CHEMWATCH

# Bulletin Board

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## Regulatory Update

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### ASIA PACIFIC

#### Plastics Plan 2.0

*2025-11-09*

The NSW Plastics Plan 2.0 sets out our next steps to reduce plastic waste in the environment and in landfill.

We have made strong progress under the first NSW Plastics Action Plan to reduce the impact of plastics on our environment and communities. For example, we've exceeded our target of reducing plastic litter items by 30% compared to baseline years (2018–19) by 2025.

But more can be done. The NSW Plastics Plan 2.0 (PDF 1.7MB) has been informed by a multi-stage consultation process and sets out the actions the NSW Government will take to:

- reduce plastic litter in our environment, in support of our target to reduce all litter items by 60% by 2030
- protect human health, the environment, and recycling streams from the impacts of microplastics and harmful chemicals in plastics
- harmonise with other states and territories where possible, while taking a leading role where further, faster action is needed.

These actions will be staged between 2026 and 2030 to ensure businesses, communities, and regulators have enough time to transition to the new requirements.

Read More

EPA NSW, 09-11-25

https://www.epa.nsw.gov.au/Your-environment/Plastics/plastics-plan-20

#### Agricultural chemical products and approved labels

*2025-11-11*

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

**Table 1:** Agricultural products based on existing active constituents

| Application no. | 138164 |
|---|---|
| Product name | Fulltec Spray Adjuvant |
| Active constituents | 199.7 g/L phosphoric acid, 80.5 g/L anionic surfactants, 38 g/L non-ionic surfactants |
| Applicant name | Spraytec Australia Pty Ltd |
| Applicant ACN | 633 431 964 |
| Date of registration | 20 October 2025 |
| Product registration no. | 93179 |
| Label approval no. | 93179/138164 |
| Description of the application and its purpose, including the intended use of the chemical product | Registration of a 199.7 g/L phosphoric acid, 80.5 g/L anionic surfactants, 38 g/L non-ionic surfactants soluble concentrate product to ameliorate pH, improve spray coverage and target penetration |

| Application no. | 138168 |
|---|---|
| Product name | Fulltec Max Adjuvant |
| Active constituents | 123.3 g/L phosphoric acid, 71.0 g/L anionic surfactants, 60.4 g/L non-ionic surfactants |
| Applicant name | Spraytec Australia Pty Ltd |
| Applicant ACN | 633 431 964 |
| Date of registration | 20 October 2025 |
| Product registration no. | 93181 |
| Label approval no. | 93181/138168 |
| Description of the application and its purpose, including the intended use of the chemical product | Registration of a 123.3 g/L phosphoric acid, 71.0 g/L anionic surfactants, 60.4 g/L non-ionic surfactants soluble concentrate product to ameliorate pH, improve spray coverage and target penetration |

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APVMA, 11-11-25

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-23-11-nov-25



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## Veterinary chemical products and approved labels

*2025-11-11*

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

**Table 4:** Veterinary products based on existing active constituents

| Application no. | 144421 |
|---|---|
| Product name | Vetsense Cortavet Cutaneous Spray Solution for Dogs |
| Active constituent | 0.584 mg/mL hydrocortisone aceponate |
| Applicant name | Vetsense Pty Ltd |
| Applicant ACN | 150 968 871 |
| Date of registration | 21 October 2025 |
| Product registration no. | 94998 |
| Label approval no. | 94998/144421 |
| Description of the application and its purpose, including the intended use of the chemical product | Registration of a 0.584 mg/mL hydrocortisone aceponate cutaneous spray solution for dogs, for the symptomatic relief of inflammatory and pruritic skin conditions, and aids in the reduction of dermatological signs in localised lesions associated with flea allergy dermatitis |

| Application no. | 149150 |
|---|---|
| Product name | Independents Own Tripletec 3-Way Combination Drench for Sheep |
| Active constituents | 25.5 g/L levamisole (as hydrochloride), 20 g/L albendazole, 1.76 g/L cobalt (as EDTA), 0.8 g/L abamectin, 0.4 g/L selenium (as sodium selenate) |
| Applicant name | The Hunter River Company Pty Limited |

| Application no. | 149150 |
|---|---|
| Applicant ACN | 133 798 615 |
| Date of registration | 28 October 2025 |
| Product registration no. | 96384 |
| Label approval no. | 96384/149150 |
| Description of the application and its purpose, including the intended use of the chemical product | Registration of a 25.5 g/L levamisole (as levamisole hydrochloride), 20 g/L albendazole, 1.76 g/L cobalt (as cobalt EDTA), 0.8 g/L abamectin and 0.4 g/L selenium (as sodium selenate) oral solution/suspension drench product for the control of gastrointestinal parasites, lungworm, itch mite and nasal bot (larval stages) and provides a selenium and cobalt supplement for sheep |

Read More

APVMA, 11-11-25

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-23-11-nov-25

## Approved active constituents

*2025-11-11*

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

**Table 6:** Approved active constituents

| Application no. | 147459 |
|---|---|
| Active constituent | Azoxystrobin |
| Applicant name | Jiangsu Sword Agrochemicals Co., Ltd |
| Applicant ACN | N/A |
| Date of approval | 22 October 2025 |
| Approval no. | 95887 |



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| Application no. | 147459 |
|---|---|
| Description of the application and its purpose, including the intended use of the active constituent | Approval of the active constituent azoxystrobin for use in agricultural chemical products |

| Application no. | 149274 |
|---|---|
| Active constituent | Chloramphenicol |
| Applicant name | Avet Health Limited |
| Applicant ACN | 616 838 101 |
| Date of approval | 23 October 2025 |
| Approval no. | 96431 |
| Description of the application and its purpose, including the intended use of the active constituent | Approval of the active constituent chloramphenicol for use in veterinary chemical products |

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APVMA, 11-11-25

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-23-11-nov-25

# AMERICA

## EPA Seeks Comment in Effort To Loosen Decade of Forever-Chemical Reporting

*2025-11-13*

The Environmental Protection Agency (EPA) is looking to change the reporting requirements companies followed from 2011 to 2022, which include exemptions for certain carcinogenic chemicals. They're accepting public comments for 45 days following the announcement.

The proposed change, announced on Monday, would loosen the reporting requirements manufacturers face when disclosing their use of perfluoroalkyl and polyfluoroalkyl substances (PFAS), a group of chemicals the International Agency for Research on Cancer classified as a Group 1 human carcinogen.

The EPA told Newsweek that it is "not rolling back any regulations on PFAS, and this proposal does not change any regulations related to future PFAS production."

"The rule that EPA is amending is a reporting rule that requires one-time reporting of PFAS manufactured or imported in any year between 2011 and 2022," the agency added.

Read More

Newsweek, 13-11-25

https://www.newsweek.com/epa-seeks-comment-loosen-decade-forever-chemical-reporting-11038546

## EPA Updates Review on Potential Paraquat Volatilization and Plans to Request Additional Data from Manufacturers

*2025-11-13*

Today, the U.S. Environmental Protection Agency (EPA) is releasing an updated review of the potential for the pesticide paraquat to volatilize from treated agricultural fields. As a result, EPA will be issuing a data call-in (DCI) notice to paraquat manufacturers requesting additional data.

In 2019, EPA completed a Draft Human Health Risk Assessment for paraquat, which included an evaluation of the potential for non-occupational bystander inhalation exposure resulting from volatilization. In 2022, EPA implemented mitigation measures, through the approval of revised paraquat product labels, that were identified in a 2021 Interim Registration Review Decision.

After EPA's approval of updated labels for paraquat, Syngenta Crop Protection submitted a new paraquat vapor pressure study in January 2024 under Section 6(a)(2) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). This section requires pesticide registrants to submit any new information regarding unreasonable adverse effects to the agency. Vapor pressure is a key parameter influencing the extent to which pesticide surface residues may convert into gaseous vapors that could move through the air, which could potentially impact workers and bystanders who live or work near or adjacent to treated fields.



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Read More

US Regulations.gov, 13-11-25

https://www.regulations.gov/document/EPA-HQ-OPP-2011-0855-0554

## Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Data Reporting and Recordkeeping Under the Toxic Substances Control Act (TSCA); Revision to Regulation

*2025-11-13*

A Proposed Rule by the Environmental Protection Agency on 11/13/2025

The U.S. Environmental Protection Agency (EPA or Agency) is proposing amendments to the Toxic Substances Control Act (TSCA) regulation for reporting and recordkeeping requirements for perfluoroalkyl and polyfluoroalkyl substances (PFAS). As promulgated in October 2023, the regulation requires manufacturers (including importers) of PFAS in any year between 2011-2022 to report certain data to EPA related to exposure and environmental and health effects. EPA is proposing to incorporate certain exemptions and other modifications to the scope of the reporting regulation. These exemptions would maintain important reporting on PFAS, consistent with statutory requirements, while exempting reporting on activities about which manufacturers are least likely to know or reasonably ascertain.

**DATES:**

Comments must be received on or before December 29, 2025. Comments on the information collection provisions of this proposed rule under the Paperwork Reduction Act (PRA) must be received by the Office of Management and Budget's Office of Information and Regulatory Affairs (OMB-OIRA) on or before December 15, 2025. Please refer to the PRA section under "Statutory and Executive Order Reviews" in this preamble for specific instructions.

Read More

US FDA, 13-11-25

https://www.federalregister.gov/documents/2025/11/13/2025-19882/perfluoroalkyl-and-polyfluoroalkyl-substances-pfas-data-reporting-and-recordkeeping-under-the-toxic

## Methylene Chloride; Regulation Under the Toxic Substances Control Act (TSCA); Compliance Date Extension

*2025-11-13*

The Environmental Protection Agency (EPA or Agency) is finalizing an extension to the compliance dates applicable to certain entities subject to the regulation of methylene chloride promulgated under the Toxic Substances Control Act (TSCA). Specifically, EPA is finalizing an 18-month extension of the Workplace Chemical Protection Program (WCPP) and associated recordkeeping compliance dates for industrial or commercial laboratories that are not owned or operated by Federal agencies or contractors acting on behalf of the Federal government. Under this final rule, all non-Federal laboratories will share the same compliance dates with Federal and Federally contracted laboratories. EPA is finalizing an extension of the compliance dates for associated laboratory activities detailed in this final rule to avoid disruption of important functions of non-Federal laboratories such as the use of environmental monitoring methods needed for cleanup sites and wastewater treatment, as well as activities associated with university laboratories or law enforcement laboratories.

**DATES:**

This final rule is effective on December 15, 2025.

Read More

US FDA, 13-11-25

https://www.federalregister.gov/documents/2025/11/13/2025-19881/methylene-chloride-regulation-under-the-toxic-substances-control-act-tsca-compliance-date-extension

## Science Advisory Committee on Chemicals (SACC); Notice of Postponement of Public Meeting

*2025-11-13*

**SUMMARY:**

The Environmental Protection Agency has postponed the virtual preparatory meeting for the Science Advisory Committee on Chemicals (SACC) to consider the scope and clarity of the draft charge questions for the peer review of the draft risk evaluation of octamethylcyclotetrasiloxane (D4). The meeting was scheduled for



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November 18, 2025, and will now be held December 1, 2025. The meeting was announced in the Federal Register on September 19, 2025.

**DATES**:

**Meeting date:** December 1, 2025, 1:00 p.m. to approximately 5:00 p.m. (EST).

**Registration:** To request time to present oral comments during the preparatory meeting, you must register by noon (12:00 p.m. EST) on November 24, 2025, and submit a written version of your oral comments by noon (12:00 p.m. EST) on November 28, 2025. For those not making oral comments, registration will remain open through the end of this meeting on December 1, 2025.

Read More

US FDA, 13-11-25

https://www.federalregister.gov/documents/2025/11/13/2025-19875/science-advisory-committee-on-chemicals-sacc-notice-of-postponement-of-public-meeting

## Hazardous lead lurks in the drinking water of US schools, experts are urging the EPA to take action

*2025-10-19*

National environmental groups are calling lead contamination in drinking water at our nation's schools a serious public health threat. A new report gives an "F" to the majority of states across the country for not doing more to address the problem, and experts say even low levels of lead in school drinking water could be harming children.

Safe drinking water at school is one of the most basic expectations parents have, but testing of school water nationwide is raising serious concerns.

Environment America Clean Water Program Director John Rumpler calls it a very big problem.

Researchers reviewed available water testing data for schools nationwide and found that in nearly every state, roughly half of the schools tested found lead at one or more taps.

Read More

Fox, 19-10-25

https://midmichigannow.com/news/spotlight-on-america/hazardous-lead-lurks-in-the-drinking-water-of-us-schools-experts-are-urging-the-epa-to-take-action-copper-rule-revisions-regulations-environment-america-us-public-interest-research-group-national-pta-national-education-association

## EUROPE

### Chemicals: Council greenlights legislative package to streamline chemical safety assessments

*2025-11-13*

The Council today formally adopted the legislative package on 'one substance, one assessment' (OSOA). The new rules streamline the EU's approach to the assessment of chemicals and shorten the gap between the identification of a possible risk and the necessary regulatory action ultimately leading to better and faster protection of people's health and the environment.

The OSOA package also improves the quality, consistency and efficiency of chemical safety assessments across EU legislation, including those related to medical devices, toys, food, pesticides and biocides. It strengthens the knowledge base on chemicals and ensure earlier detection and action on emerging chemical risks.

The package creates a new common data platform, to be managed by ECHA, that will serve as a one-stop shop for information on chemicals. It will integrate existing data from over 70 pieces of EU legislation, covering aspects such as hazards, physico-chemical properties, presence in the environment, emissions and uses. The platform will also include a database of safer alternatives to chemicals of concern, helping to promote a transition towards safer and more sustainable substances.

The new rules will also allow a more efficient use of the scientific expertise available in EU agencies by clarifying which agency is responsible for which scientific and technical tasks and improving cooperation between them, while avoiding overlaps.



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The package consists of three legislative acts:

- a regulation establishing a common data platform on chemicals
- a regulation and a directive improving cooperation and reallocating scientific and technical tasks among the EU agencies active in the field of chemicals, including the European Chemicals Agency (ECHA)

**Next steps**

Today's vote marks the end of the legislative process. The three acts will now be published in the EU's official journal and enter into force 20 days later.

The common data platform is to be established and become operative within three years form the entry into force of the regulation.

**Background**

Global chemicals production is projected to double by 2030, according to the UN Environment Programme (Global Chemicals Outlook II, 2019), highlighting the growing importance of robust EU chemical regulation.

Proposed in December 2023, the OSOA package was part of the Chemicals Strategy for Sustainability under the European Green Deal's zero pollution ambition. The strategy aims to strengthen protection for people and the environment while driving innovation towards safe and sustainable chemicals.

Read More

European Council, 13-11-25

https://www.consilium.europa.eu/en/press/press-releases/2025/11/13/chemicals-council-greenlights-legislative-package-to-streamline-chemical-safety-assessments/

## ECHA helping SMEs to comply

*2025-11-11*

The European Chemicals Agency (ECHA) has launched an updated SME hub on its website to support smaller companies with their duties under European chemicals legislation. Helping SMEs is one of the Agency's core tasks.

Helsinki, 11 November 2025 – The SME hub contains online tools and materials from Member States and ECHA, including an AI-powered virtual assistant pilot. These online resources were presented today at the SME Assembly in Copenhagen, Denmark, held as part of the EU's SME Week.

Mercedes Viñas, ECHA's Director for Submissions and Interaction said:

"ECHA's strategy underlines the importance of providing tools, advice and support, particularly to smaller companies to help them fulfil their duties under the EU chemical legislation.

"We have met with SMEs and industry representatives to better understand the specific needs that smaller companies have. As a result, we can better address their concerns. We plan to continue engaging with SMEs and their representatives to make sure that we can address their needs in our current and future activities, for example, when designing new tools for industry. The competitiveness of European small and medium-sized enterprises is pivotal to our economy's success and a priority on our agenda."

ECHA is piloting uses of artificial intelligence (AI) in its work, in this case, we want to learn if AI can support SMEs in meeting their obligations under the EU chemicals legislation. This includes, for example, a webinar for SMEs from 22 October featuring AI-generated translations, and a pilot of an AI-powered virtual assistant. Available 24/7 in all EU languages, the assistant helps companies find reliable information about their duties by providing answers based on publicly available resources, including Q&As and other content from ECHA's websites. During the pilot, ECHA will analyse the submitted questions and provided answers, as well as consider user feedback to continuously improve the assistant.

Further information

- SME hub
- SME webinar: Do you need to register under REACH?
- SME Assembly 2025



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Read More

ECHA, 11-11-25

https://echa.europa.eu/-/echa-helping-smes-to-comply

## Who am I?

*2025-11-21*

I am a heavy, bluish-white metal once used in paint and plumbing, now primarily in batteries and radiation shielding.





## Vinyl Acetate

*2025-11-21*

### USES [2,3]

Vinyl acetate is used to make other industrial chemicals (such as polyvinyl acetate polymers and ethylene-vinyl acetate copolymers). These other chemicals are used mostly to make glues for the packaging and building industries. They are also used to make paints, textiles, and paper. The Food and Drug Administration (FDA) has determined that vinyl acetate may be safely used as a coating or a part of a coating that is used in plastic films for food packaging, and as a modifier of food starch.

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

#### Exposure Sources

Industrial facilities, accidental spills, contact with products that contain vinyl acetate, and hazardous waste disposal sites are possible sources of exposure to vinyl acetate. The most important way that you can be exposed to vinyl acetate if you live around factories that make, use, store, and dispose of vinyl acetate on site or if you live near waste sites in which vinyl acetate or products that contain vinyl acetate have been disposed, is by breathing air or drinking water that contain it. You can also be exposed to vinyl acetate by skin contact with products that were made with vinyl acetate, such as glues and paints. Exposure can also occur through ingestion of food items that were packaged in plastic films containing vinyl acetate or food items that contain vinyl acetate as a starch modifier. However, exposure to vinyl acetate occurs mostly in the workplace. Workers can breathe in the chemical when they are making it or using it to make other chemicals. Workers can also have skin contact with vinyl acetate solutions.

#### Routes of Exposure

Vinyl acetate can enter your body:

- through your lungs when you breathe air containing it,
- through your stomach and intestines when you eat food or drink water containing it, or
- through your skin.

**Vinyl acetate is a clear, colourless liquid with the molecular formula C4H6O2. It has a sweet, pleasant, fruity smell, but the odour may be sharp and irritating to some people. You can easily smell vinyl acetate when it is in the air at levels around 0.5 ppm. It readily evaporates into air and dissolves easily in water. Vinyl acetate is flammable and may be ignited by heat, sparks, or flames. [1,2]**

## HEALTH EFFECTS [4]

### Acute Health Effects

- Acute inhalation exposure of workers to vinyl acetate has resulted in eye irritation and upper respiratory tract irritation.
- Nasal irritation, laboured breathing, lung damage, and convulsions have been observed in rodents acutely exposed to high levels of vinyl acetate by inhalation.
- Acute animal tests in rats, mice, and rabbits have demonstrated vinyl acetate to have moderate acute toxicity by inhalation, oral, or dermal exposure.

### Carcinogenicity

- No information is available on the carcinogenic effects of vinyl acetate in humans.
- An increased incidence of nasal cavity tumours has been observed in rats exposed by inhalation, but not mice.
- In rats exposed to vinyl acetate in drinking water, an increased tumour incidence (including neoplastic nodules of the liver, adenocarcinomas of the uterus [in females], and C-cell adenomas or carcinomas of the thyroid) was reported. However, there are many limitations to this study.
- In another drinking water study, no treatment-related tumours were observed in rats.
- EPA has not classified vinyl acetate as to its possible human carcinogenicity.

## SAFETY

### First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- **Skin Contact:** After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.



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- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
- **Ingestion:** Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

### Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling vinyl acetate:

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

Personal Protection in Case of a Large Spill:

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

## REGULATION

### United States

- **EPA:** The Environmental Protection Agency requires that discharges or accidental spills into the environment of 5,000 pounds or more of vinyl acetate be reported to the EPA.
- **FDA:** The Food and Drug Administration has determined that vinyl acetate may be safely used as a coating or a part of a coating that is used in plastic films for food packaging, and as a modifier of food starch.
- **ACGIH:** The American Conference of Governmental Industrial Hygienists has established an exposure limit of 10 parts of vinyl acetate per million parts of workplace air (10 ppm) for an 8-hour workday, 40-hour workweek.
- **NIOSH:** The National Institute for Occupational Safety and Health recommends that exposure to vinyl acetate in the workplace not exceed 4 ppm over a 15-minute period.

## REFERENCES

1. http://www.atsdr.cdc.gov/phs/phs.asp?id=669&tid=124
2. http://en.wikipedia.org/wiki/Vinyl_acetate
3. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=670&tid=124
4. http://www.epa.gov/ttn/atw/hlthef/vinylace.html
5. http://www.sciencelab.com/msds.php?msdsId=9927644
6. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx



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New Microwave Technique Could Turn CO2 Into Fuel Far More Efficiently

*2025-11-19*

A new method uses microwaves to lower the energy required for certain industrial processes.

Some industrial chemical production processes depend on heat, but traditional heating methods are often wasteful because they warm large areas that do not actually need it. A research team including scientists from the University of Tokyo developed a method to focus heat only where it is needed.

Their approach uses microwaves, similar to those in a household microwave oven, to excite specific elements within the target materials. The new system achieved energy efficiencies about 4.5 times higher than conventional techniques.

**A green transformation approach to industrial chemistry**

Although climate change involves more than just energy production and carbon dioxide (CO2), lowering energy demand and emissions remains a key challenge for science and engineering. Under the broader goal of green transformation, Lecturer Fuminao Kishimoto and his colleagues in the Department of Chemical System Engineering at the University of Tokyo are developing cleaner, more efficient industrial methods.

Their latest work could improve processes used in chemical synthesis and may lead to other environmental benefits. The basic idea behind their innovation is surprisingly simple.

“In most cases, chemical reactions occur only at very small, localized regions involving just a few atoms or molecules. This means that even within a large chemical reactor, only limited parts truly require energy input for the reaction,” said Kishimoto. “However, conventional heating methods, such as combustion or hot fluids, disperse thermal energy throughout the entire reactor. We started this research with the idea that microwaves could concentrate energy on a single atomic active site, a little like how a microwave oven heats food.”

**How it works: tuning microwaves for precision heating**

As Kishimoto explained, the concept resembles that of a microwave oven but operates under different conditions. Instead of targeting polar water molecules at roughly 2.45 gigahertz (a frequency also used by many Wi-Fi signals, which explains why internet connections can sometimes

falter when reheating food), the researchers tuned their microwaves to about 900 megahertz. This lower frequency proved optimal for exciting the material they were studying—zeolite—a porous substance that can efficiently absorb and transfer heat.

"The most challenging aspect was proving that only a single atomic active site was being heated by the microwaves. To achieve this, we spent four years developing a specialized experimental environment at Japan's world-class large synchrotron radiation facility, SPring-8," said Kishimoto.

"This involved using spongelike zeolite, which is ideal because we can control the sizes of the sponge cavities, allowing us to balance different factors of the reactions. Inside the sponge cavities, indium ions act like antennas. These are excited by the microwaves which creates heat, which can then be transferred to reaction materials passing through the sponge."

**Applications in fuel creation and carbon recycling**

By selectively delivering heat to specific materials, lower overall temperatures can be used to achieve reactions which are otherwise very demanding, such as water decomposition or methane conversion, both useful to create fuel products. They can further improve selectivity by varying the pore size of the zeolite sponge, with smaller pores yielding greater efficiency and larger pores enabling greater control over reactions.

And one key advantage is that this technique can even be used in carbon capture, recycling CO2 as part of the methane conversion, and even recycling plastics more easily.

The challenge now will be in how to scale this up to encourage industrial adoption — things that work in the lab don't directly translate into large industrial settings easily. And there are some limitations to the research that would also need to be addressed first.

The material requirements are quite complex and aren't simple or cheap to produce; it's hard to precisely measure temperatures at the atomic scale, so current data rely on indirect evidence, and more direct means would be preferred. And, despite the improvements in efficiency, there is still room for improvement here too as there are heat and electrical losses along the way.

"We aim to expand this concept to other important chemical reactions beyond CO2 conversion and to further optimize catalyst design to improve durability and scalability. The technology is still at the laboratory stage.



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Scaling up will require further development of catalysts, reactor design and integration with renewable power sources," said Kishimoto.

"While it is difficult to give an exact timeline, we expect pilot-scale demonstrations within the next decade, with broader industrial adoption depending on progress in both technology and energy infrastructure. To achieve this, we are seeking corporate partners to engage in joint development."

Sci Tech Daily, 19 November 2025

https://scitechdaily.com

## Graphene-boosted plastic makes auto parts 20% stronger, 18% lighter

*2025-11-18*

Glass-filled polypropylene is already a very commonly used plastic for automotive parts, but could it be improved? Well, yes. A new substance, Gratek, is claimed to make the plastic 20% stronger yet 18% lighter, thanks to the addition of graphene.

Widely hailed as a "wonder material," graphene takes the form of one-atom-thick sheets of carbon atoms linked to one another in a honeycomb pattern. Along with being the world's strongest human-made substance, it's also very flexible, stretchable and chemically stable, plus it exhibits high electrical and thermal conductivity.

It's no wonder, then, that Nello David Sansone – a post-doctoral researcher working in the University of Toronto's Multifunctional Composites Manufacturing Laboratory – began investigating methods of integrating graphene nanoplatelets into glass-filled polypropylene. He ultimately developed a technique for doing so while working at auto parts manufacturer Axiom Group, in a partnership with the university.

In previous groups' attempts to incorporate graphene into automotive components, the material had a tendency to cluster during processing, thus concentrating mechanical stress in unwanted areas and leading to failure.

Sansone got around this problem via a proprietary technique which causes the nanoplatelets to bond only to the glass fibers within the polypropylene matrix, keeping them from clumping. Because the graphene strengthens the fibers, fewer of them need to be used, thus

Gratek is approximately 20% stronger and 18% lighter than regular glass-filled polypropylene.

And it should be noted, the material is less than 1% graphene overall. Plus as an added bonus, due to the lower glass content in the plastic, it causes less wear and tear on the machines that are cutting and drilling it.

One potential limiting factor to Gratek is the fact that, because of the graphene in it, it's limited to being black in color. With that drawback in mind, Sansone has developed another material, Clatek, which utilizes clay-based halloysite nanotubes in place of the graphene nanoplatelets. It reportedly offers performance similar to that of Gratek, but it's white in color and can be dyed and painted.

Gratek is expected to be contracted to a major automobile manufacturer before the end of this year, while Clatek is expected to be commercially available within two years.

"It has shown real potential to make vehicles lighter, safer, and more sustainable," Sansone told us. "As for what's next for me, I'm now working on commercializing another advanced material formulation, known as AegisX, through my start-up NanoMorphix, where we're developing transparent and textile armor for military, defense, aerospace, and personal protection."

Sansone was recently the recipient of an award from Mitacs, a government-funded non-profit organization that seeks to foster technical innovation in Canada. Past recipients have developed technologies such as a towable crop-waste-to-biofuel converter, a computer-vision-based flight recorder, an augmented reality feedback system for athletes and a screw-drive amphibious robot.

New Atlas, 18 November 2025

https://newatlas.com

## Metal-phase protection enables durable acidic $CO_2$ electroreduction to formic acid

*2025-11-20*

The electroreduction of carbon dioxide (CO2) into valuable chemicals and fuels typically operates under alkaline or neutral conditions, but the carbonation side reaction causes carbon loss. In addition, the main product is formate, which requires additional treatment such as acidification to obtain formic acid.



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Acidic CO2 electroreduction can effectively mitigate carbonation issues and directly produce formic acid. However, harsh acidic environments often lead to problems such as rapid catalyst degradation and metal leaching, limiting both the activity and long-term durability of the catalyst.

In a study published in Angewandte Chemie International Edition, a research team led by Prof. Gao Dunfeng and Prof. Zhou Xukai from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences proposed a metal-phase protection strategy, and achieved durable acidic CO2 electroreduction to formic acid.

This metal-phase protection strategy enabled the in situ formation of a Bi-Cu bimetallic oxide catalyst (Bi0.31Cu1). The Bi0.31Cu1 catalyst delivered a Faradaic efficiency (FE) of above 90% for formic acid in a wide current density range from 200 to 650 mA cm−2. In a 0.5 M KCl electrolyte at pH 2, it continuously produced formic acid with a FE of around 90% at 200 mA cm−2 for 500 h.

Researchers found that the interphase interaction between Bi2O3 phase and CuBi2O4 phase within the Bi0.31Cu1 catalyst induced compressive strain and lattice contraction in Bi2O3 phase and strengthened Bi-O bond, which effectively suppressed Bi leaching during catalyst reconstruction and enhanced long-term durability.

"Our study showcases the promise of the metal-phase protection strategy for developing highly efficient catalysts with long-term durability for acidic CO2 electrolysis," said Prof. Gao.

Phys Org, 20 November 2025

https://phys.org

## Toxic Gas on an Ancient Brown Dwarf Baffles Scientists

*2025-11-20*

Phosphine has finally been spotted in the atmosphere of the brown dwarf Wolf 1130C, surprising astronomers who have struggled to find the gas elsewhere.

JWST's detailed measurements revealed phosphine at exactly the levels theory predicted, breaking a streak of unexplained non-detections.

**The Role of Phosphorus in Life and Beyond**

Phosphorus is one of the six essential elements that support life on Earth. When it combines with hydrogen, it produces phosphine (PH3), a

gas that is both explosive and highly toxic. Phosphine is present in the atmospheres of Jupiter and Saturn and has been viewed as a possible biosignature for anaerobic life because terrestrial planets have very few natural ways to generate it. On Earth, it is released through the breakdown of organic material in swampy environments.

A research group led by University of California, San Diego Professor of Astronomy and Astrophysics Adam Burgasser has now identified phosphine in the atmosphere of a cool and ancient brown dwarf called Wolf 1130C. Their findings were published in Science.

**Phosphine's Peculiar Disappearance**

The team detected phosphine in Wolf 1130C's atmosphere using data from the James Webb Space Telescope (JWST), which has the sensitivity needed to examine these faint objects in detail. What puzzles researchers is not the presence of phosphine on this brown dwarf, but its absence in other brown dwarfs and gas giant exoplanets where it has long been predicted to appear.

"Our astronomy program, called Arcana of the Ancients, focuses on old, metal-poor brown dwarfs as a means of testing our understanding of atmospheric chemistry," said lead author Burgasser. "Understanding the problem with phosphine was one of our first goals."

**The Missing Phosphine Mystery**

Phosphine forms naturally in hydrogen-rich atmospheres like those of Jupiter and Saturn. Because of this, scientists have expected to find it on gas giants around other stars and on brown dwarfs, which are larger than planets but smaller than true stars. These objects are sometimes referred to as "failed stars" because they cannot fuse hydrogen.

Despite these expectations, phosphine has been difficult to detect. Even earlier JWST observations did not show the gas, raising concerns about gaps in current models of phosphorus chemistry. "Prior to JWST, phosphine was expected to be abundant in exoplanet and brown dwarf atmospheres, following theoretical predictions based on the turbulent mixing we know exists in these sources," explained co-author Sam Beiler, who recently graduated from the University of Toledo and is now postdoctoral scholar at Trinity College Dublin.

Beiler, who has previously investigated the missing phosphine problem, added, "Every observation we've obtained with JWST has challenged the theoretical predictions — that is, until we observed Wolf 1130C."



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**A Curious System: Wolf 1130ABC**

In the star system Wolf 1130ABC, located 54 light-years from the sun in the constellation Cygnus, the brown dwarf Wolf 1130C follows a wide orbit around a tight double star system, composed of a cool red star (Wolf 1130A) and a massive white dwarf (Wolf 1130B). Wolf 1130C has been a favorite source for brown dwarf astronomers due to its low abundance of "metals" – essentially any elements other than hydrogen and helium – compared to the sun.

Unlike other brown dwarfs, the team easily spotted phosphine in JWST's infrared spectral data of Wolf 1130C. To fully understand the implications of their findings, they needed to quantify the abundance of this gas in Wolf 1130C's atmosphere. This was done by Assistant Professor of Astronomy at San Francisco State University Eileen Gonzales, also a co-author on the study.

"To determine the abundances of molecules in Wolf 1130C, I used a modeling technique known as atmospheric retrievals," explained Gonzales. "This technique uses the JWST data to back out how much of each molecular gas species should be in the atmosphere. It's like reverse engineering a really delicious cookie when the chef wouldn't give up the recipe."

**A Surprising Abundance**

Gonzales's models showed that abundant phosphine was the secret ingredient in Wolf 1130C. Specifically, she found that phosphine was present at the predicted theoretical abundances of about 100 parts per billion.

While the researchers are delighted by their discovery, it raises an issue: why is phosphine present in the atmosphere of this brown dwarf and not others?

One possibility is the low abundance of metals in Wolf 1130C's atmosphere, which may change its underlying chemistry. "It may be that in normal conditions phosphorus is bound up in another molecule such as phosphorus trioxide," explained Beiler. "In the metal-depleted atmosphere of Wolf 1130C, there isn't enough oxygen to take up the phosphorus, allowing phosphine to form from the abundant hydrogen."

The team hopes to explore this possibility with new JWST observations that will search for phosphine in the atmospheres of other metal-poor brown dwarfs.

Another possibility is that phosphorus was generated locally in the Wolf 1130ABC system, specifically by its white dwarf, Wolf 1130B.

**White Dwarfs and Ancient Fireworks**

"A white dwarf is the leftover husk of a star that has finished fusing its hydrogen," explained Burgasser. "They are so dense that when they accrete material on their surface they can undergo runaway nuclear reactions, which we detect as novae."

Astronomers have not observed any such eruptions in the Wolf 1130ABC system in the time it has been studied, but nova cycles often span thousands or even tens of thousands of years. Because this system has only been known for a little more than a century, earlier eruptions could easily have gone unnoticed. If they occurred, they might have scattered phosphorus throughout the system. Previous research has suggested that this type of event could be responsible for producing a substantial amount of the phosphorus found in the Milky Way.

**A Window Into Cosmic Chemistry**

Figuring out why Wolf 1130C displays such a distinct phosphine signature could reveal how phosphorus forms in the galaxy and how it behaves in different planetary environments. As Burgasser noted, "Understanding phosphine chemistry in the atmospheres of brown dwarfs where we don't expect life is crucial if we hope to use this molecule in the search for life on terrestrial worlds beyond our solar system."

Sci Tech Daily, 20 November 2025

https://scitechdaily.com

## Scientists Uncover Cancer-Causing Chemicals in Common Foods

*2025-11-18*

The study uses an advanced QuEChERS–GC–MS detection method to uncover hidden carcinogens in cooking oils and meats.

Many people today are placing greater emphasis on their overall health, turning daily workouts and calorie-tracking tools into regular habits. As part of this shift, more individuals are choosing diets that feature nutrient-rich foods such as fruits and vegetables.



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Although these foods are widely viewed as healthy, they can still contain polycyclic aromatic hydrocarbons (PAHs) (hydrophobic organic compounds comprising multiple fused aromatic rings) when exposed to contamination or when cooked through heating, smoking, grilling, roasting, or frying. PAHs can enter plant-based foods (such as fruits and vegetables) through atmospheric deposition from vehicle exhaust and industrial emissions, irrigation with contaminated water, or uptake from polluted soil, where they may accumulate on the surface or within edible tissues.

In animal-based foods, such as meat and fish, PAHs are often generated during processing and cooking, particularly when food is exposed directly to open flames, smoke, or very high temperatures.

Foods commonly found to contain higher levels of PAHs include:

- Smoked or grilled meats and fish (e.g., smoked salmon, bacon, barbecued chicken, charred beef).
- Roasted or charred plant foods (roasted coffee beans, dark-roasted nuts, charred vegetables, burnt toast).
- High-heat processed oils and fats (reused frying oils, highly refined vegetable oils).
- Heat-processed grain products (roasted cereals, malted grains, toasted snacks).
- Produce exposed to environmental pollution (leafy greens, root vegetables, and fruits grown near roadways or industrial areas).
- Smoke-dried teas and herbs (black tea, green tea, certain herbal teas).

**Cooking Processes That Generate PAHs**

During grilling, barbecuing, and pan frying, PAHs can form from the incomplete combustion of fats and other organic components and tend to concentrate in charred or heavily browned areas. Smoked and roasted products, including smoked meats, smoked fish, certain cheeses, and roasted coffee, frequently show measurable PAH levels. Processed foods that undergo intensive thermal treatment, such as some baked goods and cereal products, can also contain PAHs, especially when surfaces are darkly browned.

Because certain PAHs are known carcinogens, their presence in such a wide variety of foods raises important public health concerns and highlights the need for monitoring and mitigation across the food supply chain.

To protect consumers, it has become essential to efficiently extract, identify, and measure PAHs in food. Common extraction methods, including solid-phase, liquid-liquid, and accelerated solvent extraction, are generally affordable but often slow, labor intensive, and not environmentally friendly.

In recent years, researchers have highlighted the QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) method as a promising alternative for isolating organic compounds. This approach shortens analysis time, increases accuracy and recovery, and simplifies the overall preparation process, offering a safer and more dependable option for PAH testing.

**Study Overview and Objectives**

A recent study conducted by researchers in the Department of Food Science and Biotechnology at Seoul National University of Science and Technology, led by Professor Joon-Goo Lee, applied the QuEChERS method to measure eight PAHs (Benzo[a]anthracene, Chrysene, Benzo[b] fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd] pyrene, Dibenz[a,h]anthracene, and Benzo[g,h,i]perylene) in food. The results of their work were published in the journal Food Science and Biotechnology.

The researchers extracted PAHs using acetonitrile. This was followed by purification via different methods involving various combinations of sorbents. The researchers validated the QuEChERS extraction method through a number of food matrices, finding that the calibration curves for the eight PAHs demonstrated remarkable linearity, with the R2 value exceeding 0.99.

Further, the gas chromatography–mass spectrometry analysis revealed that the limits of detection ranged from 0.006 to 0.035 µg/kg, while the limits of quantification ranged from 0.019 to 0.133 µg/kg. Notably, recoveries ranged from 86.3 to 109.6% at 5 µg/kg, 87.7 to 100.1% at 10 µg/kg, and 89.6 to 102.9% at 20 µg/kg, with precision values between 0.4 and 6.9% in all food matrices.

**Significance and Industrial Impact**

Prof. Lee reveals, "This method not only simplifies the analytical process but also demonstrates high efficiency in detection compared to conventional methods. It can be applied to a wide range of food matrices."



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In the industrial sector, this method could be used for inspecting food products for safety management. Furthermore, it is expected to lead to cost reduction and improved safety for workers.

"Our research can improve public health by providing safe food. It also reduces the use and emission of hazardous chemicals in laboratory testing," concludes Prof. Lee.

Overall, this study showcases that the developed PAH analysis method based on the QuEChERS approach is environmentally friendly, rapid, and accurate.

Sci Tech Daily, 18 November 2025

https://scitechdaily.com

## Could the solution to the carbon problem be carbon itself?

*2025-11-20*

Can we use carbon to help decarbonize the world and transform the energy and chemical industries? Yes, it seems, but there are some key challenges to overcome first.

A review article in Science Advances pinpoints the potential of transforming carbon emissions into innovative catalysts used in electro- and photocatalysis systems to facilitate cost-effective decarbonization and avoid the need to use critical minerals that come with high costs and geopolitical risk.

With the energy intensive nature and large contribution to greenhouse gas emissions of many chemical processes, researchers have put considerable effort into finding ways to convert CO2 into non-volatile carbon products and storing them, which alone, even if successful, will not offset carbon at a large scale.

Carbon, as a product used in research and industry, can also be synthesized through techniques such as chemical vapor deposition, typically using hydrocarbons as the source.

The review authors from the ARC Center of Excellence for Carbon Science and Innovation (COECSI) argue that a more practical approach is to convert CO2 into high-value catalysts that can then be used to convert CO2 or carbon wastes into fuels and chemicals.

"Achieving this will advance climate goals, material innovation and contribute to a circular carbon economy," says COECSI Director and corresponding author, Prof Liming Dai.

**What makes carbon a good catalyst**

Carbon is strong, conductive and stable in the harsh conditions found in electrocatalytic cells, but carbon is catalytically inactive.

Prof Dai led a team that discovered a way to transform carbon into efficient catalysts for energy conversion. Catalytic active centers (CACs), where reactions occur, can be formed in carbon with some clever engineering at the atomic scale that includes methods such as heteroatom doping, molecular adsorption and defect engineering to break the electron symmetry in carbon's aromatic rings.

A promising area of research is the concept of doping to introduce multifunctional properties to CACs where heteroatoms and carbon atoms work in synergy to markedly enhance catalytic performance. For example, researchers developed N and P co-doped bifunctional porous graphene catalysts for Zn-air batteries that have near theoretical energy capacities.

The efficacy of the CAC is further influenced by the architecture of the carbon substrate. For example, a novel 3D tunable carbon nanotube-graphene pillar structure that resembles a field of city skyscrapers has introduced marked improvements in ion and electron transfer and a greater number of accessible CACs.

**CO2 as a carbon source**

Different processes have been employed, each with advantages and limitations, to catalytically convert CO2 into a range of carbon-based nanostructures such as graphene carbon nanoparticles, nano-onions, nano-platelets and carbon nanotube wool.

One straightforward method that thermally reduced CO2 with magnesium produced hollow-structured mesoporous carbon cubes that have shown promise as an alternative to commercial platinum-carbon catalysts in fuel cells.

A COECSI team has also converted CO2 into edge-doped graphene electrocatalysts by co-ball milling graphite with dry ice.

Typically, electrocatalytic conversion of CO2 to carbon is an energy intensive process because of the need for high temperatures.



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While still at the fundamental stage, a recent promising cerium-containing liquid metal (gallium) electrocatalytic converter successfully converted CO2 into carbonaceous and graphitic products at ambient temperature.

**The economics and pursuit of multi-carbon products**

While the review authors note limitations with each method to transform CO2, they also note the techno-economic potential for cost-effective synthesis of carbon materials from CO2.

"As the market price for carbon nanotubes (CNTs) currently exceeds $100,000 per ton, we have identified economically attractive methods to convert CO2 into carbon catalysts as alternatives to expensive noble-metal catalysts," says lead author, Prof Zhenhai Xia.

"The economics of these technologies start making sense when you also consider that to build a circular economy, we will be abating the carbon. That is, previously seen as waste, carbon now has a market value and there is an environmental penalty and cost associated with not abating carbon waste such as CO2," says Prof Rose Amal.

Further value will be realized with the economic production of comparatively high value multi-carbon products such as synthetic fuels and industrial chemicals such as ethylene.

"The challenge remains, however, to boost catalytic efficiency and yields," says Prof Shizhang Qiao.

One promising method may come in the form of metal-free and metal-doped carbon catalysts. For example, a metal-free carbon catalyst using N-doped graphene quantum dots converted CO2 to higher order hydrocarbons such as ethylene and ethanol.

Carbon catalysts have also been used to convert nitrogen and nitrite wastes to ammonia and urea, essential for fertilizers and pharmaceuticals.

From a systems perspective, there also remains the challenge of scalability and price. Further, integrating $CO_2$ capture, conversion, and material synthesis into a cost-effective, sustainable system remains technically complex.

Despite these challenges, $CO_2$-derived carbon materials offer distinct advantages over those produced from fossil-based feedstocks. They provide a sustainable and renewable carbon source, help close the carbon

loop, and potentially reduce production costs when using waste $CO_2$ streams," says Prof Dai.

Phys Org, 20 November 2025

https://phys.org

## Everyday microplastics could be fueling heart disease

*2025-11-18*

A research team at the University of California, Riverside has found that routine exposure to microplastics -- tiny pieces released from packaging, fabrics, and common consumer plastics -- may speed up the formation of atherosclerosis, the artery-narrowing condition associated with heart attacks and strokes. The effect appeared only in male mice, offering new insight into how microplastics may influence cardiovascular health in people.

"Our findings fit into a broader pattern seen in cardiovascular research, where males and females often respond differently," said lead researcher Changcheng Zhou, a professor of biomedical sciences in the UCR School of Medicine. "Although the precise mechanism isn't yet known, factors like sex chromosomes and hormones, particularly the protective effects of estrogen, may play a role."

**Microplastics Found Throughout the Environment and the Body**

Microplastics are found widely in the modern environment, including in food, drinking water, and the air. They have also been detected inside the human body. Recent clinical studies have identified microplastics in atherosclerotic plaques and associated higher concentrations with elevated cardiovascular risk, although it was not clear whether these particles directly cause arterial injury.

"It's nearly impossible to avoid microplastics completely," Zhou said. "Still, the best strategy is to reduce exposure by limiting plastic use in food and water containers, reducing single-use plastics, and avoiding highly-processed foods. There are currently no effective ways to remove microplastics from the body, so minimizing exposure and maintaining overall cardiovascular health -- through diet, exercise, and managing risk factors -- remains essential."



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**Study Design Using a Heart Disease Mouse Model**

In their paper published in Environment International, Zhou and colleagues describe their use of LDLR-deficient mice, a common model for examining atherosclerosis. Both male and female mice were placed on a low-fat, low-cholesterol diet similar to what a lean and healthy person might eat.

The team then administered microplastics daily (10 milligrams per kilogram of body weight) for nine weeks. This amount reflects levels that could realistically be encountered through contaminated food and water.

**Microplastics Intensify Plaque Formation in Male Mice**

The results showed a sharp increase in atherosclerosis, but only in males. Male mice exposed to microplastics developed 63% more plaque in the aortic root, the segment of the aorta connected to the heart, and 624% more plaque in the brachiocephalic artery, a major vessel branching from the aorta in the upper chest. Female mice exposed to the same conditions did not show significant plaque progression.

The researchers confirmed that microplastics did not cause weight gain or increased cholesterol in either sex. The mice stayed lean, and their lipid profiles remained unchanged, indicating that traditional risk factors such as obesity or high cholesterol did not explain the heightened arterial damage.

**Disruption of Artery-Lining Cells**

The study also showed that microplastics interfered with the function and makeup of cells lining the arteries. Using single-cell RNA sequencing, which identifies gene activity in individual cells, the researchers observed that microplastics altered several cell types involved in atherosclerosis. Endothelial cells -- the cells that form the inner lining of blood vessels and help regulate inflammation and circulation -- were affected the most.

"We found endothelial cells were the most affected by microplastic exposure," Zhou said. "Since endothelial cells are the first to encounter circulating microplastics, their dysfunction can initiate inflammation and plaque formation."

**Microplastics Enter Arterial Plaques and Alter Gene Activity**

Fluorescent microplastics used in the study were found inside plaques and concentrated within the endothelial layer, consistent with reports from human samples that have revealed microplastics in arterial lesions.

Another key observation was that microplastics activated harmful gene pathways in endothelial cells from both mice and humans. This included genes associated with pro-atherogenic (plaque-promoting) activity, suggesting that microplastics trigger similar biological responses across species.

"Our study provides some of the strongest evidence so far that microplastics may directly contribute to cardiovascular disease, not just correlate with it," Zhou said. "The surprising sex-specific effect -- harming males but not females -- could help researchers uncover protective factors or mechanisms that differ between men and women."

**Future Research on Sex Differences and Microplastic Types**

Zhou and his team emphasize that more work is needed to determine why males appear more susceptible. The group plans to investigate whether humans show similar patterns.

"We would like to investigate how different types or sizes of microplastics affect vascular cells," Zhou said. "We will also look into the molecular mechanisms behind endothelial dysfunction and explore how microplastics affect male and female arteries differently. As microplastic pollution continues to rise worldwide, understanding its impacts on human health -- including heart disease -- is becoming more urgent than ever."

Zhou conducted the study with collaborators from UCR, Boston Children's Hospital and Harvard Medical School in Massachusetts, and the University of New Mexico Health Sciences.

The work received partial support from the National Institutes of Health.

The title of the paper is "Microplastic exposure elicits sex-specific atherosclerosis development in lean low-density lipoprotein receptor-deficient mice."

Science Daily, 18 November 2025

https://sciencedaily.com



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## "Sticky Molecule" Offers New Vaccine Strategy Against COVID

*2025-11-20*

In a surprising discovery, a "sticky molecule" that occurs naturally in our blood vessels could be both a culprit behind blood clots and organ failure during COVID and long COVID and the key to new treatments to counter COVID-related viruses.

Researchers say the molecule, called P-selectin, could turn the tide to develop a new generation of mRNA therapies to combat not just COVID variants, but also other viruses in the same family.

The study, co-led by the Charles Perkins Centre at the University of Sydney, was published in the Journal of Clinical Investigation.

P-selectin is a molecule that already plays a major role in inflammation in our body, acting like a homing signal to immune cells during infection.

The study found that P-selectin was especially 'sticky' and attached itself readily to protein 'spikes' on the surface of coronaviruses, SARS-CoV-1, MERS-CoV, and both Wuhan and Delta strains of SARS-CoV-2 (the virus responsible for causing COVID).

"P-selectin is expressed on platelets – the cells that cause blood clots – and it promotes virus and platelet complexes that can cause dangerous blood clots, a major driver of death in severe COVID infection, and also a likely cause of long COVID," said lead researcher Dr Cesar Moreno from the University of Sydney's Charles Perkins Centre and Faculty of Science.

But P-selectin also normally controls white blood cell migration through our body., and our study found that during COVID infection, P-selectin also captures SARS-CoV-2 virus in the blood, holding the virus in blood vessels and blocking its ability to infect our cells."

Importantly, when the researchers created an mRNA-based therapy that could drive P-selectin expression in the absence of inflammation, it provided broad protection against coronavirus infection.

"Since P-selectin can catch the virus and block its ability to infect our cells, we took advantage of this to create a broad-acting mRNA therapy that can protect against known and most likely emerging coronavirus pandemic strains," said Dr Moreno.

The researchers used CRISPR genetic screening to test the entire human genome, looking for any human genes that can block SARS-CoV-2 infection. Beyond P-selectin, they found 33 other new genes that can protect us from SARS- CoV-2, and these genes can likely also be used as protective therapies against coronavirus and probably also other major viral infections.

"Vaccines have significantly reduced disease severity and deaths, but whether it's coronavirus or other strains, at some stage new pandemics will pose a threat to us. Having broad, easily manufactured mRNA therapies ready can help mitigate these risks," said senior author Professor Greg Neely, Head of the Dr. John and Anne Chong Lab for Functional Genomics at the University of Sydney.

"In some cases people can't get vaccinated, and for these people our strategy can provide another source of protection from current or emerging viral threats,"

"We now have a realistic strategy to future-proof against the next pandemic."

Technology Networks, 20 November 2025

https://technologynetworks.com

## Emerald green degradation in masterpieces: Scientists identify the culpr

*2025-11-19*

An international team of researchers have found what triggers degradation in one of the most popular pigments used by renowned 19th and 20th century painters. Using a multi-method approach, including advanced synchrotron radiation techniques, they've unveiled how light and humidity affect the masterpieces over time, and have proposed a strategy for its mitigation and monitoring. The results are out now in Science Advances.

During the 19th century, the Second Industrial Revolution sparked major advances in chemistry, giving rise to synthetic pigments that transformed art. Among them was emerald green, a vivid copper arsenite pigment admired for its brilliance and intensity.

Emerald green was used by well-known late 19th and early 20th century painters, such as Paul Cézanne, Claude Monet, Vincent van Gogh, Edvard Munch, and Robert Delaunay. Some of these painters, including Van



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Gogh, quickly realized that the paint would change over time, losing its original brilliant color, cracking and triggering surface deformations. It was discovered later that it was also highly toxic.

**Light and humidity**

Researchers believe emerald green degrades because its chemical composition is highly unstable under light, humidity, and certain atmospheric gases. These conditions can cause the pigment to react and release arsenic compounds, alter its color, or form dark copper oxides.

Now a research team led by the Institute of Chemical Sciences and Technologies "Giulio Natta" (SCITEC) of CNR and the Department of Chemistry, Biology and Biotechnology of the University of Perugia, in collaboration with the ESRF, the European Synchrotron, and the University of Antwerp, has investigated what triggers the degradation of emerald green. The study aims to improve strategies for preserving the masterpieces containing this pigment and to develop new methods to monitor their conservation state.

"It was already known that emerald green decays over time, but we wanted to understand exactly the role of light and humidity in this degradation," explains Letizia Monico, senior researcher at the SCITEC-CNR, corresponding and first author of the publication, together with Sara Carboni Marri, a former Ph.D. student from the same research group.

With these objectives, the researchers used different methods to carry out a study of paint mock-ups, historical paintings and related microsamples across multiple length scales.

First, they carried out non-invasive, in situ analyses at the macro scale on James Ensor's iconic oil painting, The Intrigue (1890), housed in the Royal Museum of Fine Arts in Antwerp (Belgium).

The goal was to assess the composition and conservation state of the green areas and to identify suitable points for microsampling. The measurements were performed using portable instruments from the University of Antwerp's research group, the mobile laboratory platform of the European Research Infrastructure for Heritage Science. These analyses were crucial for establishing preliminary insights into the conservation state of the green paint areas in a non-invasive manner, and for informing the subsequent sampling for synchrotron radiation X-ray measurements.

With these samples, the researchers came at the ESRF to use its bright X-rays and carried out micro-scale X-ray analyses at three ESRF's beamlines,

using X-ray diffraction and X-ray absorption spectroscopy. Other experiments were also carried out at the German synchrotron DESY.

"Measurements at synchrotron are crucial for these kinds of studies because they offer the only way to obtain specific information on the nature of various arsenic compounds within the paintings' stratigraphy at the submicron scale. Materials are so complex that a single technique may not be enough to get the full picture. At the ESRF, we try to make such a technique combination easier," explains Marine Cotte, scientist in charge of the ID21 beamline at the ESRF.

The team then combined these findings with results obtained from macro- and micro-scale light-based analysis of artificially aged, laboratory-prepared oil paint mock-ups and historical paints, including an Edvard Munch oil paint tube. The mock-ups, which mimicked the composition of Ensor's painting, were crucial in discovering that light and humidity activate distinct alteration pathways for emerald green in oil paints.

The researchers found that humidity promotes the formation of arsenolite ($As_2O_3$), a crystalline compound that makes the paint brittle and prone to flaking. Light, on the other hand, causes the original trivalent arsenic to oxidize into pentavalent arsenic compounds mainly at the surface, leading to a thin whitish layer that dulls the color.

**Strategies to preserve masterpieces and to monitor their conservation conditions**

Overall, the arsenic and copper speciation results showed that the degradation behavior of the light-aged paint mock-ups strongly resembles that detected in the two analyzed cross-sections of The Intrigue.

"These similarities support the conclusion that photo-oxidative degradation by light has altered the original emerald green of The Intrigue," says Geert Van der Snickt, co-author and professor from the University of Antwerp.

All in all, light and humidity affect the emerald green, but it is specifically light that poses the primary, ultimate threat to The Intrigue and potentially other masterpieces. So, researchers came up with a strategy for museums to detect and monitor the conservation status of emerald green paints in artworks.

Visual and colorimetric assessments alone are not enough to accurately determine the degradation state of emerald green paints. As this study shows, these methods need to be complemented by micro-X-ray or



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infrared analyses, which can detect degradation products such as pentavalent arsenic compounds.

The researchers also demonstrated a practical, non-invasive technique for assessing paintings directly in museums: external reflection infrared spectroscopy. This method is uniquely sensitive to the infrared signals of the degradation products containing pentavalent arsenic, allowing conservators to identify altered areas of paint on a macro scale.

"This technique is extremely valuable for guiding targeted micro-sampling and for subsequent X-ray analyses, which help determine the exact degradation state and enable early detection and monitoring of damaged paint layers," concludes Costanza Miliani, co-author of the study, coordinator of the European MOLAB platform for heritage science access, and Director of the CNR Institute of Heritage Science.

Phys Org, 19 November 2025

https://phys.org

## Donkey Poo Samples Reveal Widespread Microplastics Contamination in Kenya

*2025-11-20*

A study by the University of Portsmouth has revealed for the first time the extent of the devastating impact of plastic pollution on livestock, humans and the wider environment on the Kenyan island of Lamu.

The study was carried out by members of the Revolution Plastics Institute at The University of Portsmouth, in collaboration with The Donkey Sanctuary, The Flop Flopi Project and the Kenyan Marine and Fisheries Research Institute.

Until now the impact of plastic waste on terrestrial working animals has been largely overlooked with most of the focus being on marine animals. Professor Cressida Bowyer, Deputy Director of the Revolution Plastics Institute at the University of Portsmouth explains: "Most plastic pollution originates on land, yet its impacts on land-based animals remain chronically understudied. Our findings show how urgently this knowledge gap needs to be addressed."

Researchers took a multi-disciplinary approach, quantifying the amount of microplastics in donkey and cattle faeces, observing their natural feeding behaviour and surveying residents and visitors to understand their attitudes towards plastic pollution and donkey welfare.

Alarmingly, they found microplastics in 100 per cent of donkey (and cattle) faecal samples analysed. Vets at The Donkey Sanctuary's clinic in Lamu have long been calling for action due to the volume of donkey fatalities they see each year caused by plastic-induced colic, however this is the first published evidence of its complete and widespread impact.

In 2024, a total of 108 cases of colic were seen at the clinic, an average of 8 donkeys per month, with 14 of those subsequent fatalities. So far, in 2025, numbers are similar; clinic vets have seen 91 donkeys with colic, of which 16 have died.

Half of donkey owners surveyed admitted that with fluctuating feed prices, they could not consistently provide enough food for their animals who instead were left to roam in search of some. Analysing the animal foraging behaviours primarily at waste sites and in rural areas, researchers found at least one in every 10-20 items ingested was plastic.

As well as posing a serious risk to donkeys and livestock, a major food security concern is the potential for microplastic transfer to humans through consumption of contaminated animal products or crops fertilised with animal manure containing tiny plastic particles. Microplastics in humans has been linked to inflammation, cancer, reproductive disorders and other serious health issues.

Free-roaming donkeys are both culturally significant and a major tourist attraction on Lamu, and yet a lack of grass or edible vegetation is forcing many to forage for food at waste sites.

Rather than restricting the movement of donkeys, researchers and residents are calling for community clean-ups, better waste disposal systems, and government investment in recycling and plastic alternatives.

Dr Obadiah Sing'Oei, Programme Manager at The Donkey Sanctuary's clinic in Lamu, said: "This study is a wake-up call for collective action to end the plastics crisis here in Lamu. Time and time again we see firsthand the terrible – and preventable - suffering caused to donkeys who have ingested plastics. This study provides hard evidence of the true scale of the problem and its widespread impact. Together with our partners we will not rest until we have a joined-up solution to create a safer environment for all."

Dr Sing'Oei has been invited to present a paper called, "Plastics and One Health in Agrifood Systems: Understanding and Managing Risks" during a special Food and Agricultural Organisation (FAO) event (18-21 Nov) at its headquarters in Rome, Italy.

Leanne Proops, Professor in Animal Behaviour and Welfare at The University of Portsmouth, said: "This study demonstrates the interconnectedness of animal, human and environmental health. Pollution is placing severe pressure on the environment, harming donkeys and other livestock, which in turn affects human health and livelihoods. Here we have clear evidence that microplastics are present across an entire animal population which has serious implications for the whole ecosystem. This problem extends far beyond Lamu -underscoring the urgent need for a holistic approach to mitigate the global plastic crisis."

This first of its kind, peer-reviewed research demonstrates how deeply plastic pollution affects animals, people, and ecosystems - and highlights the urgent need for coordinated global and local action.

Technology Networks, 20 November 2025

https://technologynetworks.com

## 'Chocolate-flavored' honey created using cocoa bean shells

*2025-11-19*

A group of researchers from the State University of Campinas (UNICAMP) in the state of São Paulo, Brazil, developed a product made from native bee honey and cocoa bean shells that can be consumed directly or used as an ingredient in food and cosmetics. The results were published in the journal ACS Sustainable Chemistry & Engineering, which featured the study on its cover.

The researchers used native bee honey as an edible solvent to extract stimulants such as theobromine and caffeine, which are associated with heart health, from cocoa bean shells. These shells are usually discarded during the production of chocolate and other cocoa derivatives. The ultrasound-assisted extraction process also enriched the honey with phenolic compounds, which have antioxidant and anti-inflammatory properties.

The researchers who tasted it say that, depending on the ratio of honey to shells, it has a strong chocolate flavor, although they are still planning tests on the product's taste and other sensory properties.

"Of course, the biggest appeal to the public is the flavor, but our analyses have shown that it has a number of bioactive compounds that make it quite interesting from a nutritional and cosmetic point of view," says Felipe Sanchez Bragagnolo, the first author of the study, which he conducted during his postdoctoral research at the Faculty of Applied Sciences (FCA) at UNICAMP in Limeira.

In partnership with INOVA UNICAMP, the university's innovation agency, the authors are looking for a partner interested in licensing the patented process and bringing the product to market.

**Promoting biodiversity**

In addition to promoting the sustainable use of local biodiversity, honey from native bees was chosen for its greater potential as a solvent because it generally has higher water content and lower viscosity than honey from European bees (Apis mellifera).

Honey from five species found in Brazil was tested: borá (Tetragona clavipes), jataí (Tetragonisca angustula), mandaçaia (Melipona quadrifasciata), mandaguari (Scaptotrigona postica), and moça-branca (Frieseomelitta varia). The cocoa shells were provided by the São Paulo



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State Department of Agriculture and Supply's Comprehensive Technical Assistance Coordination Office (CATI) unit in São José do Rio Preto.

Mandaguari honey was initially chosen for process optimization due to its intermediate water and viscosity values. However, the optimized process was later used for the other honeys analyzed.

Bragagnolo points out that honey is highly susceptible to external influences, such as climate, storage conditions, and temperature. "Therefore, it's possible to adapt the process to locally available honey, not necessarily mandaguari honey," he says.

**Green chemistry**

Ultrasound-assisted extraction involves placing a probe, visually similar to a metal pen, inside a pot containing honey and shells. The probe uses sound waves to enhance the extraction of compounds from the shells, which then migrate to the solvent—in this case, honey.

This method is efficient because it creates microbubbles that implode and temporarily increase the temperature to break down the plant material. This technique is considered environmentally friendly in the food industry because it is faster and more efficient than other methods.

This was one of the positive points in another assessment included in the study, which measured the product's sustainability. The Path2Green software was used. It was developed by a group led by Professor Mauricio Ariel Rostagno from FCA-UNICAMP, who is also Bragagnolo's postdoctoral supervisor and coordinator of the study.

The tool verified compliance with 12 principles of green chemistry, such as transportation, post-treatment, purification, and application. Using an edible, local, ready-to-use solvent was one of the most important factors. On a scale of -1 to +1, the product scored +0.118.

"We believe that with a device like this, in a cooperative or small business that already works with both cocoa and native bee honey, it'd be possible to increase the portfolio with a value-added product, including for haute cuisine," Rostagno suggests.

The researchers are preparing new studies to evaluate the effect of ultrasound on honey microbiology. As with plant material, the method breaks down the cell walls of microorganisms, such as bacteria, that can degrade the product.

"Honey from native bees usually needs to be refrigerated, matured, dehumidified, or pasteurized, unlike honey from European bees, which can be stored at room temperature. We suspect that, simply by being exposed to ultrasound, the microorganisms contained in the honey are eliminated, increasing the stability and shelf life of the product," he explains.

In the future, they will test other applications using honey from native bees as a solvent for ultrasound-assisted extraction, such as processing other plant residues.

Phys Org, 19 November 2025

https://phys.org

## Oldest Chemical Evidence of Life on Earth Found Inside 3.3 Billion Year Old Rocks

*2025-11-18*

Scientists at the Carnegie Institution for Science used a powerful combination of cutting-edge chemistry and artificial intelligence to peer through the geological fog of time in search of the very first signs of life. They found the earliest and most confident chemical evidence of life on Earth from 3.33-billion-year-old sediments inside ancient rocks from South Africa. This evidence includes fragmentary traces of carbon.

The new findings essentially double the window of time that organic molecules preserved in rocks can offer useful information about early life. Before this study, no such molecular traces had been reliably found in rocks older than about 1.7 billion years.

The researchers also identified a stunningly early sign of photosynthesis inside rocks from South Africa and Canada, roughly 2.5 billion years old. It pushed back the chemical record of this world-changing process by over 800 million years.

**The Challenge of Finding Ancient Life**

Tracing back life's earliest steps requires thinking outside the box. Primitive, microscopic organisms don't fossilize like dinosaur bones and ancient Earth looked radically different than today. About three billion years ago, Earth as dominated by intense volcanic activity, making it a fiery and hellish landscape with molten magma, lava rivers, and thick plumes of volcanic gases like carbon dioxide and methane.



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The first creatures have long been buried, crushed, heated, and fractured within Earth's crust, nearly obliterating the vital clues to the origins of life — but not entirely.

While the vast majority of carbon-rich sediments have been altered to the point where even the hardiest organic molecules are broken down into small, generic fragments, modern tools may still piece together a convincing picture from these ancient carbon fragments.

Carnegie researchers Robert Hazen, Michael Wong, and Anirudh Prabhu, had a different idea from other studies. Their hypothesis is that life's molecules are rigorously selected for their biological functions, meaning they don't appear in random distributions like those found in meteorites. Even when the original, intact biomolecules are gone, the fragments they leave behind might still preserve a chemical pattern unique to life.

**Finding Life's Pattern**

"Think of it like showing thousands of jigsaw puzzle pieces to a computer and asking whether the original scene was a flower or a meteorite," Hazen explained in a press release. He added, "Rather than focus on individual molecules, we looked for chemical patterns, and those patterns could be true elsewhere in the universe."

To test this, the scientists analyzed over 400 samples. This massive sample set included modern plants, animals, fungi, fossil materials like coal, carbon-rich meteorites, synthetic organic materials, and ancient sediments. Using sophisticated spectrometry, they released the trapped chemical fragments from each sample. They then fed this data to a specific machine learning model called random forest. They then trained the model to recognize the chemical "fingerprints" left behind by biological processes.

This powerful combination proved incredibly accurate. The model could distinguish between materials of biological origin and non-living origins (like meteoritic or synthetic carbon) with over 90 percent accuracy. In fact, on known samples, it achieved up to 98 percent accuracy.

"Our results show that ancient life leaves behind more than fossils; it leaves chemical 'echoes,'" Hazen said. "Using machine learning, we can now reliably interpret these echoes for the first time."

**A New Timeline for Photosynthesis**

The machine learning tool didn't stop at finding the earliest chemical signs of life. It also provided molecular evidence of one of life's most transformative evolutionary achievements: oxygen-producing photosynthesis. This is the process used by plants, algae, and many microorganisms to harness sunlight for energy.

The model was able to detect the unique chemical patterns associated with photosynthetic life with 93 percent accuracy. Using this capability, the team identified these signatures in rocks as old as 2.52 billion years from South Africa's Gamohaan Formation, and also in 2.3-billion-year-old rocks from Canada. This finding dramatically extends the known chemical record of photosynthesis preserved in carbon molecules by more than 800 million years.

"Understanding when photosynthesis emerged helps explain how Earth's atmosphere became oxygen-rich, a key milestone that allowed complex life, including humans, to evolve," noted astrobiologist Wong.

The fact that the model could successfully extract this kind of information from "messy, degraded chemical data" opens up exciting new possibilities. If AI can reliably detect these molecular "ghosts" that survived billions of years of Earth's turmoil, the same technique could be adapt to air in the search for extraterrestrial life. For instance, the method could be applied to Martian rocks or samples from Jupiter's icy moon Europa. To this aim, the researchers plan to refine their models, perhaps even testing them on anoxygenic photosynthetic bacteria as possible analogs for organisms beyond Earth.

The findings appeared in the Proceedings of the National Academy of Sciences.

ZME Science, 18 November 2025

https://zmescience.com

## Everyday Microplastics Exposure Linked to Atherosclerosis in Males

*2025-11-19*

A mouse study led by University of California, Riverside biomedical scientists suggests that everyday exposure to microplastics — tiny fragments shed from packaging, clothing, and countless plastic products — may accelerate the development of atherosclerosis, the



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artery-clogging process that leads to heart attacks and strokes. The harmful effects were seen only in male mice, offering new clues about how microplastics may affect cardiovascular health in humans.

"Our findings fit into a broader pattern seen in cardiovascular research, where males and females often respond differently," said lead researcher Changcheng Zhou, a professor of biomedical sciences in the UCR School of Medicine. "Although the precise mechanism isn't yet known, factors like sex chromosomes and hormones, particularly the protective effects of estrogen, may play a role."

Microplastics are now found nearly everywhere: in food, water, the air, and even inside the human body. Recent human studies have detected microplastics in atherosclerotic plaques and linked higher levels to increased risk of cardiovascular disease. However, scientists didn't understand whether or how microplastics directly contribute to artery damage.

"It's nearly impossible to avoid microplastics completely," Zhou said. "Still, the best strategy is to reduce exposure by limiting plastic use in food and water containers, reducing single-use plastics, and avoiding highly-processed foods. There are currently no effective ways to remove microplastics from the body, so minimizing exposure and maintaining overall cardiovascular health — through diet, exercise, and managing risk factors — remains essential."

In a paper published in Environment International, Zhou and his team report their use of a well-established mouse model for studying heart disease: LDLR-deficient mice, which are prone to developing atherosclerosis. They fed both male and female mice a low-fat, low-cholesterol diet, similar to a lean, healthy person's diet.

The researchers then gave the mice a daily dose of microplastics (10 milligrams per kilogram of body weight) for nine weeks at levels considered environmentally relevant and similar to what humans may encounter through contaminated food and water.

The researchers found microplastics dramatically worsened atherosclerosis, but only in males. In male mice, microplastic exposure increased plaque buildup by 63% in the aortic root, the first section of the aorta that attaches to the heart; and 624% in the brachiocephalic artery, a blood vessel that branches off the aorta in the upper chest. In female mice, the same exposure did not significantly worsen plaque formation.

The study found microplastics did not make the mice obese or raise their cholesterol. The mice remained lean, and their blood lipid levels did not change, meaning the increased artery damage was not due to traditional risk factors like weight gain or high cholesterol.

The study also found microplastics altered key cells that line the arteries. Using single-cell RNA sequencing, a technology that helps identify which genes are expressed in each cell and at what level, the team found that microplastics disrupted the activity and proportions of several types of cells involved in atherosclerosis, especially endothelial cells — the cells that line blood vessels and regulate inflammation and blood flow.

"We found endothelial cells were the most affected by microplastic exposure," Zhou said. "Since endothelial cells are the first to encounter circulating microplastics, their dysfunction can initiate inflammation and plaque formation."

In the team's experiments, fluorescent microplastics were found to enter plaques and localize within the endothelial layer — findings consistent with recent human studies showing microplastics in arterial lesions.

Another finding the researchers report from their experiments is that microplastics triggered harmful gene activity in both mouse and human endothelial cells. Exposure to microplastics was found to activate pro-atherogenic (plaque-promoting) genes in endothelial cells from mice and humans, suggesting a shared biological response.

"Our study provides some of the strongest evidence so far that microplastics may directly contribute to cardiovascular disease, not just correlate with it," Zhou said. "The surprising sex-specific effect — harming males but not females — could help researchers uncover protective factors or mechanisms that differ between men and women."

Zhou and his team acknowledge that more research is needed to understand why males are more vulnerable. The researchers plan to perform studies to determine if similar effects occur in humans.

"We would like to investigate how different types or sizes of microplastics affect vascular cells," Zhou said. "We will also look into the molecular mechanisms behind endothelial dysfunction and explore how microplastics affect male and female arteries differently. As microplastic pollution continues to rise worldwide, understanding its impacts on human health — including heart disease — is becoming more urgent than ever."



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Zhou was joined in the study by colleagues at UCR, Boston Children's Hospital and Harvard Medical School in Massachusetts, and the University of New Mexico Health Sciences.

The study was partially supported by grants from the National Institutes of Health.

Technology Networks, 19 November 2025

https://technologynetworks.com

## A new way to look 'inside' water's microscopic structure

*2025-11-19*

Water is essential for all chemistry and life, yet understanding how it interacts with dissolved ions—such as sodium and magnesium—has long been a major scientific challenge.

Now, an international research team led by Uppsala University, which featured Zhong Yin, an associate professor at Tohoku University's SRIS, has developed a X-ray technique that can directly probe the electronic structure of the solvation shell, the first layer of water molecules surrounding an ion in solution.

The study, published in Nature Communications, reports the first observation of a process called intermolecular radiative decay (IRD) in liquids.

In this phenomenon, when an ion in water is ionized by X-rays, an electron from a nearby water molecule fills the ion's inner-shell vacancy, and the released energy is emitted as an X-ray photon. This emitted photon carries a distinct fingerprint of the ion's immediate environment—allowing researchers, in effect, to probe the solvation shell "from within."

"The solvation shell determines how ions behave in water, influencing everything from biological function to corrosion and battery chemistry," says lead author Johan Söderström. "Our discovery shows that X-rays can now be used to directly reveal the electronic structure of this critical interfacial region."

Using synchrotron radiation at the MAX IV Laboratory in Lund, Sweden, the team investigated aqueous solutions of sodium and magnesium ions. By analyzing the emitted X-ray photons, they identified distinct spectral signatures originating from neighboring water molecules—clear evidence of the newly discovered IRD process.

Theoretical modeling further confirmed that IRD arises from subtle orbital hybridization between the ion and surrounding water molecules. Remarkably, the process is sensitive only to the first solvation shell, making IRD a uniquely selective probe of local chemical environments in liquids.

"This is the radiative cousin of the well-known intermolecular coulombic decay," explains senior author Olle Björneholm. "But unlike electron-based methods, IRD emits X-rays that can escape from deep within the liquid, enabling us to explore the bulk properties of the solution."

"ICD is a well-known non-local decay channel and a prominent source of slow electrons, which are particularly interesting because of their ability to induce DNA strand breaks. We were wondering whether an analogous process might exist for photons," says Zhong Yin.

Beyond sodium and magnesium, the researchers have also shown that IRD is observable in other systems, including transition metal ions and anions, suggesting that the phenomenon is general—and potentially transformative for the study of aqueous and biological chemistry.

This discovery paves the way for element- and site-specific studies of solvation structure, chemical bonding, and ultrafast dynamics in liquids using advanced synchrotron and free-electron laser sources.

Phys Org, 19 November 2025

https://phys.org

## How superheavy chemistry could rearrange the periodic table

*2025-08-08*

Researchers have directly observed the heaviest atom yet participating in a chemical reaction and forming a molecule. The finding pushes "superheavy" chemistry, which involves extremely massive radioactive elements, to a new level – and could even lead to a rearrangement of the periodic table.

Some exotic chemical elements are hard to experiment with, which makes it difficult to determine their proper placement within the periodic table. For instance, the radioactive element copernicium is placed among a group called the transition metals, but it behaves more like noble gases, which belong in a different section.



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This problem may affect elements at the table's very bottom too, heavy and radioactive atoms called actinides, says Jennifer Pore at the Lawrence Berkeley National Laboratory in California. To check the properties of actinides, she and her colleagues carried out a chemical reaction that created a molecule containing the heaviest actinide, nobelium, which is element 102.

To make the element, the researchers used a particle accelerator that smashed a beam of very energetic calcium atoms into a chunk of lead. Nobelium atoms emerged in the aftermath of this collision and reacted with nitrogen and water molecules in the air. A fast-acting detector, similar to a particle-sensing machine called a mass spectrometer, then identified the resulting molecules more precisely than in any past attempt to do superheavy chemistry.

Next, the team re-ran their experiment with a chunk of thulium instead of lead. This created an actinide called actinium, which is element 89. By comparing how easy it was for water to stick to actinium versus nobelium, the researchers confirmed that the two elements behave similarly enough to belong in the same row of the periodic table.

Nobelium is not only properly placed on the periodic table; it has also become the heaviest element that researchers have directly observed forming a new molecule – although the heaviest element ever created is still oganesson, element 118. And the procedure used to create molecules that contain nobelium, then precisely identify them, could lead to new breakthroughs.

Sophia Heinz at GSI Helmholtz Centre for Heavy Ion Research in Germany says the new experiment is a real technical advance for superheavy chemistry. Molecules containing elements heavier than nobelium had been made before, but researchers could never directly identify them, she says. "The possibility to directly study single molecules is an important step forward."

Peter Schwerdtfeger at Massey University in New Zealand says that the new experiment "opens the door to many more future experiments with different superheavies".

Even before any new experiments are done, the findings are making an impact. Pore and her team thought that they would have to add extra molecules into the experiment for actinium and nobelium to react with. Unexpectedly, however, the superheavies reacted with substances that were already present: nitrogen and water in the air. Anastasia Borschevsky

at the University of Groningen in the Netherlands says this may force scientists to re-examine previous superheavy experiments in which researchers assumed that they were looking at atoms – because they may have also been observing molecules that contained those atoms. "This will keep us theoreticians busy for a while," says Schwerdtfeger.

For Pore, the next challenge is doing chemistry with even heavier elements, such as dubnium, which is element 105. To do so, the team may have to speed up their procedure because the heavier elements get, the less time they spend in a stable state before decaying into a different element.

"If things go well, we want to do the bigger guys at the end [of the periodic table]. We don't have any [heaviness] limits with this technique," says Pore. And unlike nobelium, some of those bigger elements might end up needing to find new places on the periodic table.

New Scientist, 8 August 2025

https://newscientist.com

## New Microwave Technique Could Turn CO2 Into Fuel Far More Efficiently

*2025-11-19*

A new method uses microwaves to lower the energy required for certain industrial processes.

Some industrial chemical production processes depend on heat, but traditional heating methods are often wasteful because they warm large areas that do not actually need it. A research team including scientists from the University of Tokyo developed a method to focus heat only where it is needed.

Their approach uses microwaves, similar to those in a household microwave oven, to excite specific elements within the target materials. The new system achieved energy efficiencies about 4.5 times higher than conventional techniques.

**A green transformation approach to industrial chemistry**

Although climate change involves more than just energy production and carbon dioxide (CO2), lowering energy demand and emissions remains a key challenge for science and engineering. Under the broader goal of green transformation, Lecturer Fuminao Kishimoto and his colleagues



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in the Department of Chemical System Engineering at the University of Tokyo are developing cleaner, more efficient industrial methods.

Their latest work could improve processes used in chemical synthesis and may lead to other environmental benefits. The basic idea behind their innovation is surprisingly simple.

"In most cases, chemical reactions occur only at very small, localized regions involving just a few atoms or molecules. This means that even within a large chemical reactor, only limited parts truly require energy input for the reaction," said Kishimoto. "However, conventional heating methods, such as combustion or hot fluids, disperse thermal energy throughout the entire reactor. We started this research with the idea that microwaves could concentrate energy on a single atomic active site, a little like how a microwave oven heats food."

**How it works: tuning microwaves for precision heating**

As Kishimoto explained, the concept resembles that of a microwave oven but operates under different conditions. Instead of targeting polar water molecules at roughly 2.45 gigahertz (a frequency also used by many Wi-Fi signals, which explains why internet connections can sometimes falter when reheating food), the researchers tuned their microwaves to about 900 megahertz. This lower frequency proved optimal for exciting the material they were studying—zeolite—a porous substance that can efficiently absorb and transfer heat.

"The most challenging aspect was proving that only a single atomic active site was being heated by the microwaves. To achieve this, we spent four years developing a specialized experimental environment at Japan's world-class large synchrotron radiation facility, SPring-8," said Kishimoto.

"This involved using spongelike zeolite, which is ideal because we can control the sizes of the sponge cavities, allowing us to balance different factors of the reactions. Inside the sponge cavities, indium ions act like antennas. These are excited by the microwaves which creates heat, which can then be transferred to reaction materials passing through the sponge."

**Applications in fuel creation and carbon recycling**

By selectively delivering heat to specific materials, lower overall temperatures can be used to achieve reactions which are otherwise very demanding, such as water decomposition or methane conversion, both useful to create fuel products. They can further improve selectivity by

varying the pore size of the zeolite sponge, with smaller pores yielding greater efficiency and larger pores enabling greater control over reactions.

And one key advantage is that this technique can even be used in carbon capture, recycling CO2 as part of the methane conversion, and even recycling plastics more easily.

The challenge now will be in how to scale this up to encourage industrial adoption — things that work in the lab don't directly translate into large industrial settings easily. And there are some limitations to the research that would also need to be addressed first.

The material requirements are quite complex and aren't simple or cheap to produce; it's hard to precisely measure temperatures at the atomic scale, so current data rely on indirect evidence, and more direct means would be preferred. And, despite the improvements in efficiency, there is still room for improvement here too as there are heat and electrical losses along the way.

"We aim to expand this concept to other important chemical reactions beyond CO2 conversion and to further optimize catalyst design to improve durability and scalability. The technology is still at the laboratory stage. Scaling up will require further development of catalysts, reactor design and integration with renewable power sources," said Kishimoto.

"While it is difficult to give an exact timeline, we expect pilot-scale demonstrations within the next decade, with broader industrial adoption depending on progress in both technology and energy infrastructure. To achieve this, we are seeking corporate partners to engage in joint development."

Sci Tech Daily, 19 November 2025

https://scitechdaily.com

## Scientists observe metabolic activity of individual lipid droplets in real time

*2025-11-19*

A research team has developed a fluorescent probe that allows scientists to visualize how individual lipid droplets break down inside living cells in real time. The probe changes its fluorescence properties depending on the chemical composition of each droplet, which allows researchers to observe not only their location within cells, but also their metabolic activity during lipid breakdown.



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The findings, published in the Journal of the American Chemical Society, may contribute to the development of new strategies to treat metabolic diseases such as obesity and diabetes, as well as cancers associated with abnormal lipid metabolism.

"Lipid droplets are cellular organelles that not only store excess lipids but also play critical roles in lipid metabolism. However, understanding how individual droplets function has been challenging," Professor Shigehiro Yamaguchi, from the Institute of Transformative Bio-Molecules (ITbM) at Nagoya University, explained.

"Traditional methods require destroying cells and can only measure the average behavior across many droplets. This approach misses important differences and leaves key questions about how cells regulate their energy reserves unanswered. Our organic fluorescent probe LipiPB Red fills this gap, allowing us to observe functional differences among individual droplets for the first time."

**ATGL enzyme drives varied lipid droplet breakdown rates in liver cancer cells**

The fluorescence lifetime of LipiPB Red—how long it continues to emit light after absorbing light energy—depends on the type of lipid molecule inside each droplet. When triglycerides (the main storage form of neutral lipids) are the major component, the probe shows longer fluorescence lifetimes.

As they are enzymatically degraded into diglycerides (partially hydrolyzed forms of triglycerides), the fluorescence lifetime becomes shorter. By monitoring these changes, the researchers could identify which lipid droplets were actively breaking down.

Using LipiPB Red, the team observed that lipid droplets in liver cancer cells break down at markedly different rates, even within the same cell, a phenomenon not seen in other cell types. Scientists had assumed that all droplets within a cell would behave similarly, which was true for other cell types. Further experiments revealed that an enzyme called ATGL (adipose triglyceride lipase) is responsible for these differences.

"ATGL is already known to be important for converting triglycerides to diglycerides during lipid droplet breakdown, but we found that its activity differs dramatically among individual droplets within the same cell," said Professor Masayasu Taki from the Institute for Glyco-core Research (iGCORE), Gifu University.

"When ATGL was inhibited, the differences disappeared, confirming its central role. These findings indicate that liver cancer cells metabolize lipids in a uniquely heterogeneous manner, which may be linked to their abnormal energy regulation."

**Direct visualization of step-by-step lipid degradation**

The team also achieved the first direct visualization of the sequential lipid breakdown process in real time. They observed that lipid droplets are first degraded enzymatically through lipolysis, followed by further breakdown via autophagic pathways (lipophagy). Although how lipid droplet breakdown is regulated remains controversial, LipiPB Red allows direct observation of the process within living cells.

LipiPB Red also provides a powerful new tool to study fundamental questions about cellular energy regulation and could reveal how cells make decisions about when and how to access their energy reserves during stress, exercise, or disease.

"We can now study how different treatments or conditions affect cellular lipid metabolism at a level of detail that was not possible before. This technology will advance our understanding of lipid metabolism and could help develop new therapeutic approaches for metabolic disorders and cancer," Professor Taki said.

Phys Org, 19 November 2025

https://phys.org

## New Catalyst Design Solves a Decades-Old Chemical Challenge

*2025-11-19*

Researchers have created an iron-based catalyst that controls methane's extreme reactivity, opening the door for natural gas to serve as a sustainable feedstock for high-value chemicals, including pharmaceuticals.

Natural gas, one of the most plentiful energy resources on Earth, consists mainly of methane, ethane, and propane. Although it is commonly burned for power and contributes to greenhouse gas emissions, researchers have long looked for ways to convert these stable hydrocarbons into useful chemicals instead. Their low reactivity has made this goal difficult, limiting natural gas as a sustainable starting point for chemical manufacturing.



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A research group led by Martín Fañanás at the Centre for Research in Biological Chemistry and Molecular Materials (CiQUS) at the University of Santiago de Compostela has now introduced a method that overcomes this barrier. Their approach converts methane and other components of natural gas into flexible chemical "building blocks" that can be used to create high-value products, including pharmaceuticals. The work, published in Science Advances, marks an important step toward a more efficient and environmentally responsible chemical industry.

In a key demonstration, the CiQUS team produced the bioactive compound dimestrol, a non-steroidal estrogen used in hormone therapy, directly from methane. This milestone shows how their technique can generate complex and valuable molecules from a simple and inexpensive resource.

**Taming Free Radicals to Unlock New Chemical Pathways**

The researchers focused their approach on a reaction known as allylation, which adds a small chemical "handle" (an allyl group) to the gas molecule. This added group acts as a flexible anchor that allows many different products to be built in later steps, including pharmaceutical ingredients and common industrial chemicals. Until now, a major obstacle was that the catalytic system often generated unwanted chlorinated byproducts, which disrupted the entire process.

To overcome this obstacle, the team engineered a tailor-made supramolecular catalyst. "The core of this breakthrough lies in designing a catalyst based on a tetrachloroferrate anion stabilized by collidinium cations, which effectively modulates the reactivity of the radical species generated in the reaction medium," explains Prof. Fañanás. "The formation of an intricate network of hydrogen bonds around the iron atom sustains the photocatalytic reactivity required to activate the alkane, while simultaneously suppressing the catalyst's tendency to undergo competing chlorination reactions. This creates an optimal environment for the selective allylation reaction to proceed."

Beyond its effectiveness, the method stands out for its sustainability. It uses iron—a cheap, abundant, and far less toxic metal than the precious metals typically used in catalysis—and operates under mild temperature and pressure conditions, powered by LED light. This significantly reduces both environmental impact and energy costs.

This work is part of a broader research line funded by the European Research Council (ERC), focused on upgrading the main components

of natural gas. In a complementary advance published in Cell Reports Physical Science, the same team presented a method to directly couple these gases with acid chlorides, yielding industrially relevant ketones in a single step. Both studies, based on photocatalytic strategies, position CiQUS as a leader in developing innovative chemical solutions to harness abundant raw materials.

**Transforming Natural Gas into Versatile Chemical Intermediates**

The ability to convert natural gas into versatile chemical intermediates opens up new possibilities for industry, laying the foundation to gradually replace petrochemical sources with more sustainable alternatives.

Sci Tech Daily, 19 November 2025

https://scitechdaily.com

## Nearly 47 million Americans live near hidden fossil fuel sites

*2025-11-20*

Fossil fuels pollute the air when they are extracted and when they are burned, but the steps between those two points involve far more than familiar scenes of drilling equipment and smoke-filled power plants. These visible operations represent only the beginning and end of a five-stage process that brings fossil fuels from the ground to their final use.

Oil and gas move through several additional stages before reaching power facilities. They are refined to remove unwanted materials, stored in specialized facilities, and transported across the country. These activities form a vast mid-supply chain network that stretches across the United States and often operates out of public view.

**Millions Live Near Fossil Fuel Infrastructure**

A new analysis led by Boston University researchers provides the first nationwide estimate of how many people live close to this infrastructure. Published in Environmental Research Letters, the study finds that 46.6 million people in the contiguous United States live within 1.6 km (roughly a mile) of at least one component of the fossil fuel supply chain. This accounts for 14.1% of the population.

Previous studies have shown that communities near extraction sites and end-use facilities experience higher rates of adverse birth outcomes and asthma, and there is growing interest in potential links to other conditions,



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including leukemia. However, the health effects of living near facilities in the middle of the supply chain remain far less understood. Some sites in these stages have been found to emit volatile organic compounds and other harmful pollutants.

"This study helps us get a general size of the potential problem, and really starts the process of doing a better job of understanding exactly what the hazards are and how many people are potentially exposed," said Jonathan Buonocore, the paper's first author, an assistant professor of environmental health at BU's School of Public Health (SPH), and core faculty at BU's Institute for Global Sustainability (IGS). "Especially for these more obscure pieces of energy infrastructure, this is the first step to tracking what emissions and stressors those are imposing on the communities."

**Where Americans Live Along the Energy Supply Chain**

The researchers also examined how exposure varies across different types of infrastructure. Nearly 21 million Americans live near end-use facilities such as power plants. More than 20 million live within a mile of extraction sites, including oil and gas wells. Storage locations, which include peak shaving facilities, underground gas storage sites, and petroleum product terminals, have over 6 million nearby residents. Fewer people reside near refining or transportation facilities. About 9 million people live close to multiple infrastructure types, meaning they are counted in more than one category.

"There is reason to believe that there could be air pollution coming from each of these stages, from consistent pollution, gas leaks, or blowouts, when gas or oil flows from a well uncontrollably," said Mary Willis, the study's senior author, an assistant professor of epidemiology at SPH, and core faculty at IGS. "All of these stages can reasonably impact a range of population health outcomes, yet the basic information of who is even near the infrastructure components has not been examined to date."

**Environmental Inequities and Urban Concentration**

The study highlights clear disparities in where fossil fuel infrastructure is located. Communities that are predominantly non-white experience higher exposure across all stages of the supply chain, reinforcing findings from previous environmental justice research.

The analysis also shows that proximity is far more common in urban areas. Almost 90% of the people living near end-use, transportation, refining, and storage sites are located in cities.

Looking at individual infrastructure types revealed trends that could guide future policy. A single piece of storage infrastructure has, on average, 2,900 residents living within a mile, while an extraction site typically has only 17. This reflects the fact that extraction sites are more numerous but located in less populated regions, whereas storage facilities are fewer in number but tend to be placed in densely populated areas.

"That means that if a local policymaker in an urban area were to take interest in reducing exposures, they may receive the most impact per piece of infrastructure if they focus on storage," Buonocore said.

**A New National Database Makes This Research Possible**

This study is the first to use the Energy Infrastructure Exposure Intensity and Equity Indices (EI3) Database for Public Health, introduced by Buonocore and Willis in spring 2024 at the Power & People Symposium. The research team also included Fintan Mooney, Erin Campbell, Brian Sousa, Breanna van Loenen, Patricia Fabian, and Amruta Nori-Sarma.

Before EI3, information on fossil fuel infrastructure was scattered across local, state, and federal databases, and some data sources required payment or special access. With support from an IGS Sustainability Research Grant jointly funded by IGS and SPH, the team combined available data into a single national resource. Their dataset is hosted on Harvard Dataverse. The grant also helped launch the SPH Energy and Health Lab, which Buonocore and Willis co-direct.

"The study really shows that there are big knowledge gaps across the supply chain, in terms of the hazards people are being exposed to, the consequent health impacts, and who is being exposed," Buonocore said. "With a lot of these different types of infrastructure, the hazards have not been fully characterized. Characterizing hazards and understanding who is most heavily exposed should be the first steps of understanding the possible health impacts. This research takes the first steps down that path."

**Looking Ahead to Better Policies and Future Research**

Although some states and municipalities regulate where fossil fuel operations can take place, many areas still allow infrastructure to be located very close to homes and schools. The team hopes their work will lead to more studies that can support informed policymaking and



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improve public health. Future research may include detailed monitoring of air, water, noise, and light pollution near facilities, and investigations using new datasets such as Medicaid records or information on specific groups like pregnancy planners.

"We're really the first group thinking about this as an integrated system. By quantifying all of these factors at once, we're potentially able to, down the line, directly compare: what are the health effects of living near an extraction site, compared to living near a storage site?" Willis said. "Having that in one database is the first step to doing any health studies in the future on this integrated system."

Science Daily, 20 November 2025

https://sciencedaily.com

## Graphene-boosted plastic makes auto parts 20% stronger, 18% lighter

*2025-11-18*

Glass-filled polypropylene is already a very commonly used plastic for automotive parts, but could it be improved? Well, yes. A new substance, Gratek, is claimed to make the plastic 20% stronger yet 18% lighter, thanks to the addition of graphene.

Widely hailed as a "wonder material," graphene takes the form of one-atom-thick sheets of carbon atoms linked to one another in a honeycomb pattern. Along with being the world's strongest human-made substance, it's also very flexible, stretchable and chemically stable, plus it exhibits high electrical and thermal conductivity.

It's no wonder, then, that Nello David Sansone – a post-doctoral researcher working in the University of Toronto's Multifunctional Composites Manufacturing Laboratory – began investigating methods of integrating graphene nanoplatelets into glass-filled polypropylene. He ultimately developed a technique for doing so while working at auto parts manufacturer Axiom Group, in a partnership with the university.

In previous groups' attempts to incorporate graphene into automotive components, the material had a tendency to cluster during processing, thus concentrating mechanical stress in unwanted areas and leading to failure.

Sansone got around this problem via a proprietary technique which causes the nanoplatelets to bond only to the glass fibers within the

polypropylene matrix, keeping them from clumping. Because the graphene strengthens the fibers, fewer of them need to be used, thus Gratek is approximately 20% stronger and 18% lighter than regular glass-filled polypropylene.

And it should be noted, the material is less than 1% graphene overall. Plus as an added bonus, due to the lower glass content in the plastic, it causes less wear and tear on the machines that are cutting and drilling it.

One potential limiting factor to Gratek is the fact that, because of the graphene in it, it's limited to being black in color. With that drawback in mind, Sansone has developed another material, Clatek, which utilizes clay-based halloysite nanotubes in place of the graphene nanoplatelets. It reportedly offers performance similar to that of Gratek, but it's white in color and can be dyed and painted.

Gratek is expected to be contracted to a major automobile manufacturer before the end of this year, while Clatek is expected to be commercially available within two years.

"It has shown real potential to make vehicles lighter, safer, and more sustainable," Sansone told us. "As for what's next for me, I'm now working on commercializing another advanced material formulation, known as AegisX, through my start-up NanoMorphix, where we're developing transparent and textile armor for military, defense, aerospace, and personal protection."

Sansone was recently the recipient of an award from Mitacs, a government-funded non-profit organization that seeks to foster technical innovation in Canada. Past recipients have developed technologies such as a towable crop-waste-to-biofuel converter, a computer-vision-based flight recorder, an augmented reality feedback system for athletes and a screw-drive amphibious robot.

New Atlas, 18 November 2025

https://newatlas.com





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