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ASIA PACIFIC

Can we still trust Australia's sunscreens?

2025-10-09

Summer is just around the corner and many Australians are confused right now about which sunscreens they can trust.

That uncertainty has only grown since Choice testing revealed in June that 16 out of 20 popular sunscreens failed to meet their sun protection factor (SPF) claims.

People are wondering which sunscreens have enough SPF and whether the number on the label can even be trusted.

Given an investigation by the Therapeutic Goods Administration (TGA) is ongoing, these are challenging questions to address specifically, but this is what we know so far.

Read More

ABC News, 09-10-25

~https://www.abc.net.au/news/2025-10-09/sunscreen-spf-factor-labelling-tga/105866434s

APVMA Annual Report 2024–25

2025-10-10

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has released its Annual Report for FY2024–25, highlighting a year of significant change and achievements for the regulator.

Prepared in accordance with relevant legislation, the Annual Report provides a comprehensive overview of the agency's operations, achievements, and challenges during the 2024–25 financial year.

This report outlines the agency's performance against strategic goals and regulatory responsibilities, and reflects our commitment to accountability by providing transparency to Parliament and the Australian public.

Key highlights include:

- Launching a new Strategic and Corporate Plan
- Implementing a multi-faceted transformation strategy

- Reinvigorating key stakeholder engagement forums
- Reporting on the outcomes of the Corporate Plan 2024-25

The APVMA remains committed to working collaboratively with stakeholders to support the Australian Government's priorities and deliver on its regulatory mandate. We look forward to building on this year's progress and driving further improvements in regulatory science, service delivery, and stakeholder engagement as reforms continue to be progressed.

The full Annual Report for FY2024–25 is now available on the APVMA website.

Read More

APVMA, 10-10-25

https://www.apvma.gov.au/news-and-publications/news/apvma-annual-report-2024-25

AMERICA

Toxic 'Forever Chemicals' Show Up in Most Tested Reusable Menstrual Products

2025-10-03

Reusable menstrual underwear and pads promise sustainability—but hidden PFAS raise troubling questions.

The promise of reusable period products seems simple: less waste, lower costs, and a better deal for the planet. But tucked inside those layers of fabric, scientists keep finding something that doesn't belong: toxic "forever chemicals."

It started with a hunch. Back in 2019, Sierra magazine asked Graham Peaslee, a physicist at the University of Notre Dame, to test samples of menstrual underwear. His lab uncovered measurable levels of PFAS—per- and polyfluoroalkyl substances. That revelation snowballed into a $5 million lawsuit against the brand Thinx.

Fast-forward to 2023. The New York Times sent Peaslee another batch: 44 period and incontinence products. His tests again showed PFAS,

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sometimes at levels that suggested packaging contamination, sometimes high enough to indicate deliberate use in the fabrics themselves.

Read More

NNY360, 04-10-25

https://www.zmescience.com/science/news-science/toxic-forever-chemicals-show-up-in-most-tested-reusable-menstrual-products/

EPA's PFAS Rulemaking Trajectory: Key Updates Across CERCLA, TSCA, RCRA, SDWA and CWA

2025-10-09

- The U.S. Environmental Protection Agency (EPA) is retaining its Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) designations for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) and plans to propose a new framework to guide future designations with economic impact considerations.
- With a targeted regulatory approach, the agency aims to narrow the scope of drinking water regulations to PFOS and perfluorooctanoic acid PFOA only.
- The recently released Unified Regulatory Agenda outlines seven upcoming actions related to per- and polyfluoroalkyl substances (PFAS) at varying stages in the rulemaking process and utilizes a broad range of legislative authorities.
- These actions span multiple environmental statutes – including the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), Safe Drinking Water Act (SDWA) and Clean Water Act (CWA) – and provide further insight into the Trump Administration's trajectory on PFAS regulations.

Read More

Holland & Knight Alert, 09-10-25

https://www.hklaw.com/en/insights/publications/2025/10/epas-pfas-rulemaking-trajectory-key-updates

EPA Adds Additional PFAS to the Toxics Release Inventory

2025-10-07

Today, the U.S. Environmental Protection Agency (EPA) announced the automatic addition of a per- and polyfluoroalkyl substance (PFAS) to the list of chemicals covered by the Toxics Release Inventory (TRI). Sodium perfluorohexanesulfonate (PFHxS-Na) (CASRN 82382-12-5) was added to the TRI list pursuant to the Fiscal Year 2020 National Defense Authorization Act (NDAA). This addition is due to EPA finalizing a toxicity value in 2025 entitled "IRIS Toxicological Review of Perfluorohexanesulfonic Acid (PFHxS, CASRN 335-46-4) and Related Salts." The TRI chemical list already includes PFHxS and some of the salts identified in the assessment; however, PFHxS-Na, which is also identified in the assessment, was not on the TRI list. Accordingly, per the framework for automatic additions of PFAS that the 2020 NDAA provides, the publication of this assessment adds PFHxS-Na to the TRI list with an effective date of January 1, 2026, bringing the total number of PFAS subject to TRI reporting to 206.

TRI data are reported to EPA annually by facilities in designated industry sectors that manufacture, process or otherwise use TRI-listed chemicals above set quantities. The data collected are available online and include quantities of such chemicals released into the environment or otherwise managed as waste.

Read More

US EPA, 07-10-25

https://www.epa.gov/chemicals-under-tsca/epa-adds-additional-pfas-toxics-release-inventory

David Keeling confirmed as new head of OSHA

2025-10-08

The former Amazon and UPS safety executive takes on the role as the agency is expected to advance a heat safety regulation.

David Keeling has been confirmed to lead the Occupational Safety and Health Administration as the assistant secretary of labor. The U.S. Senate voted 51-47 to approved his confirmation, along with a block of dozens of other nominees for other federal agencies, on Tuesday.

Keeling is Amazon's former director of road and transportation safety, a job he left in mid-2023 to do consulting, according to LinkedIn. He also spent

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about 36 years working for the United Parcel Service in several regional safety manager and director roles before becoming its vice president of global health and safety.

Keeling is stepping into OSHA's lead role as the agency works to develop a federal standard meant to protect workers from extreme heat. That draft rule aims to require many employers to provide workers with access to water, rest and shade. A comment period for the rule was recently extended to the end of October.

Read More

Manufacturing Dive, 08-10-25

https://www.manufacturingdive.com/news/osha-amazon-ups-david-keeling-senate-confirmed-assistant-secretary/802364/

EUROPE

PFAS: Battle in Brussels over acceptable daily intake standards for forever chemical TFA

2025-10-03

Trifluoroacetic acid (TFA) – the smallest of the "forever chemicals" – is present everywhere, but how problematic are the general population's exposure levels? On September 23, MEPs and European Union member states agreed to include the chemical, a member of the per- and polyfluoroalkyl substances (PFAS) family, known as "forever chemicals," in water resource monitoring plans. Since 2024, EU health authorities have also been engaged in a process of reassessing the risks it poses to human health.

In a report published on Monday, September 29, the Pesticide Action Network (PAN) Europe sheds new light on this process. The Brussels-based NGO obtained access to confidential documentation that chemical industry stakeholders provided to EU authorities for the purpose of calculating the acceptable daily intake standards for TFA.

Read More

Le Monde, 03-10-25

https://www.lemonde.fr/en/environment/article/2025/10/03/pfas-battle-in-brussels-over-acceptable-daily-intake-standards-for-forever-chemical-tfa_6746060_114.html

EU leaders contaminated with PFAS "forever chemicals

2025-10-06

Harmful PFAS substances have been found in the blood of 24 EU leaders from 19 countries, confirming that no one is immune to exposure from these persistent "forever chemicals."

All 24 of the top politicians tested [1], who included EU environment Commissioner Jessika Roswall and Danish environment minister Magnus Heunicke, were found to be contaminated with PFAS. For half of the EU leaders, contamination exceeded levels [2] beyond which health impacts cannot be ruled out.

Six of the detected PFAS (PFOA, PFOS, PFHxS, PFNA, PFDA and PFUnDA) are already regulated in Europe – either under the EU POPs Regulation or under the REACH Regulation [3] – underscoring their lasting impact and continued threat to human health and the environment.

Led by the Danish Ministry of Environment and Gender Equality, together with the European Environmental Bureau (EEB) and ChemSec, this bold initiative exposes the widespread contamination of PFAS and will hopefully encourage EU leaders to respond quickly to the growing urgency of this pollution crisis.

Read More

EEB, 06-10-25

https://eeb.org/eu-leaders-contaminated-with-pfas-forever-chemicals/

Denmark bans more PFAS pesticides to protect groundwater

2025-10-06

The Danish Environmental Protection Agency has withdrawn the approval of 8 more pesticides that contain PFAS active substances. They can form and leach TFA into the groundwater. Pesticides approved for use in Denmark must not pose a risk to groundwater. In June, they already

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banned 25 other products. PFAS pesticides that have not yet been directly linked to TFA are still allowed in Denmark. The Danish Nature Conservation Organisation applauds the decision but calls for a swift ban of the other PFAS pesticides, especially the very harmful insecticide lambda-cyhalothrin.

The pesticide products that are now banned contain one of six active substances that can form TFA (trifluoroacetic acid). TFA leaks into groundwater, is toxic to reproduction and does not decompose. In 2025, the Danish Environmental Protection Agency has reassessed six PFAS active substances used in 33 pesticide formulations. This research project, "TriFluPest", was initiated by the Danish Environmental Protection Agency and carried out by the National Geological Surveys for Denmark & Greenland (GEUS). They included other professional knowledge from ongoing EU assessments. The six PFAS pesticide active substances examined are: fluazinam, fluopyram, diflufenican, mefentrifluconazole, tau fluvalinat, and flonicamide.

Read More

PAN Europe, 06-10-25

https://www.pan-europe.info/blog/denmark-bans-more-pfas-pesticides-protect-groundwater

INTERNATIONAL

225+ organisations call for Big Polluters to be kicked out of COP30

2025-10-01

Over 225 organizations, including CEO, demand: "Kick Big Polluters Out, Don't Invite Them to the COP30 Table!

- Civil society groups and networks representing millions condemn COP30 President Designate's invitation to corporate interests without protections against conflicts of interest, calling it a "dangerous oversight" that threatens climate action.
- Letter highlights systemic corporate capture of climate talks, including COP30 team's partnership with a PR firm simultaneously representing major oil and gas corporations.

REACH Update

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New OECD QSAR Toolbox version available

2025-10-08

The OECD QSAR Toolbox 4.8 includes several enhancements to improve its usability, transparency and security:

- Possibility to import and visualise structural data and metadata from metabolism databases
- New and updated databases and profiles
- Updated documentation of QSAR predictions in line with the OECD QSAR Assessment Framework
- Updated libraries to ensure security and support

The OECD QSAR Toolbox is a collaborative project between ECHA, OECD and its member and partner countries. It is used worldwide in hazard assessment of chemicals to avoid unnecessary animal testing.

Read More

ECHA, 08-10-25

https://echa.europa.eu/view-article/-/journal_content/title/echa-weekly-8-october-2025

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Janet's Corner

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Who am I?

2025-10-17

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

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

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

Sulfur Dioxide

2025-10-20

Sulfur dioxide (also sulphur dioxide) is the chemical compound with the formula SO2. [1] It is a colourless gas with a pungent, irritating and rotten odour. [2] Sulfur dioxide is non-flammable and reacts easily with other substances to form harmful compounds, such as sulfuric acid, sulfurous acid and sulfate particles.

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

USES [2,3]

Sulfur dioxide is used:

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

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

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

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- **Consumer products:** Some solvents, dechlorination agents, bleaches and fumigation products.

Routes of Exposure

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

HEALTH EFFECTS [4]

Acute Health Effects

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

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

exercising asthmatics are sensitive to the respiratory effects of low concentrations (0.25 ppm) of sulfur dioxide.

Studies in animals support the human data regarding respiratory effects of sulfur dioxide. At low levels (less than 1 ppm) of sulfur dioxide exposure, guinea pigs displayed changes in their ability to breathe as deeply or as much air per breath. More severe symptoms seen in animals exposed to high concentrations of sulfur dioxide include decreased respiration, inflammation or infection of the airways, and destruction of areas of the lung. It has also proved to be harmful to the reproductive systems of experimental animals and caused developmental changes in their newborn.

SAFETY

First Aid Measures [5]

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

Personal Protective Equipment [5]

- **Respiratory Protection:** Emergency Use: Use SCBA or positive pressure air line with mask and escape pack in areas where concentration is unknown or above the exposure limits.
- **Eye Protection:** Safety glasses and face shield.
- **Skin Protection:** General Use: Leather gloves, safety shoes, and safety glasses for handling cylinders. Acid resistant gloves and splash suit when connecting, disconnecting, or opening cylinders. Emergency Use: Totally encapsulated chemical resistant suit.

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- **CAUTION:** Contact with cold, evaporating liquid on gloves or suit may cause cryogenic burns or frostbite. Cold temperatures may also cause embrittlement of PPE material resulting in breakage and exposure.

REGULATION

United States

OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-1	**5 ppm (13 mg/m³) TWA**	**HE14**	**Upper respiratory irritation, nosebleeds**
OSHA PEL - Construction Industry See 29 CFR 1926.55 Appendix A	5 ppm (13 mg/m³) TWA	HE14	Upper respiratory irritation, nosebleeds
OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	5 ppm (13 mg/m³) TWA	HE14	Upper respiratory irritation, nosebleeds
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	2 ppm (5 mg/m³) TWA 5 ppm (13 mg/m³) STEL	HE4	Blindness
		HE9	
		HE11	Breathing difficulties
		HE14	Eye and respiratory irritation, eye and skin burning

OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-1	5 ppm (13 mg/m³) TWA	HE14	Upper respiratory irritation, nosebleeds
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2009)	0.25 ppm (0.65 mg/m³) STEL A4	HE9	
		HE10	Decreased lung function, chronic respiratory symptoms
		HE11	Lower respiratory irritation and symptoms
		HE14	Upper respiratory irritation
CAL/OSHA PELs	2 ppm (5 mg/m³) TWA 5 ppm (10 mg/m³) STEL		

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

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

REFERENCES

1. http://en.wikipedia.org/wiki/Sulfur_dioxide
2. http://www.npi.gov.au/resource/sulfur-dioxide
3. http://www.environment.gov.au/resource/sulfur-dioxide-so2
4. http://www.atsdr.cdc.gov/phs/phs.asp?id=251&tid=46
5. http://avogadro.chem.iastate.edu/msds/sulfur_dioxide.pdf
6. https://www.osha.gov/dts/chemicalsampling/data/CH_268500.html

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7. http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/639/Workplace_Exposure_Standards_for_Airborne_Contaminants.pdf

Ocean carbon in, biodegradable plastic out

2025-10-06

Not-so-fun fact: our oceans hold 150 times more carbon dioxide than the Earth's atmosphere. Adding to that causes ocean acidification, which can disrupt marine food chains and reduce biodiversity.

Addressing this could not only help restore balance to underwater ecosystems, but also take advantage of an opportunity to sustainably use this stored CO2 for a variety of purposes – including producing the industrial chemicals needed to make plastic.

The first towards this is called Direct Ocean Capture – which refers to removing dissolved carbon directly from seawater – happens through electrochemical processes. While there are a bunch of companies working on this, it hasn't extensively been applied at scale yet, and the cost benefit doesn't look great at the moment (it's estimated that removing 1 ton of CO2 from the ocean could cost at least US$373, according to Climate Interventions).

Scientists from the Chinese Academy of Sciences and the University of Electronic Science and Technology of China – both in Shenzhen, China – have devised a DOC method which involves converting the captured CO2 into biodegradable plastic precursors. This approach is also described as operating at 70% efficiency, while consuming a relatively small amount of energy (3 kWh per kg of CO2), and working out to an impressive $230 per ton of CO2.

What's also worth noting is the use of modified marine bacteria for the last step. Here's a breakdown of the process, described in a paper appearing in Nature Catalysis:

First, electricity is used in a special reactor to acidify natural seawater. This converts the invisible, dissolved carbon into pure gas, which is collected. The system then restores the water's natural chemistry before returning it to the ocean.

Next, the captured CO2 gas is fed into a second reactor containing a bismuth-based catalyst to yield a concentrated, pure liquid called formic acid. Formic acid is a critical intermediate because it is an energy-rich food source for microbes.

Engineered marine microbes, specifically Vibrio natriegens, are fed the pure formic acid as their sole source of carbon. The microbes metabolize the formic acid and efficiently produce succinic acid, which is then used

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directly as the essential precursor to synthesize biodegradable plastics, such as polybutylene succinate (PBS).

That's a pretty good start. The researchers note there's room for optimization to boost yields and integrate this system into industrial processes. It could also be altered to produce chemicals for use in fuels, drugs, and foods.

It also remains to be seen how quickly the team can commercialize this DOC method, because it may have formidable competition. For example, Netherlands-based Brineworks says it will get to under $200/ton by 2030 with its electrolysis-based solution. The next couple of years will be worth watching in this fascinating niche of decarbonization.

New Atlas, 6 October 2025

https://newatlas.com

New family of fluorescent molecules glows in water, enhancing visualization of cells

2025-10-16

A team of researchers at the Departments of Physical Chemistry and Organic Chemistry of the University of Malaga and The Biomimetic Dendrimers and Photonic Laboratory of the research institute IBIMA Plataforma BIONAND has achieved a breakthrough that combines materials science and biomedicine. They have developed a new family of fluorescent molecules with promising applications in the study of living cells and the medicine of the future. The study has just been published in Advanced Materials.

The team of researchers has created a new family of fluorescent molecules that glow in a surprising way. These types of molecules typically lose part of their intensity or change to more dull colors when dissolved in water or other biological media. However, these new molecules do just the opposite: They emit a higher fluorescence intensity because their coloration shifts to the blue region of the light spectrum.

This behavior, which scientists described as "counterintuitive," is key because it means that dyes work better in aqueous media like the inside of a cell, something essential for biomedical applications. In other words, they do not turn off when they are needed most but rather maintain—and even enhance—their brightness in real conditions of use.

This breakthrough takes on a real meaning when applied to biomedicine. These new dyes allow researchers to "photograph" the inside of the cells with great precision and without damaging them, thanks to a technique called multiphoton microscopy. This method enables deeper penetration into living tissues, obtaining clearer and safer images.

The most striking thing is their ability to selectively mark mitochondria, the well-known powerhouses of cells, responsible for supplying the energy required for life, playing a key role in diseases such as cancer or neurodegenerative pathologies.

The experiments showed that these new molecules offer images of a quality comparable to that of fluorescence, but with a decisive advantage: They are easier and cheaper to produce. This opens the door to more accessible diagnostic tools to study essential cellular processes and, in the future, improve early detection of diseases.

The study was conducted by José Manuel Marín Beloqui, Juan T. López Navarrete and Juan Casado Cordón, all researchers at the Faculty of Science, together with scientists from the Biomimetic Dendrimer and Photonics Laboratory of IBIMA Plataforma BIONAND, and directed by Ezequiel Pérez-Inestrosa, along with Carlos Benítez Martín and Francisco Nájera Albendín.

"These results are tremendously encouraging," said UMA Professors Pérez-Inestrosa and Casado. "Not only do these molecules challenge an established rule in fluorescent chemistry, but they also open the door to new tools for studying diseases where mitochondrial function is key. It is an example of what is achieved when fundamental chemistry meets research applied to biomedicine."

Phys Org, 16 October 2025

https://phys.org

Does washing your fruit and veggies remove chemicals?

2025-09-16

Are you a religious fresh produce washer, or do you give your broccoli more of a cursory splash? Or maybe you don't bother at all.

Testing recently uncovered the presence of a banned chemical in fresh berries sold in New South Wales. High levels of another legal pesticide were also detected during this testing.

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So, how effective is washing fruit and veggies at reducing the amount of chemical residues we generally consume?

Can pesticides be washed off fruits and veggies?

Julian Cox is an associate professor of food microbiology at the University of New South Wales and a member of the Food Safety Information Council board.

Dr Cox says washing fresh produce "reduces risks in all sorts of ways".

"Any washing will mitigate risk … and simply the physical act of washing will help move material from the surface, be it bugs, be it soil, be it chemical residues."

Some produce is easier to wash than others, Dr Cox says.

"With something like raspberries — softer fruits — you really can't do too much with them in terms of physical action."

He says this is why a lot of fruit and vegetables sold commercially are washed before sale using a food-grade cleaning solution with an ingredient such as chlorine.

Food and nutrition scientist Emma Beckett, based in Newcastle/Awabakal, says she cleans raspberries by dunking them into a mixture of vinegar and water.

She says it doesn't negatively impact the flavour at all.

Dr Beckett also advises washing your hands before washing your fresh produce.

"Otherwise, you're washing what's on your hand onto the thing you think you're washing."

Jian Zhao is also an associate professor at the University of New South Wales, whose research areas fall within food science and technology.

He says washing fresh produce does reduce your risk of chemical intake, particularly with the help of baking soda.

Dr Zhao says this is because baking soda is an "alkaline substance" that will "accelerate the breakdown of certain types of chemical residue".

If the produce is smooth-skinned, he says running water with some rubbing is probably enough, but for harder-to-clean produce, he

recommends soaking them in water with some salt or baking soda for about 10 minutes.

How is pesticide use controlled in Australia?

A spokesperson from Food Standards Australia New Zealand (FSANZ) — which sets out the legal requirements for food produced and sold in Australia — says it "undertakes periodic safety checks for chemicals of public health concern".

The spokesperson says the Australian Pesticides and Veterinary Medicines Authority (APVMA) registers and approves chemical uses and sets maximum residue limits (MRLs).

The spokesperson says these are "set well below the level that could pose health and safety risks to consumers".

The ABC's Background Briefing found residue testing happens every 4–6 years nationally, and it's largely focused on exports.

Last month, the APVMA announced a review into the use of dimethoate on blueberries, raspberries and blackberries as "new information" revealed Australians were eating "significantly more berries" than when it had last reviewed the use of dimethoate in 2017.

Do pesticides get absorbed into fruit and veggies?

Dr Zhao says, "fruit and vegetables do absorb a small amount of pesticides, which is considered as part of the [MRLs]".

Dr Beckett says that "some pesticides are incorporated into the structures of the plants, and others sit on the outside of the plant as a barrier".

This impacts the usage limits and rules around when this product can be used in relation to when it is harvested (the withholding period), she explains.

According to FSANZ, "Where a chemical specifies a withholding period or pre-harvest time between application and harvest, these directions must be followed. In this way, any residues left on the produce should meet the MRL requirements."

ABC News, 16 September 2025

https://abc.net.au

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Super-sticky hydrogel is 10 times stronger than other glues underwater

2025-08-06

A rubber duck that was stuck to a seaside rock for more than a year has proved the strength of a new sticky material. The adhesive could be used in deep-sea robots and repair work, or as surgical glue for medical procedures.

"We developed a super-adhesive hydrogel that works extremely well even underwater – something very few materials can achieve," says Hailong Fan at Shenzhen University in China. Hydrogels are stretchy and soft materials.

Fan, then at Hokkaido University in Japan, and his colleagues analysed 24,000 sticky protein sequences from many different organisms to identify the stickiest combinations of amino acids, the building blocks of proteins. They used that information to create 180 different types of adhesive hydrogel. Then, they trained artificial intelligence models on the hydrogels' material properties to predict even better recipes for super-sticky materials.

This process let the team develop a new class of versatile and sticky hydrogel. The material bonds to surfaces even when it has been unstuck and restuck multiple times or immersed in seawater, says Fan. It exceeded 1 megapascal of adhesion strength underwater – about 10 times stronger than most soft, sticky materials under the same conditions.

The research "demonstrates a paradigm shift in the way we can design high-performance soft materials", says Zhao Qin at Syracuse University in New York state. He praised the team for identifying stickiness patterns in natural proteins and capturing them in the new material.

The most whimsical demonstration of the hydrogel's sticky strength involved keeping that yellow rubber duck attached to the wave-soaked rock by the shore. In a more practical experiment, the hydrogel instantly sealed a leaking water pipe. This suggests it could help repair underwater structures or make flexible electronics and robotics water-resistant.

The material was also biocompatible, which the researchers proved by implanting it under the skin of mice. This could make it useful for biomedical applications, such as affixing implants or working as surgical glue.

The hydrogel's stickiness is remarkable, says Qin, but he notes that the material must be relatively thick to perform well. He hopes to see it tested

outside ideal experimental conditions, especially in real-world situations with rough, contaminated or moving surfaces.

The researchers have submitted a patent for the new material through Hokkaido University, where most of them work.

New Scientist, 6 August 2025

https://newscientist.com

Atom-swapping blueprint could streamline synthesis of pharmaceutical building blocks

2025-10-16

Researchers from NUS have pioneered a photocatalytic atom-swapping transformation that converts oxetanes into a variety of four-membered saturated cyclic molecules, which are key scaffolds in medicinal chemistry. By introducing a new synthetic blueprint for these prized drug motifs, this discovery could potentially streamline the synthesis of pharmaceuticals and complex drug analogs that would otherwise require multi-step routes.

The research team was led by Associate Professor Koh Ming Joo from the NUS Department of Chemistry, together with Assistant Professor Zhang Xinglong from The Chinese University of Hong Kong, Hong Kong, China.

The research was published in the journal Nature on 15 October 2025.

Non-aromatic (saturated) heterocycles and carbocycles form the skeleton of countless bioactive and functional molecules. Four-membered saturated cyclic molecules such as azetidines, thietanes and cyclobutanes are increasingly valued in drug discovery for their desirable physicochemical properties, such as potency, stability, metabolic stability and target specificity. However, the traditional retrosynthetic approaches typically deconstruct the ring into simpler starting materials that have to be prepared separately through numerous steps. This approach is often energy- and time-consuming and generates excessive waste, particularly in the assembly of complex drug molecules.

Assoc Prof Koh said, "The conventional way of constructing four-membered rings employs cycloaddition or nucleophilic substitution chemistries that limit the range of obtainable molecular scaffolds. There is an urgent need to design a new approach that not only simplifies the synthesis of small-ring pharmacophores but also unlocks uncharted regions of the chemical space."

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New atom-swapping logic accelerates synthesis of non-aromatic drug scaffolds

The researchers developed a skeletal editing strategy that selectively exchanges the oxygen atom of an oxetane building block for another functional group (nitrogen, sulfur, or carbon), through reaction with appropriate reagents. This transformation process is achieved by using a photocatalyst to break the oxetane ring into a reactive dibromide compound under visible light.

The ring is then rebuilt using different nucleophiles to give a range of four-membered heterocycles and carbocycles in one pot. Computational studies by Asst Prof Zhang's group provided insights into the underlying mechanism and the origins of the high chemoselectivity.

To demonstrate the value of their method, the researchers successfully simplified the preparation of advanced drug intermediates, reducing the number of synthetic steps from 8 to 12 steps down to four steps, delivering substantial cost savings and waste reduction. The researchers also applied their method to the late-stage editing of complex bioactive oxetanes to obtain heterocyclic drug candidates with enhanced properties, bypassing the need to make them from scratch.

"Our atom-swapping manifold offers a convenient diversification platform to transform readily accessible oxetane feedstocks into different classes of high-value saturated cyclic compounds in one operation. This would empower chemists in their synthetic endeavors by providing new opportunities in making cyclic functional molecules for important applications such as drug discovery," added Assoc Prof Koh.

Studies are ongoing to extend the methodology to heterocyclic drug compounds of various ring sizes relevant to therapeutics.

Phys Org, 16 October 2025

https://phys.org

Hydrogel-Based Pill for Weight Loss Shows Promising Results

2025-10-17

An expanding pill could soon offer a new and affordable weight loss treatment, following a successful clinical trial at University Hospital Southampton.

Sirona is a hydrogel-based pill that is designed to aid weight loss by reducing hunger.

After it is swallowed, the pill expands in your stomach, making you feel full faster. This helps you eat less without needing strong medications or injections.

The treatment has been developed by Oxford Medical Products (OMP).

OMP partnered with the NIHR Southampton and Bristol Biomedical Research Centres for the clinical trial, together with the North Bristol and Milton Keynes NHS Trusts.

Participants in Southampton took part at University Hospital Southampton's NIHR clinical research facility.

In the trial, funded by Innovate UK and supported by the National Institute for Health and Care Research (NIHR), participants lost up to 13.5% of their body weight in just six months. On average, people with class 1 obesity (BMI 30-35) lost 6.4% of their body weight.

Participants also ate on average 400 fewer calories per day compared to those taking a placebo. For context, recent Government-led research suggests that even a 216-calorie daily reduction could cut the UK's obesity rate in half.

Results have been published in the journal Obesity.

The trial was led by chief investigator Professor James Byrne within the NIHR Southampton Biomedical Research Centre.

Mr Byrne, a consultant surgeon at University Hospital Southampton, said: "Obesity is a chronic and often progressive disease. With obesity rates continuing to rise, these results are an important step towards providing a highly differentiated treatment option.

"This trial demonstrated Sirona could be a safe, affordable, and non-pharmacological treatment to support long-term weight management."

Sirona has been designed to help two main groups of people. It could benefit those who are overweight (with a BMI between 25-30) and want to stop their weight from progressing into obesity. It could also support people who are coming off GLP-1 medications (like Ozempic or Mounjaro) and want to avoid regaining weight after stopping treatment.

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GLP-1 medications have become very popular for weight loss, with around 1.5 million users in the UK. However, a significant proportion of users pay out of pocket and prices have recently doubled for some doses.

Sirona aims to be much cheaper, easier to tolerate, and available to more people.

Camilla Easter, CEO of Oxford Medical Products, said: "Sirona has demonstrated amazing results during testing with UK hospitals, which have now been externally peer-reviewed. Next, we are setting sights on commercial UK release plans, targeting 2027 to make Sirona available."

Sirona is a dual-polymer hydrogel pill. That means it's made from two types of safe materials that expand in the stomach. It doesn't use drugs or chemicals to change how your body works.

The pill was well tolerated during the 24-week study. There were no serious adverse events.

OMP is planning a pivotal study in the UK and USA to further assess the effectiveness of Sirona and confirm these results.

Technology Networks, 17 October 2025

https://technologynetworks.com

A new gold-perovskite catalyst achieves record-high acetaldehyde yields from bioethanol at lower temperatures.

2025-10-17

A new gold-perovskite catalyst achieves record-high acetaldehyde yields from bioethanol at lower temperatures.

Acetaldehyde plays an important role as a chemical building block and is commonly produced through the ethylene-based Wacker oxidation process. However, this traditional method is both expensive and environmentally damaging. Researchers have long sought a cleaner and more sustainable alternative, such as converting bioethanol into acetaldehyde through selective oxidation. Yet, most catalysts developed for this purpose face a difficult balance between activity and selectivity, often producing less than 90% acetaldehyde.

A major advance came over a decade ago when Liu and Hensen identified a unique Au0-Cu+ interaction in an advanced Au/MgCuCr2O4 catalyst.

Their system delivered over 95% acetaldehyde yield at 250°C and maintained its performance for more than 500 hours. Although this was a major breakthrough, scientists continue to search for safer and more efficient catalysts that can drive ethanol oxidation effectively at lower temperatures.

A New Generation of Perovskite Catalysts

Recently, the research team led by Prof. Peng Liu (Huazhong University of Science and Technology) and Prof. Emiel J.M. Hensen (Eindhoven University of Technology) reported significant progress in selective ethanol oxidation. They developed a series of Au/LaMnCuO3 catalysts with varying Mn/Cu ratios, among which the Au/LaMn0.75Cu0.25O3 composition exhibited a pronounced synergistic effect between gold nanoparticles and moderately Cu-doped LaMnO3 perovskite. This synergy enabled efficient ethanol oxidation below 250oC, outperforming the previously benchmarked Au/MgCuCr2O4 catalyst. The findings were published in the Chinese Journal of Catalysis.

To improve the efficiency of converting bioethanol into acetaldehyde—a valuable chemical used in plastics and pharmaceuticals, researchers developed a new class of catalysts based on perovskite materials. These supports were synthesized using a sol-gel combustion method and then coated with gold nanoparticles. By adjusting the ratio of manganese to copper in the perovskite structure, the team identified an optimal composition (Au/LaMn0.75Cu0.25O3) that achieved a high acetaldehyde yield of 95% at 225°C and maintained stable performance for 80 hours.

Catalysts with higher copper content were less effective, largely because copper tends to lose its active form during the reaction. The improved performance of the optimized catalyst is linked to a cooperative interaction between gold, manganese, and copper ions.

Decoding the Catalyst's Atomic-Level Mechanism

To better understand how these elements work together, the researchers used advanced computational techniques, including density functional theory and microkinetic simulations. These studies revealed that doping copper into the perovskite creates active sites near the gold particles that help activate oxygen and ethanol molecules more efficiently. The optimized catalyst also showed a lower energy barrier for key reaction steps, making the process more efficient. Both experimental and

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theoretical results highlight the importance of fine-tuning the catalyst composition to achieve better performance.

Sci Tech Daily, 17 October 2025

https://scitechdaily.com

Greener gold: Sustainable gold extraction process achieved through cyanide recycling

2025-10-16

Since the modern gold rushes of the 1970s and 1980s, gold has been one of Australia's major exports. Australia is the second-largest gold producer globally behind China and holds the second largest known gold resources in the world.

In 2024 alone, the nation generated nearly 300 tonnes of gold, worth about $34 billion AUD, making it the fifth-most valuable export.

With current geopolitical instability driving investors to purchase gold and other precious metals to secure their investments, gold prices have reached unprecedented highs.

A recent report forecasts that record prices and growing export volumes will push Australia's gold earnings to $60 billion AUD in both 2025–26 and 2026–27. If this trend continues, gold could soon rival coal and iron ore as one of the nation's top exports.

Australia's mines are now ramping up production to meet market demands, and with more output there is a need to consider the implications of the traditional but toxic leaching methods being used.

Cyanide and gold extraction

Cyanide is widely used in gold extraction as it easily and selectively combines with gold (and silver), making it useful in separating these precious metals from their ore.

However, due to its highly toxic nature, it can result in substantial environmental impacts and public health risks if released into the environment.

Since the 1970s, cyanide spills have resulted in major fish kills, contaminated drinking water supplies and harmed agricultural lands.

One of the most catastrophic incidents occurred in Romania in the year 2000. At Aural Gold Mine, a tailings dam ruptured, spilling 3.5 million cubic feet of cyanide-contaminated waste into the Tisza and Danube Rivers. Not only did it kill fish and poison water supplies in the immediate area, but traveled as far as 400 kilometers downriver to Hungary and former Yugoslavia.

A need for green in the new gold rush

CSIRO Principal Research Scientists Dr. Paul Breuer and Dr. Xianwen Dai have developed a patented technology that offers a more sustainable and profitable future for gold processing.

Sustainable Gold Cyanidation Technology is a new process that improves gold recovery while recycling toxic cyanide, delivering both economic gains and environmental benefits.

Dr. Dai, who validated the process chemistry and economics of the technology during a month-long, continuous bench scale mini-piloting campaign, believes the innovation is a leap forward for gold processors.

"Our process surpasses the commonly practiced cyanide destruction technology and we are now ready for pilot scale demonstration in the field," said Dr. Dai.

Managing cyanide's toxic risks

Today, the gold mining industry reduces the environmental risks by destroying residual cyanide in the process tailings before discharge to tailings storage facilities.

CSIRO's new technology further reduces the level of toxic compounds left in the tailings and the amount of cyanide needed to be transported to site, lowering the risk of environmental impacts.

"This technology enables the recovery of cyanide and other toxic compounds, some base metals and valuable soluble gold that typically remains unrecovered in cyanidation tailings," said Dr. Dai.

At the same time, it reduces environmental risks and costs linked to cyanide use, transport, tailings storage, and potential dam failures."

Track record of sustainable gold recovery innovation

This isn't the first sustainable gold breakthrough by CSIRO.

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Dr. Breuer's team previously produced Australia's first cyanide-free gold using a process called "Going for Gold." This landmark innovation won the 2014 Australian Mining Prospect Award for replacing cyanide with thiosulfate, a non-toxic alternative. They successfully delivered a safer, more sustainable process without the environmental risks of leakage, spillage, or exposure to toxic chemicals.

"On the path to commercialization, we partnered with small gold producer, Eco Minerals Research, to build a mobile gold processing demonstration plant based in Menzies, Western Australia," said Dr. Breuer.

"The plant enabled us to trial and improve the process to ensure it was robust and practical at scale for commercial operation."

In 2019, the technology was transferred to Australian company, Clean Mining, which today offers the technology products and licenses to industry. The technology can also replace toxic mercury used by artisanal and small gold miners.

Going for Gold was built on CSIRO's previous work tailoring a niche cyanide-free solution to Barrick Gold's Goldstrike Mine. Successfully operating from 2014 to 2024, the site processed up to 13,000 tonnes of ore per day.

A golden opportunity for Australian gold producers

Dr. Breuer and his team are now excited about the sustainable improvements the Sustainable Gold Cyanidation Technology process offers the gold industry.

After a month-long lab-scale pilot testing, the Sustainable Gold Cyanidation Technology is now at Technology Readiness Level 4 and set for scale up.

Dr. Breuer and Dr. Dai are seeking industry partners for pilot projects and are open to collaborations with gold producers, engineering firms, and suppliers.

"The technology can deliver much greater economic and environmental benefits beyond what is possible with current cyanide recovery and recycling technologies," said Dr. Breuer.

"With sufficient interest we will be able to progress to pilot and demonstration in the field, which will hopefully lead to improved gold yields, environmental outcomes and sustainability for the gold industry."

Phys Org, 16 October 2025

https://phys.org

Sun-powered device extracts lithium without wrecking the environment

2025-09-05

The mining of lithium for batteries – the key to the electric vehicle revolution and levelling out the power supplied by renewables – is environmentally damaging. But an experimental sun-powered method that produces fresh water as well as lithium could make it more sustainable.

Today, most lithium is obtained from underground brine reservoirs in the Andes. The brine is concentrated by letting it evaporate in open-air ponds for months, and the subsequent extraction of lithium carbonate from the concentrated brine requires large quantities of fresh water. What's more, as the brine is pumped out of the reservoirs, fresh water in the rocks above may flow down to replace it, causing the water table to fall. In other words, mining has a major impact on the water supply.

Many groups are working on direct lithium extraction methods that don't require open-air evaporation. One such approach, developed by Yu Tang at Lanzhou University in China and her colleagues, would also produce freshwater that could be used or to be pumped back underground.

The team based their technique on a form of manganese oxide that has two key properties. Firstly, it converts a lot of the sunlight falling on it into heat. Secondly, it can selectively bind to lithium ions.

In their design, a thin layer of brine or seawater flows down a sun-facing layer of manganese oxide. As the sun warms the material, the water evaporates and the lithium ions bind to the oxide. Once the layer is saturated, the ions can be removed using an acidic solution, and the material can be reused.

Because the process takes place inside a sealed system, the water that evaporates condenses out and can be harvested. The team has tested a small prototype over five cycles of lithium adsorption and release, and

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the harvested water met the drinking standards of the World Health Organization.

"It is very clever," says Ugo Bardi at the University of Florence in Italy. In principle, it could provide a more sustainable source of lithium, he says.

"The paper looks credible," says Bardi. "The potential problem I can see is the stability of the material: for how many cycles can it be used in real-world conditions?"

New Scientist, 5 September 2025

https://newscientist.com

"Virtual Spectrometer" Quickly Assesses a Material's Quality

2025-10-16

Manufacturing better batteries, faster electronics, and more effective pharmaceuticals depends on the discovery of new materials and the verification of their quality. Artificial intelligence is helping with the former, with tools that comb through catalogs of materials to quickly tag promising candidates.

But once a material is made, verifying its quality still involves scanning it with specialized instruments to validate its performance — an expensive and time-consuming step that can hold up the development and distribution of new technologies.

Now, a new AI tool developed by MIT engineers could help clear the quality-control bottleneck, offering a faster and cheaper option for certain materials-driven industries.

In a study appearing today in the journal Matter, the researchers present "SpectroGen," a generative AI tool that turbocharges scanning capabilities by serving as a virtual spectrometer. The tool takes in "spectra," or measurements of a material in one scanning modality, such as infrared, and generates what that material's spectra would look like if it were scanned in an entirely different modality, such as X-ray. The AI-generated spectral results match, with 99 percent accuracy, the results obtained from physically scanning the material with the new instrument.

Certain spectroscopic modalities reveal specific properties in a material: Infrared reveals a material's molecular groups, while X-ray diffraction visualizes the material's crystal structures, and Raman scattering

illuminates a material's molecular vibrations. Each of these properties is essential in gauging a material's quality and typically requires tedious workflows on multiple expensive and distinct instruments to measure.

With SpectroGen, the researchers envision that a diversity of measurements can be made using a single and cheaper physical scope. For instance, a manufacturing line could carry out quality control of materials by scanning them with a single infrared camera. Those infrared spectra could then be fed into SpectroGen to automatically generate the material's X-ray spectra, without the factory having to house and operate a separate, often more expensive X-ray-scanning laboratory.

The new AI tool generates spectra in less than one minute, a thousand times faster compared to traditional approaches that can take several hours to days to measure and validate.

"We think that you don't have to do the physical measurements in all the modalities you need, but perhaps just in a single, simple, and cheap modality," says study co-author Loza Tadesse, assistant professor of mechanical engineering at MIT. "Then you can use SpectroGen to generate the rest. And this could improve productivity, efficiency, and quality of manufacturing."

The study's lead author is former MIT postdoc Yanmin Zhu.

Beyond bonds

Tadesse's interdisciplinary group at MIT pioneers technologies that advance human and planetary health, developing innovations for applications ranging from rapid disease diagnostics to sustainable agriculture.

"Diagnosing diseases, and material analysis in general, usually involves scanning samples and collecting spectra in different modalities, with different instruments that are bulky and expensive and that you might not all find in one lab," Tadesse says. "So, we were brainstorming about how to miniaturize all this equipment and how to streamline the experimental pipeline."

Zhu noted the increasing use of generative AI tools for discovering new materials and drug candidates, and wondered whether AI could also be harnessed to generate spectral data. In other words, could AI act as a virtual spectrometer?

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A spectroscope probes a material's properties by sending light of a certain wavelength into the material. That light causes molecular bonds in the material to vibrate in ways that scatter the light back out to the scope, where the light is recorded as a pattern of waves, or spectra, that can then be read as a signature of the material's structure.

For AI to generate spectral data, the conventional approach would involve training an algorithm to recognize connections between physical atoms and features in a material, and the spectra they produce. Given the complexity of molecular structures within just one material, Tadesse says such an approach can quickly become intractable.

"Doing this even for just one material is impossible," she says. "So, we thought, is there another way to interpret spectra?"

The team found an answer with math. They realized that a spectral pattern, which is a sequence of waveforms, can be represented mathematically. For instance, a spectrum that contains a series of bell curves is known as a "Gaussian" distribution, which is associated with a certain mathematical expression, compared to a series of narrower waves, known as a "Lorentzian" distribution, that is described by a separate, distinct algorithm. And as it turns out, for most materials infrared spectra characteristically contain more Lorentzian waveforms, while Raman spectra are more Gaussian, and X-ray spectra is a mix of the two.

Tadesse and Zhu worked this mathematical interpretation of spectral data into an algorithm that they then incorporated into a generative AI model.

"It's a physics-savvy generative AI that understands what spectra are," Tadesse says. "And the key novelty is, we interpreted spectra not as how it comes about from chemicals and bonds, but that it is actually math — curves and graphs, which an AI tool can understand and interpret."

Data co-pilot

The team demonstrated their SpectroGen AI tool on a large, publicly available dataset of over 6,000 mineral samples. Each sample includes information on the mineral's properties, such as its elemental composition and crystal structure. Many samples in the dataset also include spectral data in different modalities, such as X-ray, Raman, and infrared. Of these samples, the team fed several hundred to SpectroGen, in a process that trained the AI tool, also known as a neural network, to learn correlations between a mineral's different spectral modalities. This training enabled SpectroGen to take in spectra of a material in one modality, such as in

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Once they trained the AI tool, the researchers fed SpectroGen spectra from a mineral in the dataset that was not included in the training process. They asked the tool to generate a spectra in a different modality, based on this "new" spectra. The AI-generated spectra, they found, was a close match to the mineral's real spectra, which was originally recorded by a physical instrument. The researchers carried out similar tests with a number of other minerals and found that the AI tool quickly generated spectra, with 99 percent correlation.

"We can feed spectral data into the network and can get another totally different kind of spectral data, with very high accuracy, in less than a minute," Zhu says.

The team says that SpectroGen can generate spectra for any type of mineral. In a manufacturing setting, for instance, mineral-based materials that are used to make semiconductors and battery technologies could first be quickly scanned by an infrared laser. The spectra from this infrared scanning could be fed into SpectroGen, which would then generate a spectra in X-ray, which operators or a multiagent AI platform can check to assess the material's quality.

"I think of it as having an agent or co-pilot, supporting researchers, technicians, pipelines and industry," Tadesse says. "We plan to customize this for different industries' needs."

The team is exploring ways to adapt the AI tool for disease diagnostics, and for agricultural monitoring through an upcoming project funded by Google. Tadesse is also advancing the technology to the field through a new startup and envisions making SpectroGen available for a wide range of sectors, from pharmaceuticals to semiconductors to defense.

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Technology Networks, 16 October 2025

https://technologynetworks.com

Chemical language models don't need to understand chemistry, study demonstrates

2025-10-25

Language models are now also being used in the natural sciences. In chemistry, they are employed, for instance, to predict new biologically active compounds. Chemical language models (CLMs) must be extensively trained. However, they do not necessarily acquire knowledge of biochemical relationships during training. Instead, they draw conclusions based on similarities and statistical correlations, as a recent study by the University of Bonn demonstrates. The results have now been published in the journal Patterns.

Large language models are often astonishingly good at what they do, whether that's proving mathematical theorems, composing music, or drafting advertising slogans. But how do they arrive at their results? Do they actually understand what constitutes a symphony or a good joke? It is not so easy to answer that question. "All language models are a black box," emphasizes Prof. Dr. Jürgen Bajorath. "It's difficult to look inside their heads, metaphorically speaking."

Nevertheless, Bajorath, a cheminformatics scientist at the Lamarr Institute for Machine Learning and Artificial Intelligence at the University of Bonn, has attempted to do just that. Specifically, he and his team have focused on a special form of AI algorithm: transformer CLM.

This model works in a similar way to ChatGPT, Google Gemini and Elon Musk's "Grok", which are trained using vast quantities of text, enabling them to generate sentences independently. CLMs, on the other hand, are usually based on significantly less data. They acquire their knowledge from molecular representations and relationships, e.g., the so-called SMILES strings. These are character strings that represent molecules and their structure as a sequence of letters and symbols.

Systematic manipulation of training data

In pharmaceutical research, scientists often attempt to identify substances that can inhibit certain enzymes or block receptors. CLMs can be used to predict active molecules based on the amino acid sequences of target proteins. "We used sequence-based molecular design as a test system to better understand how transformers arrive at their predictions," explains Jannik Roth, a doctoral student working with Bajorath.

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"After the training phase, if you introduce a new enzyme to such a model, it may produce a compound that can inhibit it. But does that mean that the AI has learned the biochemical principles behind such inhibition?"

CLMs are trained using pairs of amino acid sequences of target proteins and their respective known active compounds. In order to address their research question, the scientists systematically manipulated the training data.

"For example, we initially only fed the model specific families of enzymes and their inhibitors," explains Bajorath. "When we then used a new enzyme from the same family for testing purposes, the algorithm actually suggested a plausible inhibitor."

However, the situation was different when the researchers used an enzyme from a different family in the test, i.e., one that performs a different function in the body. In this case, the CLM failed to correctly predict active compounds.

Statistical rule of thumb

"This suggests that the model has not learned generally applicable chemical principles, i.e., how enzyme inhibition usually works chemically," says the scientist. Instead, the suggestions are based solely on statistical correlations, i.e., patterns in the data. For example, if the new enzyme resembles a training sequence, a similar inhibitor will probably be active. In other words, similar enzymes tend to interact with similar compounds.

"Such a rule of thumb based on statistically detectable similarity is not necessarily a bad thing," says Bajorath, who leads the area "AI in Life Sciences and Health" at the Lamarr Institute. "After all, it can also help to identify new applications for existing active substances."

However, the models used in the study lacked biochemical knowledge when estimating similarities. They considered enzymes (or receptors and other proteins) to be similar if they matched 50%–60% of their amino acid sequence, and, accordingly, suggested similar inhibitors. The researchers could randomize and scramble the sequences at will, as long as sufficient original amino acids were retained.

However, often only very specific parts of an enzyme are necessary for it to perform its task. A single amino acid change in such a region can render an enzyme dysfunctional. Other areas are more important for structural integrity and less relevant for specific functions. "During their training, the

models did not learn to distinguish between functionally important and unimportant sequence parts," says Bajorath.

Models simply repeat what they have read before

The results of the study therefore show that the transformer CLMs trained for sequence-based compound design lack any deeper chemical understanding, at least for this test system. In other words, they merely recapitulate, with minor variations, what they had already picked up in a similar context at some point.

"This does not mean that they are unsuitable for drug research," says Bajorath. "It is quite possible that they suggest drugs that actually block certain receptors or inhibit enzymes."

However, this is certainly not because they understand chemistry so well, but because they recognize similarities in text-based molecular representations and statistical correlations that remain hidden from us. This does not discredit their results. However, they should not be overinterpreted either.

Phys Org, 15 October 2025

https://phys.org

The mystery of highly reactive oxygen has finally been solved

2025-10-01

After several decades, researchers are finally getting a grasp on when an odd and destructive type of oxygen arises in chemical reactions in living cells and certain batteries.

Not all oxygen molecules are created equal. In some, their two most energetic electrons have opposite values of quantum spin while in others their spins match. When they are opposites, the molecule is known as "singlet oxygen", which is highly reactive so it can cause toxic changes in proteins and fats within cells and eat away parts of some batteries. Since the 1960s, chemists have been working to determine when exactly this evil twin of the oxygen that we happily breathe arises in chemical reactions. Stefan Freunberger at the Institute of Science and Technology Austria and his colleagues have now figured it out.

They carried out a series of experiments that started with a molecule of superoxide – a compound that contains oxygen and participates in

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chemical reactions used by mitochondria to power cells – and ended with the production of oxygen in either form. While cells have enzymes that help this process, the team tried different "mediator" molecules. This allowed them to record oxygen-making reactions with a broad range of driving forces, or energy differences that force the reaction to happen in the first place. They discovered that it is exactly this driving force that matters – for singlet oxygen to form, this force had to get very high.

"There was really truly a fierce debate about whether or not it [singlet oxygen] forms in the environment of cells. Up to now it has never been clarified," says Freunberger.

Because mitochondria have high pH values that keep the driving force low, the new work implies that singlet oxygen is not produced in high quantities within these cellular powerhouses, which protects the cell from damage.

Kristopher McNeill at ETH Zürich in Switzerland says that the question of singlet oxygen production has consequences beyond biology. "Wherever it's generated it can damage or react with things that are in the neighbourhood," he says. The analysis in the new study pertains to certain kinds of batteries and could be part of an explanation for why they sometimes corrode from the inside, says McNeill.

New Scientist, 1 October 2025

https://newscientist.com

How the pioneers of metal-organic frameworks won the Nobel prize

2025-10-16

From wooden models to thousands and thousands of structures, Julia Robinson tells the story of how Richard Robson, Susumu Kitagawa and Omar Yaghi won the 2025 Nobel prize in chemistry

With their seemingly infinite potential applications, metal–organic frameworks (MOFs) are a vibrant international field of research. But just a few decades ago, these highly porous materials, in which metal ions are linked together by organic molecules in a regular repeating pattern to create a 3D network, were but a fleeting concept in a university lecture hall.

The expansion of the field since then can only be described as an explosion. In the early 2000s, there were just a handful of research groups

dedicated to MOFs and a few dozen papers published each year but now the rate of publishing has increased exponentially – with almost 10,000 papers published in 2024 and over 100,000 MOF structures recorded to date.

The recognition of Richard Robson of the University of Melbourne in Australia, Susumu Kitagawa of Kyoto University in Japan and Omar Yaghi of the University of California, Berkeley in the US in this years' chemistry Nobel prize for the development of MOFs will have come as little surprise to many in the field.

'We were so excited, over the moon, and we started clapping,' says Kyriaki Koupepidou, a postdoc in Kitagawa's lab. 'It was such an unreal experience – we had a big screen, and they pulled up the picture of the three pioneers, and we kept that on the screen as inspiration for our experiments.'

However, the endless applications for these structures – and the speed at which the field developed – is something few could have predicted in those early years.

'One of the things that I will treasure in my retirement is just being lucky to see a whole new field of chemistry develop right from the start and from a front row seat,' says Stuart Batten, a chemist at Monash University in Melbourne, Australia, who was the first student in Robson's group to work on MOFs.

'I can remember we would go down to the library and look at the journals, which in Australia were about three months behind the rest of the world because they had to be posted, and every few months you'd go "Oh, someone else has done one. We've got competition." And now, you literally just can't keep up,' he says. 'Seeing that transition from our group being the only ones talking about it at conferences, to now whole conferences [and] whole journals devoted to the field is still a little bit surreal.'

Inspired by wooden rods and balls

There are some indications that coordination-type polymers and frameworks go back as far as the 1800s, but Robson's seminal work stems from the 1970s, when he was teaching undergraduate students at the University of Melbourne in Australia. In 1974, about eight years into his time teaching chemistry at the university, Robson got a new boss who was keen to come up with new ideas to brighten up their teaching. He tasked

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Robson with producing models from wooden balls and rods to enable first year undergraduates to explore chemical structures.

Inspired by the structure of diamond, the first compound Robson created was a similar structure based on positively charged copper ions. The copper ions were combined with a molecule with four arms – a tetracyanotetraphenylmethane – each with a nitrile group at the end that was attracted to the copper ions. The result was a large molecular construction with a regular crystalline structure like diamond. However, unlike diamond, it contained a number of large cavities filled with randomly distributed and freely moving solvent molecules and counter ions.

'I think even to his own surprise, it actually worked … he expected to just get amorphous rubbish in the bottom of his reactions, instead of these beautiful little crystals,' says Batten.

The birth of coordination polymers

In exploring these ideas, Robson worked closely with his colleague and close friend Bernard Hoskins, an x-ray crystallographer. Previously Robson had been quite isolated in his work, but he says it was through his collaborations with Hoskins, and later, the inorganic chemist Brendan Abrahams, that 'the whole thing became viable'.

'In the late 1980s, I was able to get compounds in crystalline form and Bernard was able to determine the structure and things began to develop from there … we began to get students … and then it expanded from there,' Robson explained in a door-step interview at the University of Melbourne the day after the Nobel prize was announced.

He published his work in 1989 in the Journal of the American Chemical Society, in which he referred to the structures as 'coordination polymers' – a term he still prefers over MOFs. In other interviews he has said he realised 'almost immediately' that this was going to be a big field of science.

'It was very exciting because all those structures were new,' says Batten. 'No one had done anything like that before. Nowadays, people are used to seeing the beautiful symmetry and connectivity and architecture of MOFs, but in those days, it was a complete surprise, every one that turned up.'

Robson went on to create several new types of molecular constructions with cavities filled with various substances, and showed they could perform ion exchange. He also predicted several important features of

these frameworks: the possibility of integrating catalytic sites within the frameworks and the generation of efficient heterogenous catalysts, for example.

Deanna D'Alessandro, a chemical and biomolecular engineer at the University of Sydney, says that Robson's work was 'a very important discovery' for the Australian chemistry community.

'We have this interesting lineage in Australia, where coordination chemistry in particular, and inorganic chemistry is a very strong discipline of chemistry – many of us went overseas about the same time, and then we came back to Australia. [Now] we're mid-career researchers who were in the cohort who saw that great history and wanted to carry that on for Australia.'

But a significant problem with Robson's frameworks is that many of them were unstable and collapsed easily; the next part of the story, leading to more stable structures, took place in Japan.

Kitagawa's quest for stability

Kitagawa had been in good company during his PhD in the quantum chemistry lab at Kyoto University – his academic 'grandfather' was Kenichi Fukui who shared the 1981 Nobel prize in chemistry for his theories on the course of chemical reactions, while senior to him in the same laboratory was Akiro Yoshino, who shared the 2019 prize for his work on lithium-ion batteries.

During his academic career Kitagawa had always had a lot of freedom to explore his research, but it was when he moved onto a private university – Kindai University – that his boss was keen that they start working on copper(i) chemistry, although many of his peers couldn't understand why.

'[With copper(i)] the d-shell is fully occupied, [there's] no d-d transition, no colour, no magnetism,' explains Kitagawa. 'So most of the coordination chemistry society said "Why you are doing such boring copper(i) chemistry?"'

However, he likens the chemistry of copper(i) to a 'gold mine'. 'Copper(i) has a d10 shell that has a spherical charge distribution … that means [it is] easy to crystallise, to show an extended structure. In the case of iron [or] cobalt, the electron distribution is isotropic so it is very difficult to show such a beautiful structure.'

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He explained how using copper(i) they obtained some 'very beautiful structures' but that, at times, it was challenging because they often had to borrow the crystallography equipment. They persisted, however, and one day they observed a porous structure.

'My student said "Professor, this has many pores, and in the pores, the organic molecules are accommodated,"' Kitagawa remembers. 'That was my inspiration, completely. That's the point. I switched my target [to porous structures] – the turning point.'

They published a paper in 1992 to show their first molecular construction – a two-dimensional material based on copper(i) coordinated with pyrazine and acetonitrile, containing cavities with loosely bound acetone molecules.

'Many, many people told me "This structure looks like a zeolite, but you synthesised this using organic molecules. This should not be stable,"' says Kitagawa. And it was true: the structure used neutral ligands meaning the bonding energy was weak – around 100 kilojoules per mole.

So Kitagawa set out with a strategy of building a structure that still had neutral linkers but that had stronger bonds and was therefore more stable, while also maintaining the all-important porous structure. However, he was somewhat hindered along the way – research funders could not see the point to his work and many of his grant applications were rejected.

'In Japan, we have the fundamental research fund – it is competitive, but the success rate is 20–25%. But the total fund is not so large, so we tried to get the larger funds, because for porous materials chemistry, we need a lot of instruments,' he says. 'Ultimately, I had an interview, but the interviewer said "This is unstable, we cannot believe [in it]." So I was disappointed.'

But he was not put off. Kitagawa was inspired by a quote from the famous French chemist and microbiologist Louis Pasteur 'chance favours only the prepared mind' and he ultimately believed that this was an area of chemistry that was only set to expand.

A vision of frameworks

For five years he persisted through an endless process of trial and error until finally, they had a breakthrough – creating a framework that was both stable and had a function – when they decided to switch the copper(i) to another metal ion – cobalt(ii) – along with a neutral organic ligand molecule, 4,4' -bipyridine.

'Using a neutral molecule means we obtain the porous structure – we can get the cavities,' Kitagawa explains. 'So, we succeeded. Also, instead of the Cu+ we used Co2+ and this shows the bonding energy to be more than 200kJ per mol – so a stronger bond.'

This work was published in a 1997 paper in which his team also demonstrated successful gas adsorption of methane, nitrogen and oxygen at room temperature. The cavities of the cobalt(ii) structure were initially filled with water, but the framework could be shown to adsorb and release the gas substances when in a dry state.

To maintain momentum, Kitagawa knew that he had to convince funders of what made metal–organic frameworks unique. In 1998, he set out his vision in the Bulletin of the Chemical Society of Japan, laying out the notion of different 'generations' of frameworks – from the structurally beautiful, but unstable, to the practically robust and useful.

It was at this point that he predicted that MOFs should have a level of softness and flexibility – a third generation of MOFs – and while no one was absolutely against this, they wanted to see an example. So Kitagawa set out to develop a flexible MOF.

'In 2002, we observed the first one – [with] a very beautiful hysteretic adsorption that is very close to the haemoglobin oxygen adsorption … all the people believed this – it was easy to show the public,' he says.

Kitagawa later went on to develop the idea of a fourth generation of MOFs which referred to a comprehensive design of microstructures leading to complex functionality.

Yaghi and MOF-5

However, Kitagawa was not the only one who had been working hard to develop MOFs during this time. Starting out as a research group leader at Arizona State University, US, in the early 1990s, Yaghi was keen to find more controlled ways to create materials, using rational design to connect different chemical constituents to make large crystals.

The work was challenging, but a few years later his team started combining metal ions with organic molecules. In 1995, Yaghi published the structure of two different 2D materials that were like nets and held together by copper or cobalt. They demonstrated that the cobalt structures had channels in which aromatic guest molecules could selectively bind and were so stable they could be heated to 350°C without

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collapsing, even after removal of the guest molecules. It was in this paper that he first coined the term 'metal–organic framework'.

However, it was in 1999 that Yaghi established the next milestone in the development of MOFs when he presented the synthesis of MOF-5, an exceptionally spacious and stable molecular construction that, even when empty, could be heated to 300°C.

'A gram of a MOF, which is no larger than a sugar cube, encompasses a space as large as a football field,' explained Yaghi in a press conference organised by the University of California, Berkeley, following the Nobel prize announcement on 8 October 2025. 'So you can imagine how powerful these materials are in terms of compacting gases without having to use lots of energy, such as high pressure or low temperature.'

'The moment that the whole field changed was the MOF-5 paper that Omar published, where he showed that you could remove guests from the pores of these materials, and they would remain permanently porous and take up gas,' says Christian Doonan, a professor at the University of Adelaide in Australia, who worked as a postdoc in Yaghi's lab between 2007 and 2010.

'I remember Omar telling me the story about how after publishing that paper, he got a call from Ullrich Müller at BASF, who basically said "Is this real?" And Omar said "Yes". And he said, "Well, we should meet." That was the start of an enduring relationship between Omar and BASF with respect to metal–organic framework chemistry.'

The reticular revolution

Yaghi showed that it was possible to modify and change MOFs to give them different properties. To highlight this, he produced 16 variants of MOF-5, with cavities that were both larger and smaller than those in the original material. It was in a 2003 review article that he defined the term 'reticular synthesis' (or reticular chemistry) as 'the process of assembling judiciously designed rigid molecular building blocks into predetermined ordered structures (networks), which are held together by strong bonding'. He further expanded on this idea with the term 'isoreticular'.

'Isoreticular design [is] where you take a known structure and then by changing the building blocks – for example, the length of the building blocks – you can preserve the topology while changing the functionalities,' explains Petra Ágota Szilágyi, an expert in porous materials and catalysis at

the University of Oslo in Norway. 'By enlarging or lengthening the linkers, you can make the pores bigger.'

This is helpful when adapting MOFs for specific applications.

'For gas capture, you want to adjust these properties really judiciously,' Szilagyi adds. 'So you want to have the pore sizes of a particular diameter. Also, you want to have potentially particular functional groups in the linkers or on the nodes which will interact at a particular strength with the gas you want to capture. This is really the philosophy, that you can take these generic structures and you can, by altering or varying components of them, fine tune their properties.'

MOFs' killer apps

It was after these breakthroughs that MOFs took off in a big way. When Doonan joined Yaghi's group a few years later, he says the trajectory of MOFs was 'almost vertical'.

'It was at the point where the chemistry was reasonably well understood about how to make these materials and how to study them. Then I started in the period of "As chemists, what can we do with these materials?"' Doonan says. 'That was an incredible time to be in the laboratory – other people had done the hard work in breaking new ground, and then I managed to join the lab when the field was accepted and really taking off.'

The large surface area, designability and ease of fabrication of MOFs (or coordination polymers) have provided chemists with a valuable 'toolkit', says D'Alessandro.

'You're a bit like an architect, and you can decide "I want this functionality, I want this shape, this size, this colour, I want that over there." And you can do that in a MOF. You can have different properties. Over the years, we've seen the usefulness [and] practicality of MOFs evolve, and their ability to be scaled up with a view towards practical, real-world applications.'

The development of new MOFs has focused around three key functions – storage, separation and conversion – and the potential applications from these are almost endless.

'These frameworks encompass space within which one can trap gases such as carbon dioxide or hydrogen,' Yaghi said during the 8 October press conference. 'They could even be designed to seek out contaminants in water like PFAS or organic contaminants from water or contaminants from the atmosphere. The amazing thing is that you can also modify their pores

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so that you can catalyse reactions and some applications where we take poisonous molecules and make them to be harmless molecules through passing them through the pores of these materials. The power of MOFs is that they open new avenues of applications that other materials could not do.'

In addition to gas storage, applications include biosensors, batteries and fuel cell technology, separation science, synthesis and catalysis, water harvesting, and capture and destruction of harmful agents. There are also several medical applications including drug delivery, biobanking and diagnostics and even some potential uses in defence.

Challenges and opportunities

'If there are going to be game-changing solutions to the world's problems, there's a very good chance that a MOF will be at the heart of it,' says Mike Zaworotko, a crystal engineer at the University of Limerick in Ireland. 'MOFs offer a limitless range of opportunities and properties. It's focusing on the immediate tasks and the right MOF for the right application – that's now the challenge.'

Russell Morris, a chemist at the University of St Andrews, in Scotland, says the environmental applications of the MOFs are the ones that are most developed. 'Carbon capture, hydrogen storage, methane storage, water harvesting, all those sorts of things – those are the ones that really get a lot of people interested.'

However, he says, 'The world is our oyster. There's so many different possibilities, and everybody's coming up with different ideas.'

Although many MOFs that have been created have only been used on a lab scale, many companies are now investing in their commercialisation. In 2016, for example, NuMat Technologies in the US launched ION-X, a compressed gas cylinder the uses the storage function of MOFs to enable the safe transportation of hazardous gases. In 2023, BASF became the first company to successfully produce MOFs on a commercial scale for carbon capture for the Canadian technology provider Svante Technologies.

But, as versatile as they are, MOFs are not without their challenges – not all MOFs can be scaled up easily while also maintaining their properties, and there are also considerations to be made around cost and potential environmental toxicity. 'A big problem is also their synthesis – often it takes place under harsh conditions,' says Szilagyi. 'But there have been beautiful examples in which they were able to use green chemical concepts …

more sustainable precursors and reagents, but also making the conditions milder.'

Despite the challenges, it's clear that this year's Nobel prize has gone to the fathers of a field that has already had a significant impact on the world. 'We're seeing the translation, and we're seeing the commercialisation,' says D'Alessandro. 'Their usefulness and their practical application has become apparent … it's clear that they have made a really big imprint on the world.'

'This is sort of the end of the beginning,' says Zaworotko. 'The design and recognition of the field is there. There's no upper limit to how many MOFs you can make.'

Julia Robinson is a science correspondent for Chemistry World

Chemistry World, 16 October 2025

https://chemistryworld.com

Chemists achieve ethylene electrosynthesis from acetylene at ampere-level current density

2025-10-15

Ethylene is traditionally obtained through steam cracking of petroleum-derived hydrocarbons. Recently, the semi-hydrogenation of coal-derived acetylene has emerged as an alternative to produce ethylene. In particular, electrocatalytic acetylene semi-hydrogenation (EASH) is advantageous because it is driven by renewable energy and has low carbon emissions.

However, the practical application of ethylene electrosynthesis via EASH has been hindered by slow reaction rate, limited ethylene selectivity, and low energy efficiency. In addition, studies have primarily focused on tuning catalytic active sites at the nanoscale and atomic scale, and the critical role of mesoscopic mass transport within electrodes has often been overlooked.

In a study published in Angewandte Chemie International Edition, a research team led by Prof. Bao Xinhe and Prof. Gao Dunfeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences achieved ethylene electrosynthesis from acetylene at ampere-level current density by promoting interparticle mass transport.

Researchers showed quantitatively the crucial role of interparticle mass transport within the catalyst layer of a gas diffusion electrode. By

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increasing the average interparticle distance of Cu cubes, they improved acetylene adsorption and ethylene desorption, leading to enhanced EASH performance.

The Cu cube electrode with a large average interparticle distance of 265 nm exhibited an ethylene Faradaic efficiency of 97.4% at a current density of 1.0 A cm−2 and a maximum ethylene partial current density of 1.5 A cm−2 in an alkaline membrane electrode assembly electrolyzer.

Moreover, the researchers revealed that increasing the interparticle distance of Cu cubes effectively promoted mass transport, enabling efficient ethylene electrosynthesis under industrially relevant conditions.

"Our study demonstrates the key role of mesoscopic mass transport in electrocatalysis. This factor should be considered in designing high-performance electrocatalytic systems," said Prof. Gao.

Phys Org, 15 October 2025

https://phys.org

When atoms go rogue: High-entropy MXenes defy materials logic

20125-10-11

By breaking the rules of atomic order, scientists have created MXenes unlike any seen before. Nine metals now share a single atom-thin sheet, their once-neat layers dissolved into a patchwork of possibility. The result could redefine how we design materials for the harshest places on Earth and beyond.

History has shown that materials science has long prized symmetry and stability, celebrating crystals whose atoms lock into place like repeating tiles on an infinite floor. It is this type of order that gives rise to strength, conductivity, and control in a laboratory and real-world setting. But in one peculiar family of carbides, the script of symmetry and stability shifted. Here, what should have been chaos turned out to be strength, as if disorder and order were two faces of the same design.

That paradox emerged from work led by researchers at Purdue and Drexel Universities, who set out to see what would happen if they pushed a well-known family of layered carbides beyond its limits. The idea was both straightforward and bold: take a structure prized for its order and force it to host different layers of metals simultaneously to see how far it would go before collapsing into useless disorder.

Much to the scientists' surprise, that collapse never came. Instead, the material reached a tipping point. Once a specific threshold was crossed, order ceased, as predicted by the researchers. But instead of failure, entropy itself stepped in as the stabilizer, holding the structure together as a two-dimensional sheet. What looked like chaos instead uncovered a hidden strength. Out of that deliberate disorder came a new approach to designing materials.

MAX Phases: The Scaffolding Beneath

To understand what made this experiment possible, you must step back half a century into the 1970s, when scientists discovered a curious set of layered ceramics they called MAX phases. Their formula – written as $M'_{n+1}AX_n$ – hid a simple idea: sheets of transition metals bound to carbon or nitrogen, stacked with intervening layers of "A" elements like aluminum or silicon.

What made these materials unusual was their ability to combine qualities rarely found together. They had the toughness of ceramics, able to resist heat and wear, but also conducted electricity much like metals. That combination earned them attention, and their architecture proved especially interesting. The metal layers fell into distinct positions, some bonded outward to the A-layers and others inward to the carbon. It was a framework that seemed to invite both order and potentially, disruption.

For decades, these MAX phases were studied for their durability and conductivity. But their real importance emerged in 2011, when researchers realized MAX phases were more than simply layered ceramics. By carefully etching away their A-layers, they could peel the structure into ultrathin sheets just a few atoms thick. These sheets became known as MXenes.

From MAX to MXene

While MXenes inherited the toughness and conductivity of their parent phases, their real promise lay in the surfaces exposed when etched. Scientists discovered that these surfaces could be fine-tuned with oxygen, hydroxyl, or fluorine, giving them a way to adjust Mxene behavior for different tasks.

What emerged was a new class of two-dimensional materials, versatile in ways that graphene and other atom-thin sheets were not. MXenes could disperse in water, self-assemble into films, and be modified at the surface, almost like programmable matter. Within a few years they were

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being tested for energy storage, electromagnetic shielding, catalysis, and sensors.

The Breakthrough: Entropy Takes Over

Yet for all their promise, MXenes were still bound by their MAX origins. Most were made from ordered phases with only a few metals, and that very order, once their strength, became their limitation. To push those possibilities to their limit, the Purdue–Drexel team set out to force MAX phases to their breaking point.

They synthesized 40 different compositions, layering anywhere from two to nine transition metals into the same structure. Each new metal introduced competing preferences – some tending toward one atomic site, others toward another.

"Imagine making cheeseburgers with two to nine ingredients (layers)," said Babak Anasori of Purdue University. "However, if we add one or more ingredients … then the metals do not follow any preference for order, and true disorder (high entropy) is achieved."

With up to about six metals, the system behaved as expected: enthalpy, the energetic pull toward order, kept the structure biased. But once the count rose to seven or more, something shifted. Energetic preferences dissolved, and every configuration became equally likely. Entropy – enthalpy's disordered doppelganger – stepped in and took over.

What should have collapsed turned instead into stability. Etching these high-entropy MAX phases into MXenes erased the neat divide between order and disorder, leaving a patchwork of possibilities spread across an atom-thin sheet. That patchwork carried into their chemistry: oxygen groups came to dominate their surfaces, while hydroxyl and fluorine fell away as more metals were introduced.

Properties of Entropy-Forged MXenes

Despite that disorder, the MXenes retained their parent metallic character. In fact, their electrical resistivity dropped dramatically as the number of metals increased, in some cases by nearly an order of magnitude. Infrared emissivity fell in parallel, pointing to materials that could endure the extreme environments of heat and radiation.

"This study indicates that short-range ordering – the arrangement of atoms over a short distance of a few atomic diameters – in high-entropy materials determines the impact of entropy versus enthalpy on their

structures and properties," said Brian Wyatt, a postdoctoral researcher at Purdue and first author of the study.

The result was not fragility, but resilience born of a platform strengthened by complexity. What began as a limit-test became a new way to engineer strength: designing within disorder itself.

Why It Matters: Tough Jobs, Real Applications

The implications go far beyond the laboratory. By showing that disorder can be engineered, these MXenes open a new frontier in materials design. Metallic, conductive, and dispersible in water, these MXenes endure where most materials fail. That resilience makes them candidates for the toughest jobs imaginable; from the vacuum of space to the crushing pressures of the deep ocean and the corrosive grind of electrochemical systems.

"We want to continue pushing the boundaries of what materials can do, especially in extreme environments where current materials fall short," said Anasori.

Their tunable surfaces add another layer of promise. MXenes show exceptional sensitivity to gases such as oxygen, ammonia, and nitrogen dioxide. Their two-dimensional structure gives them high surface area, while their adjustable terminations make them unusually selective and responsive. Unlike graphene or MoS_2, MXenes can be tuned both from the surface down and, through entropy, from the lattice up.

Bigger Picture

While MXenes' story is only just beginning, history has shown that new materials often reframe the boundaries of possibility. Bronze enabled early tools and weapons. Steel reshaped cities and industry. And silicon gave rise to the digital world. MXenes may represent the next step in that lineage.

What makes this chapter different is the principle at its core. In trying to break order, scientists found a new way to build without it. Entropy became the architect.

"This is exactly where AI will become an enabling technology," said Anasori. "Guidance from computational science, machine learning and AI will be crucial for navigating the infinite sea of new materials, guiding their development and helping to select the structures and compositions with required properties for specific technologies."

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What that future will look like depends on how far high-entropy MXenes can be scaled, purified, and tailored to real-world needs, such as batteries that can endure extreme environments, sensors that can detect volatile and toxic gases, or materials able to survive where others have historically failed. Even if we don't yet know what the future of Mxenes holds, the lesson here is that purpose can be found in disorder, and strength can emerge from what looks like, at first glance, chaos.

This study was published in the journal Science.

New Atlas, 11 October 2025

https://newatlas.com

Study Links Maternal Blood PFAS Levels to Children's Brain Development

2025-10-13

Researchers from the University of Turku and Turku University Hospital, Finland, and Örebro University, Sweden, have discovered that the levels of PFAS in mothers' blood during pregnancy is associated with their children's brain structure and function.

In recent years, researchers have found associations between the levels of per- and polyfluoroalkyl substances (PFAS) in mothers' blood during pregnancy, and their children's neurodevelopmental outcomes. A recent study led by the University of Turku, Finland, expands on this by demonstrating that maternal PFAS predict their children's brain structural and functional outcomes.

PFAS are man-made chemicals used in manufacturing products resistant to water, oil, temperature, or electrical conductivity, such as cooking utensils, clothes, furniture, food packaging, flooring, dental floss, and firefighting foams. Similar to plastics, they are non-biodegradable, and have been nicknamed "forever chemicals" for this reason. They are now found in all ecosystems on earth, and their presence in the soil is estimated to last for over 1,000 years.

"Humans consume PFAS from drinking water, food, or in some cases exposure through occupation. They are ubiquitous in our blood, and our bodies do not break them down," says Senior Researcher Aaron Barron from the University of Turku, the lead author of the study.

Over the last decade, accumulating research has implicated blood PFAS levels in adverse health outcomes, especially hormone biosynthesis,

metabolism, and immune system function. For this reason, PFAS have begun to attract a considerable amount of public, political, and academic interest, and are now being increasingly regulated in manufacturing and water supplies.

Different PFAS were associated with different brain regions

The new study was set within the FinnBrain Birth Cohort Study, a longitudinal birth cohort established at the University of Turku in 2011. Some of the mothers donated a blood sample during pregnancy, and their blood PFAS levels were measured by mass spectrometry at Örebro University in Sweden. Their children came back for a follow-up visit at 5 years old, and they underwent multimodal magnetic resonance brain imaging at Turku University Hospital. The final analysis included 51 mother–child pairs.

The researchers found that maternal PFAS were linearly associated with many aspects of their children's brain structure. The three main brain regions involved were the corpus callosum, the brain's largest white matter tract; the surface area and volume of the posterior grey matter volume, in the occipital lobe; and the hypothalamus, which regulates our body's homeostasis and endocrine function. None of the associations were any different in boys and girls.

Additionally, some PFAS were associated not only with brain structure, but also brain functional connectivity based on functional MRI scans.

"We were able to measure seven different PFAS in this study, and found that individual compounds had specific associations with offspring brain structure, and in some cases two different PFAS had opposite relationships with the same brain region," explains Professor Tuulia Hyötyläinen from Örebro University.

The PFAS could be divided into two groups based on their chemical structure – whether they contain a carboxylic acid or a sulphonic acid functional group. In most cases, except for in the hypothalamus, the carboxylate-containing PFAS were the ones that were more strongly associated with brain outcomes in children.

"At the moment, it is unclear whether PFAS are directly affecting brain development, although it's known that they pass the placenta and the blood-brain barrier to accumulate in the brain, and can disturb developing brain cells. It's also unclear whether these associations are harmful, beneficial, or neutral, and future studies will be needed to determine the

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functional implications of our findings," explains Professor Hasse Karlsson from the University of Turku.

Technology Networks, 13 October 2025

https://technologynetworks.com

Nanoparticles may be the secret ingredient in making ultimate plastics

2025-09-25

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

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

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

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

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

Qian says that his team's approach is compatible with existing industrial processes and could be scaled up to large quantities. "This strategy could

revolutionise applications requiring lightweight, strong, tough and easily processable materials—such as automotive and aerospace composites, sustainable packaging, biomedical devices and advanced recyclable plastics," he says.

New Scientist, 25 September 2025

https://newscientist.com

Generation of harmful slow electrons in water is a race between intermolecular energy decay and proton transfer

2025-10-15

When high-energy radiation interacts with water in living organisms, it generates particles and slow-moving electrons that can subsequently damage critical molecules like DNA. Now, Professor Petr Slavíček and his bachelor's student Jakub Dubský from UCT Prague (University of Chemistry and Technology, Prague) have described in detail one of the key mechanisms for the creation of these slow electrons in water, a process known as Intermolecular Coulombic Decay (ICD). Their powerful mathematical model successfully explains all the data from complex laser experiments conducted at ETH Zurich (Hans-Jakob Woerner team).

The work, which deepens the fundamental understanding of radiation chemistry, has been published in the journal Nature Communications.

A detailed knowledge of the processes in aqueous solutions, combined with advances in research technologies using high-energy radiation, is transforming the field of radiation chemistry. In the future, these insights could lead to significant changes in various fields, including medicine, particularly in developing more sensitive and controllable applications for devices based on ionizing radiation.

Intermolecular Coulombic Decay (ICD) was first experimentally proven in water about 15 years ago, but until recently, all experiments have been conducted on isolated molecules or very small water clusters. The new research from the Prague-Zurich collaboration is the first to quantify the competition of ICD with proton transfer and nonadiabatic relaxation in liquid water and to establish the isotope dependence.

The study shows that after an inner-valence electron is ejected from a water molecule by radiation, the ICD process is not 100% efficient. It is in a race against other phenomena, primarily ultrafast proton transfer

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between neighboring water molecules and nonadiabatic relaxation. By performing experiments on both regular (H_2O) and heavy water (D_2O), the researchers showed that ICD is more efficient in heavy water. This isotope effect confirms that the slower movement of deuterium nuclei gives the electronic decay process more time to occur, providing clear evidence of the competition.

"Our model predicts all the data that the instruments in these challenging experiments can measure," says Professor Slavíček. "Therefore, we can also trust it in areas where instruments cannot yet see, and we can explain what happens in a solution after exposure to high-energy radiation."

The stochastic model is based on inputs from quantum mechanics, which are typically only feasible to calculate for limited systems like single water molecules or small clusters. These inputs, combined with the experimental results, were developed into a probabilistic model that provides a complete picture of ICD in a realistic environment.

Remarkably, the author of the published stochastic model is Jakub Dubský, who recently completed his bachelor's degree at UCT Prague and is preparing to continue his master's studies at the University of Oxford.

"It is extraordinary when an undergraduate student delivers work at the level of a doctoral candidate, resulting in a real, functional product that brings entirely new knowledge," adds Professor Slavíček in praise of his student's contribution.

Phys Org, 15 October 2025

https://phys.org

Handheld Sensor Detects PFAS in Water Within Minutes

2025-10-15

They linger in our water, our blood, and the environment—"forever chemicals" that are notoriously difficult to detect.

But researchers at the UChicago Pritzker School of Molecular Engineering (UChicago PME) and Argonne National Laboratory have collaborated to develop a novel method to detect miniscule levels of per- and polyfluoroalkyl substances (PFAS) in water. The method, which they plan to share via a portable, handheld device, uses unique probes to quantify levels of PFAS "forever chemicals," some of which are toxic to humans.

"Existing methods to measure levels of these contaminants can take weeks, and require state-of-the-art equipment and expertise," said Junhong Chen, Crown Family Professor at the UChicago Pritzker School of Molecular Engineering and Lead Water Strategist at Argonne National Laboratory. "Our new sensor device can measure these contaminants in just minutes."

The technology, described in the journal Nature Water, can detect PFAS present at 250 parts per quadrillion (ppq) – like one grain of sand in an Olympic-sized swimming pool. That gives the test utility in monitoring drinking water for two of the most toxic PFAS—perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS)—for which the U.S Environmental Protection Agency (EPA) recently proposed limits of 4 parts per trillion.

"PFAS detection and elimination is a pressing environmental and public health challenge," said Andrew Ferguson, Professor of Molecular Engineering at UChicago PME. "Computer simulations and machine learning have proven to be an incredibly powerful tool to understand how these molecules bind to molecular sensors and can guide experimental efforts to engineer more sensitive and selective molecular probes."

"Even though they are typically present at miniscule concentrations, PFAS do have certain molecular characteristics that differentiate them from other things dissolved in water, and our probes are designed to recognize those features," said Seth Darling, a Senior Scientist at both Argonne and UChicago.

A detection challenge

PFAS are oil- and water-resistant chemicals that are used for a wide range of consumer and industrial products, including non-stick pots and pans, fast food packaging, firefighting foam, raincoats, and stain-resistant carpeting. Often called "forever chemicals," they are incredibly long-lasting and do not naturally degrade, but instead accumulate in the environment and people's bodies over time.

In recent years, studies have linked PFAS to health concerns, including cancers, thyroid problems and weakened immune systems. In light of some of these findings, the EPA proposed the new limits for PFOS and PFOA.

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"The problem with enforcing these limits is that it's very challenging and time-consuming to detect PFAS," said Chen. "You currently can't just take a sample of water and test it at home."

The gold standard for measuring PFAS levels is an expensive laboratory test known as liquid chromatography/tandem mass spectrometry, which separates chemical compounds and provides information on each one.

Researchers attempting to make their own faster and cheaper PFAS tests face a few challenges: for one thing, PFAS chemicals are often present in water at much lower concentrations than dozens of other, more common contaminants. In addition, there are thousands of different PFAS chemicals with only slight variations between their chemical structures—but important differences in their health effects and regulations.

But Chen's team has been developing highly sensitive, portable sensors on computer chips for the last fifteen years. Chen is already using the technology in a lead sensor for tap water, and his lab group suspected that the same method could be used in PFAS sensing. Their proposal to adapt the technology for PFAS became part of the National Science Foundation Water Innovation Engine in the Great Lakes.

Designed by AI

The gist of Chen's sensor is that if a PFAS molecule attaches to his device, it changes the electrical conductivity that flows across the surface of the silicon chip. But he and his colleagues had to figure out how to make each sensor highly specific for just one PFAS chemical—such as PFOS.

To do this, Chen, Ferguson, Darling, and team turned to machine learning to help select unique probes that could sit on the sensing device and ideally bind only the PFAS of interest. In 2021, they won a Discovery Challenge Award from the UChicago Center for Data and Computing (CDAC) to support their use of artificial intelligence in designing PFAS probes.

"In this context, machine learning is a tool that can quickly sort through countless chemical probes and predict which ones are the top candidates for binding to each PFAS," said Chen.

In the new paper, the team showed that one of these computationally-predicted probes does indeed selectively bind to PFOS—even when other chemicals common in tap water are present at much higher levels. When water containing PFOS flows through their device, the chemical binds to

the new probe and changes the electrical conductivity of the chip. How much the conductivity changes depends on the level of PFOS.

To ensure that the readings from the new device were correct, the team collaborated with EPA and used EPA-approved liquid chromatography/ tandem mass spectrometry methods to confirm concentrations and verified that the levels were in line with what the new device detected. The team further showed that the sensor could maintain its accuracy even after many cycles of detection and rinsing, suggesting the potential for real-time monitoring.

"Our next step is to predict and synthesize new probes for other, different PFAS chemicals and show how this can be scaled up," says Chen. "From there, there are many possibilities about what else we can sense with this same approach— everything from chemicals in drinking water to antibiotics and viruses in wastewater."

The end result may eventually be that consumers can test their own water and make better choices about their environment and what they consume.

Technology Networks, 15 October 2025

https://technologynetworks.com

Adelaide researchers hope new light-activated material will help combat PFAS 'forever chemicals'

2025-09-08

Adelaide researchers say they have developed a new method to combat PFAS, with the hopes it could one day be used to help clean up the environment.

Per- and polyfluoroalkyl substances (PFAS) are a group of almost 15,000 synthetic chemicals that have been used in a range of industrial and domestic products since the 1950s.

The durability of PFAS chemicals also means they can persist in the environment for decades, and build up in the bodies of humans and animals over time.

Two of the best-known types of PFAS are perfluorooctane sulfonate (PFOS), previously used in firefighting foams, and perfluorooctanoic acid (PFOA), historically used to make Teflon cookware.

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Both chemicals have been discontinued or are being progressively phased out in many countries, including Australia.

But scientists at an Adelaide lab have been working on a new method they say could help break down PFAS, involving a photocatalyst powder and UV light.

Lead researcher Cameron Shearer and his team at the University of Adelaide have been working on their method for around five years.

Dr Shearer said their research started to yield positive results in early 2024.

He said the method involved mixing a metal sulfide powder with a solution containing a concentrated amount of PFAS, before exposing it to a UV light.

This process energises the powder, driving a chemical reaction that degrades the extremely strong carbon-fluorine bonds that PFAS contains.

Dr Shearer said researchers had seen both partial and complete degradation of PFAS samples in their studies, leaving by-products like fluoride behind.

"Although it has been a very helpful chemical for society, we now have enough alternatives that we don't need to use anymore," he said.

PhD student Mahmoud Adel Hamza has worked on the research with Dr Shearer.

"We used some actual contaminated PFAS samples from a site here in South Australia and we treated it … we ended up with completely degraded PFAS in [the] area sample, not just like lab-scale, lab-sized samples," he said.

Method years away, researchers say

Mr Hamza estimated that researchers would need another three to five years before the powder could be scaled up, with the hopes of one day reaching commercial markets.

Several aspects of the method and light-activated powder itself need greater development.

Dr Shearer said researchers also wanted to move towards using sunlight over UV light to energise the powder, to make it more economically viable.

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"Unfortunately, even though this is a health issue that we are trying to solve, there are economics involved in whether this would go to market or not," Dr Shearer said.

Dr Shearer said other parts of their ongoing work would include checking the toxicity of their degraded solution, to see if the produced samples of water and fluoride are safe.

The stability of the powder will also need more work, to improve its longevity and the speed of the degradation process.

"It's very effective against long PFAS chain, so these are the ones that are the greatest concern around their toxicity," Dr Shearer said.

"However, we do not get quite the same activity for the very short PFAS molecules."

Although there is still a long road ahead, researchers hope the method could one day be used to help clean up contaminated areas.

ABC News, 9 September 2025

https://abc.net.au

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Technical Notes

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Characterization of engineered stone dust-induced reactive oxygen species generation and cytotoxicity in vitro

Bibliometric analysis of research trends and hotspots on organic solvent induced hearing loss

Research progress on population load and hepatotoxicity of glyphosate

ENVIRONMENTAL RESEARCH

The hidden hazard in kitchen environment: A preliminary study of health risks associated with inhaling acrylamide during French fries frying

From waterways to the brain: Unraveling the environmental triggers of depression through PPCPs-gene network convergence

PHARMACEUTICAL/TOXICOLOGY

Environmental co-exposure to roxarsone and heavy metals drives bacterial antibiotic multidrug resistance via genetic and phenotypic adaptations

Environmental exposure to toxic and essential metals and glucose homeostasis in adolescents: A cross-sectional analysis of the Hong Kong School Children Cohort

Organophosphorus Pesticide Degradation by Microorganisms: A Review

OCCUPATIONAL

The impact of climate change on the flux and fate of metals in freshwater systems: Implications for metal exposure across different scales

Exposure to consecutive extreme ozone-heatwave events and neurological disorders: a retrospective cohort study in Nanjing, China