFAS at all," says Golovin.

"We're not quite there yet, but this is an important step in the right direction."

Sci Tech Daily, 11 August 2025

https://scitechdaily.com

Chemours ordered to immediately limit PFAS emissions into Ohio River

2025-08-13

A federal judge in the US has ordered chemicals giant Chemours to immediately stop releasing unlawful levels of per- and polyfluoroalkyl substances (PFAS) into the Ohio River from its Washington Works plant in West Virginia.

'The Defendant has a history of violating its permit, knows it is violating its permit, and intends to continue violating its permit. This is unacceptable under the Clean Water Act,' district judge Joseph Goodwin wrote in his 7 August ruling. Therefore, he granted the non-profit West Virginia Rivers Coalition's request for a preliminary injunction for Chemours to reduce discharges of hexafluoropropylene oxide dimer acid (HFPO-DA or Gen-X), from its Washington Works facility.

'In this case, there is no ambiguity,' the judge stated. 'The level of discharge far exceeds the legal limits that bind Chemours. Those pollutants endanger the environment, aquatic life, and human health. Today, that unlawful, unpermitted discharge stops.' The injunction will stand until the court issues another order or Chemours demonstrates 'sustained compliance' with the permit's HFPO-DA limits, the court said.

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AUG. 22, 2025

For many years the company had been surpassing permitted limits for discharges of Gen-X chemicals into the Ohio River with increasing frequency and severity, according to legal advocacy organisation Public Justice, which helped represent the West Virginia Rivers Coalition. In November 2024, Chemours exceeded its permitted limits for HFPO-DA at two specific outlets by as much as 454% and 166%, Public Justice said.

Chemours responded that it is 'disappointed in the court's ruling, strongly disagree[s] with its characterisations, and plan[s] to appeal the decision'. Its Washington Works facility has 'demonstrated positive progress in reducing its PFAS emissions, and HFPO-DA discharges at the plant in question 'have fallen within the permitted limits in recent months,' Chemours added.

Earlier this month, DuPont and spin-offs including Chemours agreed to settle with the state of New Jersey, US, over PFAS contamination across the state, in a proposed deal valued at more than $2 billion (£1.5 billion), including $875 million in damages across the state. Payments will be split between DuPont, Corteva and Chemours, which would pay 50%.

In June 2023, Chemours, DuPont de Nemours and Corteva jointly agreed in principle to pay almost $1.2 billion to settle PFAS-related claims covering a defined set of US waterways. Chemours agreed to contribute approximately half the amount, with DuPont paying a third, and Corteva the rest.

Chemistry World, 13 August 2025

https://chemistryworld.com

Ultra-thin sound-blocking material effectively dampens traffic noise

2025-07-25

If you live in a noisy urban area, you're gonna love the sound of this. Researchers in Switzerland have developed a material that can dampen street noise while being four times thinner than similar-performing absorbers used in construction.

This new material from the Acoustics/Noise Reduction lab at the Swiss Federal Laboratories for Materials Science and Technology (EMPA) institute in Dübendorf doesn't yet appear to have a name.

But beyond its ultra-thin profile, it has a neat trick up its sleeve: it can be can be tuned to specific frequency ranges, depending on what's causing a din outside, and what kind of space it's being installed in.

Curiosities

It's essentially a mineral gypsum or cement foam that's specially produced to have pores of different sizes, and it's packed in multiple thin layers to create more variation.

"The varying pore structure of the mineral foams forces air particles to take a longer route to get into the material and out again. Despite the low thickness, this creates the impression of a much thicker absorber for the sound waves," EMPA researcher Bart Van Damme explained.

Using a numerical model, the researchers can "simulate and even specifically influence the acoustic behavior of the entire material by varying pore size, perforation and layer structure."

The team tested this new material by fitting enough 2.1-inch (5.5-cm)-thick panels to cover about 130 sq ft (12 sq m) of a driveway in Zurich, where one end opens out on a public street and the other opens into a courtyard. The panels helped reduce traffic noise by 4 decibels, and was particularly effective at dampening the sound of cars approaching or leaving the driveway.

A significantly thinner sound absorption material like this allows builders and architects greater flexibility in designing and constructing living spaces, since they don't gobble up as many inches as traditional insulation materials.

The material's pore size, perforation, and layer structure can also be varied to change its acoustic behavior to suit different kinds of spaces – like stairwells, offices, large halls, and classrooms.

What's more, it's weatherproof, fireproof, and recyclable, making it a versatile choice for indoor and outdoor use.

That said, the material isn't yet perfect in its current form. It's not as performant at quietening high frequencies as rock wool, and the perforation process is presently done by hand and therefore labor-intensive. To address the latter, the EMPA team's next step will be to streamline mass production. It's already collaborating with Swiss material maker De Cavis on this material, so hopefully it will be able to help make the world a little less noisy soon enough.

New Atlas, 25 July 2025

https://newatlas.com

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