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ASIA PACIFIC

China Labor Compliance in Hot Weather: What Foreign Companies Need to Know

2025-07-09

China labor compliance amid extreme heat is a growing concern for foreign-invested enterprises. As temperatures rise across the country, so does regulatory scrutiny. This guide outlines key legal obligations, local policy variations, and practical recommendations to help foreign-invested enterprises (FIEs) manage heat-related labor risks while aligning with global standards.

During China's peak summer months, prolonged heat waves across many regions pose serious health risks to outdoor and high-temperature workplace employees. For FIEs operating in China, ensuring compliance with local heat-related labor protection regulations—while aligning with global management standards and maintaining a positive employee experience—has become a critical compliance and operational challenge.

China's regulatory approach to labor protections during extreme heat is becoming increasingly stringent, combining mandatory national rules with region-specific flexibility. Foreign companies unfamiliar with local nuances—such as the requirement to provide high-temperature allowances or differing regional standards—risk labor inspection penalties and potential disputes with employees.

Read More

China Briefing, 09-07-25

https://www.china-briefing.com/news/china-labor-compliance-extreme-heat-guide/

New airborne contaminants hub now live!

2025-07-08

Work processes in industries like mining, foundry, manufacturing and agriculture can release dusts, gases, fumes, vapours, or mists into the air. These are known as airborne contaminants, and they cannot always be smelled or seen.

Safe Work Australia's new airborne contaminants hubprovides practical information to help employers and workers:

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recognise what airborne contaminants are and how they can impact health

understand their WHS duties and how to manage risks from airborne contaminants, and

learn about workplace exposure limits and what they need to do to prepare for the changes on 1 December 2026.

Visit the new hub for easy-to-use resources, including downloadable infographics, information on what you should be doing in your workplace, and a comparative table of changes coming to workplace exposure limits.

Read More

Safe Work Australia, 08-07-25

https://www.safeworkaustralia.gov.au/safety-topic/managing-health-and-safety/airborne-contaminants

AMERICA

Delaware Enacts Senate Bill No. 72 in Response to Weakened PFAS Federal Regulations

2025-07-10

On June 30, 2025, Delaware legislators unanimously passed regulations that would require water providers in the state to begin testing for per- and polyfluoroalkyl substances (PFAS) next year, one year sooner than federal requirements, and aim to reduce PFAS levels in drinking water to almost zero by 2029. The new regulations come just as the Trump Administration threatens to weaken federal PFAS regulations.

The state's new PFAS regulations are akin to the US Environmental Protection Agency's (EPA) regulations setting maximum contaminant levels (MCLs) for two types of PFAS, specifically PFOA (perfluorooctanoic acid) and PFOS (perfluorooctane sulfonate), to 4 parts per trillion (ppt). Delaware will also require drinking water providers to ensure levels of three other types of PFAS (PFHxs (perfluorohexane sulfonic acid), PFNA (perfluorononanoic acid) and GenX chemicals) do not exceed 10 ppt and set a Hazard Index MCL of 1 for mixtures containing two or more types of PFAS (PFHxS, PFNA, HFPO-DA, or PFBS). Unlike the new Delaware regulations, the EPA's current proposal eliminates restrictions on these types of PFAS in drinking water.

Read More

JD Supra, 10-07-25

https://www.jdsupra.com/legalnews/delaware-enacts-senate-bill-no-72-in-8349693/

Microplastics Proposed for Candidate Chemical Listing in California: Key Considerations for Businesses

2025-07-09

California's Department of Toxic Substances Control (DTSC) proposed adding microplastics as a Candidate Chemical to be regulated under the Safer Consumer Products (SCP) program on June 20, 2025. This action and its subsequent steps – typically reserved for specific chemical compounds, not broad categories like "microplastics" – could provide DTSC with the means to regulate a wide variety of plastic-containing products, including packaging, in an unprecedented way.

If fully implemented, the proposal could have significant and costly impacts on businesses that manufacture or sell plastic-containing products. DTSC's move reinforces California's increasingly significant role in a growing global effort to address plastics and microplastics, with similar regulatory initiatives being taken in Canada, the European Union (EU), and elsewhere in the United States.

Read More

JD Supra, 09-07-25

https://www.jdsupra.com/legalnews/microplastics-proposed-for-candidate-4698069/

FDA Seeks Input on a New Method for Ranking Chemicals in Food for Post-market Assessments

2025-06-18

Today, the U.S. Food and Drug Administration (FDA) released for public comment its proposed method for ranking chemicals in the food supply. This method provides a transparent, systematic, and science-based approach to determine which chemicals the agency would prioritize for post-market assessments through the agency's post-market chemical review program. It will allow the FDA to allocate resources more efficiently, ensuring that the agency focuses on food chemicals that may present

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the greatest potential public health risk, including risk to sensitive populations, and are of high public concern.

Determining if a chemical—either one intentionally added to food or a contaminant that is not intentionally added—needs to be further evaluated based on new information takes a structured and science-based approach to ensure that the FDA's reviews are most protective of the health of consumers. The method released today uses Multi-Criteria Decision Analysis (MCDA) to determine a score for each chemical based on evaluating the information about a chemical against a pre-determined set of criteria. The method is similar in approach and criteria to one that the U.S. Environmental Protection Agency uses for prioritizing chemicals, but the FDA's method takes into account factors specific to exposure from food and uses a scoring method similar to the FDA's Risk Ranking Model for Traceability.

The FDA is committed to radical transparency as the agency develops processes for prioritizing chemicals in food for a post-market assessment. These processes will help to ensure that FDA is taking a risk-informed approach in reviewing data and information about the safety of chemicals in the food supply to protect the health of consumers.

Seeking Public Comments

Stakeholder input is critical to inform the FDA's method and overall approach to post-market assessments of chemicals in the food supply. The FDA encourages the public to comment in docket FDA-2025-N-1733 in response to the questions listed in Section 4 of the method description document. The last day to submit comments on the method is July 18, 2025. After the public comment period closes, the FDA will submit the method and public comments for further evaluation by external scientific experts in line with the requirements of the Information Quality Act.

Read More

US FDA, 18-06-25

https://www.fda.gov/food/hfp-constituent-updates/fda-seeks-input-new-method-ranking-chemicals-food-post-market-assessments

EPA Withdraws Proposed Rule under TSCA for 18 Chemical Substances

2025-07-08

The U.S. Environmental Protection Agency is withdrawing Proposed Significant New Use Rules (SNURs) released in June 2023 for 18 chemicals derived from plastic waste for use in producing products such as transportation fuels. After the proposed rule's publication, EPA received comments, including adverse ones, which encouraged the agency to remand or modify the TSCA section 5(e) Order and SNURs. The proposed SNURs are being withdrawn because the Toxic Substances Control Act (TSCA) Section 5 (e) Order on which they were based was withdrawn on December 18, 2024, in response to litigation. At the time the TSCA section 5(e) Order was withdrawn, manufacture of the 18 chemicals had not commenced.

Further information on this withdrawal can be found at federalregister.gov. To access the docket on July 9, 2025, please visit www.regulations.gov at docket EPA-HQ-OPPT-2023-0245.

Read More

US Regulations.gov, 08-07-25

https://www.regulations.gov/

EUROPE

Denmark orders tender to achieve gas storage target

2025-07-09

The Danish Energy Agency (DEA) has requested the state-run operator of the country's two underground storage facilities, Gas Storage Denmark, to prepare a tender for new deliveries of natural gas for storage during September.

In a statement on Tuesday, the DEA said the tender will be held after the country missed its 1 July European Union interim storage fill target of 60%. At the end of June, Denmark's gas storage facilities were filled to just 33%, the agency said.

According to Gas Infrastructure Europe (GIE) — the association representing European gas infrastructure operators — as of 7 July,

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Denmark held about 320 million cubic metres of gas in storage, with the percentage of storage just over 34% and the lowest among EU members.

"Denmark is currently below the EU targets, and we therefore have an obligation to act. There is gas available on the market, and the planned tender is intended to help ensure that more of this gas is stored in Danish facilities. This will contribute to security of supply throughout the winter," said DEA deputy director general Peter Hansen.

Read More

Upstream, 09-07-25

https://www.upstreamonline.com/energy-security/denmark-orders-tender-to-achieve-gas-storage-target/2-1-1843701

Deposit, drink, return: Lisbon is the first European capital with a citywide reusable cup scheme

2025-07-09

The system could remove thousands of discarded cups from Lisbon's public spaces every night.

Every night, around 25,000 cups are used in Lisbon's entertainment areas. Although many cups are sold as "reusable", until now there was no system in place to ensure the effective collection, cleaning and recirculation of these containers.

Through a new citywide reusable cup system, supported by a local deposit and return model, Lisbon has become the first European capital to implement an initiative that aims to combat plastic waste, reduce emissions and introduce a smart reuse model in the city's restaurant sector and bustling nightlife.

Read More

Euronews, 09-07-25

https://www.euronews.com/green/2025/07/03/deposit-drink-return-lisbon-is-the-first-european-capital-with-a-citywide-reusable-cup-sch

Sustainable products – exemptions to prohibiting the destruction of unsold apparel and footwear

2025-06-30

About this initiative

Summary

EU rules for sustainable products identify the destruction of unsold consumer products as an environmental problem and prohibit the destruction of unsold apparel, clothing accessories and footwear. To ensure the measure is proportionate, they provide exemptions for cases where such products cannot be used and have to be delivered to recycling or other waste treatment plants.

This initiative aims to specify these exemptions.

Topic

Environment

Type of act

Delegated regulation

Expert group

E03969

Feedback period

30 June 2025 - 11 August 2025 (midnight Brussels time)

The Commission would like to hear your views.

This draft act is open for feedback for 6 weeks. Feedback will be taken into account for finalising this initiative. Feedback received will be published on this site and therefore must adhere to the feedback rules.

More about draft acts

Read More

European Commission, 30-06-25

https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14591-Sustainable-products-exemptions-to-prohibiting-the-destruction-of-unsold-apparel-and-footwear_en

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With over 100 new alternatives to PFAS, ChemSec Marketplace becomes key industry resource

2025-06-30

PRESS RELEASE: As global pressure mounts to eliminate harmful PFAS chemicals from products and supply chains, ChemSec announces a major update to its online chemical substitution platform — ChemSec Marketplace.

ChemSec Marketplace now features over 100 new PFAS-free alternatives, including cutting-edge solutions for complex applications in textiles, electronics and food packaging.

"PFAS bans are coming — and the industry knows it," says Dr. Jonatan Kleimark, Head of Corporate Sustainability at ChemSec. "This update delivers ready-to-use safer solutions for companies that want to act now and stay competitive in a rapidly shifting regulatory landscape."

Read More

Chemsec, 30-06-25

https://chemsec.org/with-over-100-new-alternatives-to-pfas-chemsec-marketplace-becomes-key-industry-resource

Plan for stronger EU chemical industry

2025-007-08

The Commission has presented an action plan for the chemicals industry to strengthen the competitiveness and modernisation of this sector.

The action plan addresses key challenges – high energy costs, unfair global competition, and weak demand, while promoting investment in innovation and sustainability. It proposes the following measures

- **Resilience and level playing field:** establishing a Critical Chemical Alliance to address the risks of capacity closures in the sector and applying trade defence measures to ensure fair competition
- **Affordable energy and decarbonisation:** swiftly implementing the Affordable Energy Action Plan to help reduce high energy and feedstock costs
- **Lead markets and innovation:** highlighting fiscal incentives and tax measures to boost demand for clean chemicals
- **Taking action on per- and polyfluoroalkyl substances (PFAS):** minimising PFAS emissions through a robust, science-based restriction,

while ensuring continued use in critical applications under strict conditions where no alternatives are available

The plan is accompanied by a simplification package, the so-called 6th Omnibus, to further streamline and simplify key EU chemicals legislation. This includes simplifying hazardous chemical labelling rules, clarifying EU cosmetics regulations, and easing registration for EU fertilising products. These measures should save at least €363 million annually for the industry.

The EU chemical industry is the 4th largest manufacturing sector, with 29 000 companies providing 1.2 million direct jobs and supporting 19 million across supply chains. The European chemicals industry action plan builds on the Competitiveness Compass and Clean Industrial Deal, while the simplification package delivers on President von der Leyen's commitment to simplify EU laws and cut administrative burdens, helping businesses innovate and grow.

Read More

European Commission, 08-07-25

https://commission.europa.eu/news-and-media/news/plan-stronger-eu-chemical-industry-2025-07-08_en

EU Environment and Climate Ministers test for toxic PFAS 'forever chemicals' in their blood

2025-07-10

In a bold demonstration of political will and concern over chemical pollution, 32 Environment and Climate Ministers have been invited to have their blood tested for PFAS – harmful 'forever chemicals' linked to cancer and other serious health risks – during today's Informal Council Meeting in Aalborg.

The initiative, led by the Danish Ministry of Environment and Gender Equality in partnership with the European Environmental Bureau (EEB) and ChemSec, aims to raise awareness of the growing PFAS pollution crisis affecting citizens and environment across Europe. Blood samples will be analysed for 13 PFAS substances, known for persisting in the environment and accumulating in the human body.

As one of the first actions of Denmark's EU Council Presidency, Environment Minister Magnus Heunicke launched the initiative and invited all EU environment ministers as well as ministers from EFTA-countries and Ukraine to take the PFAS blood test.

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"PFAS accumulates both in the environment and in humans, and once it is present, it is very difficult to deal with. In humans, we know that PFAS can, among other things, cause cancer, and it can also affect aquatic environments and animals. It is crucial that we now take strong action against PFAS pollution, which is why measures must be taken across the EU to prevent, contain, and clean up PFAS. Pollution is occurring throughout the EU, and we need to cooperate. We are now highlighting the issue by allowing the ministers to test their own blood for PFAS." said Magnus Heunicke, Minister for Environment of Denmark.

Denmark, alongside Germany, the Netherlands, Norway, and Sweden, has submitted a joint proposal to the European Commission to ban the production, sale, and use of almost all PFAS under the EU's REACH regulation. The European Chemicals Agency's (ECHA) scientific committees are currently assessing the health, environment and socio-economic impacts of the proposal as well as the availability of safer alternatives. Based on the opinion from the scientific committees, the European Commission will put forward a proposal to be discussed by the Member States in the REACH Committee.

Read More

EEB, 10-07-25

~https://eeb.org/eu-environment-and-climate-ministers-test-for-toxic-pfas-forever-chemicals-in-their-blood/s

UK REACH restriction for lead in ammunition, 27 June 2025

2025-07-10

Decision on a restriction proposal for lead in ammunition under UK REACH, including a draft amendment.

Documents

UK REACH restriction for lead in ammunition

PDF, 184 KB, 12 pages

This file may not be suitable for users of assistive technology.

Request an accessible format.

Draft amendment for lead in ammunition restriction

PDF, 145 KB, 5 pages

This file may not be suitable for users of assistive technology.

Request an accessible format.

Details

Decision on a restriction proposal for lead in ammunition under UK REACH.

Restricted uses

Use of lead bullets and shot for live quarry and target shooting. This restriction comes with specific derogations and exemptions.

Date of decision

27 June 2025

Draft amendment

The draft amendment has been produced in accordance with the provisions of the UK REACH Regulations, regarding Annex 17 of UK REACH Regulation (EC) No 1907/2006 of the European Parliament and of the Council .

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Read More

Gov, UK, 10-07-25

https://www.gov.uk/government/publications/uk-reach-restriction-for-lead-in-ammunition-27-june-2025

Animal Testing Under REACH: It's Time to Take "Last Resort" Seriously

2025-07-08

The European legal framework requires its Member States to pay full regard to animal welfare standards when formulating and implementing policies. Yet, when it comes to chemical safety, the EU's flagship regulation, REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), still relies heavily on animal testing, despite its stated commitment to making this a "last resort."

The European legal framework requires its Member States to pay full regard to animal welfare standards when formulating and implementing policies. Yet, when it comes to chemical safety, the EU's flagship regulation, REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), still relies heavily on animal testing, despite its stated commitment to making this a "last resort."

REACH was designed with the core objective to protect people and the environment from dangerous chemicals. At the same time, the regulation claims to support and promote the use of non-animal methods as one of its overarching purposes, as outlined in its first article. In reality, this commitment is not being upheld: almost two decades into its implementation, REACH still relies on often-outdated testing methods, which involve not only significant animal suffering, but questionable scientific reliability.

Read More

Euractiv, 08-07-25

https://www.euractiv.com/section/eet/opinion/animal-testing-under-reach-its-time-to-take-last-resort-seriously/

Janet's Corner

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Who am I?

2025-07-18

I am element number 14. I am a metalloid, meaning I have properties of both metals and nonmetals. You'll find me everywhere in modern technology, forming the basis of computer chips and solar cells due to my unique semiconducting abilities. I'm the second most abundant element in Earth's crust, often found in sand and quartz. I have a relatively high melting point and a grayish, lustrous appearance.

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

I am element number 14.

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Hazard Alert

JUL. 18, 2025

Methyl Methacrylate

2025-07-18

Methyl methacrylate is an organic compound with the formula CH2=C(CH3)COOCH3. It is the methyl ester of methacrylic acid (MAA) and is a monomer produced on a large scale for the production of poly(methyl methacrylate) (PMMA). Methyl methacrylate is a colourless liquid with an acrid fruity odour. It is a flammable liquid and is slightly soluble in water and is soluble in some organic solvents. [1,2]

USES [2,3]

Methyl methacrylate is used in the manufacture of methacrylate resins and plastics e.g., Plexiglas. The principal uses of methyl methacrylate are: cast sheet and other grades (advertising signs and displays, lighting fixtures, glazing and skylights, building panels and sidings, and plumbing and bathroom fixtures), moulding/extrusion powder, and coatings (latex paints, lacquer, and enamel resins). It is also used in the impregnation of concrete to make it water-repellent, and also has uses in the fields of medicine and dentistry to make prosthetic devices and as a ceramic filler or cement.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

Potential for exposure exists for employees of manufacturers of methyl methacrylate and its polymers, as well as doctors, nurses, dentists, and dental technicians. Individuals may also be exposed to methyl methacrylate via consumption of contaminated water. Exposure to methyl methacrylate can occur in the workplace or in the environment following releases to air, water, land, or groundwater. In addition, exposure can occur when people use certain exterior latex house paints, adhesives, inks, and floor polishes.

Routes of Exposure

Exposure to methyl methacrylate is primarily occupational, through dermal and inhalation routes. Methyl methacrylate enters the body when people breathe air or consume water or food contaminated with methyl methacrylate. It can also be absorbed through skin contact. Methyl methacrylate does not remain in the body due to its breakdown and removal.

Methyl methacrylate is an organic compound with the formula CH2=C(CH3)COOCH3.

HEALTH EFFECTS [4]

Acute Health Effects

Methyl methacrylate is irritating to the skin, eyes, and mucous membranes in humans. An allergic response to dermal exposure may develop. Respiratory symptoms reported in humans include chest tightness, dyspnea, coughing, wheezing, and reduced peak flow. Neurological symptoms, including headache, lethargy, lightheadedness, and sensation of heaviness in arms and legs, have occurred in humans following acute exposure to methyl methacrylate. In mice and rats acutely exposed to high concentrations of methyl methacrylate by inhalation, degenerative olfactory changes in the nasal passages and lung damage have been observed. High doses of methyl methacrylate may cause pulmonary oedema. Acute oral exposure of animals to methyl methacrylate has caused damage to the liver. Tests involving acute exposure of rats, mice, rabbits, and guinea pigs have demonstrated methyl methacrylate to have low to moderate acute toxicity by inhalation or oral exposure.

Carcinogenicity

From a retrospective epidemiology study, a causal relationship between occupational exposure and increased incidences of colon and rectal cancers has been suggested; however, the causal relationship could not be established when relative accumulated total exposures and latency were considered. No carcinogenic effects were observed in several inhalation and oral animal studies. EPA considers methyl methacrylate not likely to be carcinogenic to humans.

Other Effects

No adequate reproductive or developmental studies in humans are available. Inhalation exposure of rats to maternally toxic levels of methyl methacrylate resulted in foetal abnormalities (haematomas and skeletal anomalies) and decreased foetal weight and crown-rump length.

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.

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- **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.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek 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. Seek medical attention.
- **Ingestion:** Do not induce vomiting. 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.

Workplace Controls & Practices [4]

Control measures include:

- Methyl methacrylate is flammable in presence of open flames and sparks.
- It is explosive in presence of heat.
- To extinguish small fires use dry chemical powder. For large fires use alcohol foam, water spray or fog.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling methyl methacrylate:

- 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.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

- American Conference of Governmental and Industrial Hygienists' threshold limit value is 410mg/m3.
- National Institute of Occupational Safety and Health's recommended exposure limit is 410mg/m3.
- NIOSH's immediately dangerous to life or health concentration is 4100mg/m3
- Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average is 410mg/m3.

REFERENCES

1. http://en.wikipedia.org/wiki/Methyl_methacrylate
2. http://www.npi.gov.au/substances/methyl-methacrylate/index.html
3. http://www.epa.gov/ttn/atw/hlthef/methylme.html
4. http://www.epa.gov/chemfact/methy-fs.txt
5. http://www.sciencelab.com/msds.php?msdsId=9927360

Researchers Develop Method to Completely Recycle Carbon Fiber Composites

2025-06-27

Deconstructing epoxy resins with hot acetic acid has the potential to provide a scalable and affordable solution for recycling a material used in a range of high-value consumer products, according to new research from the Bio-Optimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE) consortium.

Carbon fiber composites (CFCs) are high-strength, low-weight materials made from epoxy-amine resins that encase long carbon fibers. CFCs enable lighter and more efficient bicycles, planes, and automobiles and are a critical component of the pressure vessels used for compressed natural gas shipping and storage. However, the cost and energy-intensive production of CFCs limits their application, and there is a near total lack of scalable and economically viable recycling methods for these important materials.

CFCs are generally made with epoxy-amine resins, similar in chemistry to many epoxies commonly found in hardware stores. These composites form a stiff and resistant plastic, but also one that cannot be dissolved or melted. While the resins are relatively cheap, the fibers they surround are not, so the resulting composites are quite expensive—many CFCs can cost well over $50 per pound.

"For a reasonable analogy, imagine a cake," said Stephen Dempsey, a postdoctoral researcher at the National Renewable Energy Laboratory (NREL) and one of the first authors of the study. "Once the egg, flour, and sugar are in the batter and that cake is baked, it's basically impossible to get them back out. It is similar here: The resin is chemically interlocked, and the bonds are quite strong. We have to do something intense to get the fibers out, but we also must be careful not to degrade the chemicals in the resin beyond what's necessary, as that would waste all the time, energy, and raw materials that went into making them in the first place."

But even then, there is a bit more complexity than in baking, because these resins are often made of highly complex mixtures of molecules. Some of these compounds are common, and shared across many industries that use CFCs, but others are not. In addition, it is currently challenging to identify exactly what the resin chemistry is before recycling. A recycling method for CFCs must therefore be extremely robust and capable of handling diverse resin formulations.

The BOTTLE team's solution ended up being surprisingly simple. Hot acetic acid, the same compound that is found in vinegar, can cleave all the key bonds within these resins. Former NREL postdoctoral researcher Ciaran Lahive (now at University of Manchester), and co-first author on this study, demonstrated this reaction during an intensive reaction screening effort for another project.

The team learned something remarkable: Not only do the polymer networks in the resin solubilize rapidly, but the acetic acid also stabilizes their chemical components, enabling high yields of reusable chemical building blocks. Extensive optimization work from NREL interns Katie Stevenson (now at Columbia University) and Sydney Reiber (now at the University of Graz) led to a process effective on end-of-life waste from a variety of industries.

Importantly, the researchers also determined there was no impact on the strength of the recycled carbon fibers (rCF), which is critical to ensuring they retain their value after being extracted from the composite. To demonstrate this, they took 80 grams of a scrap mountain-bike frame made of composite material and deconstructed it. Using the carbon fibers they had just extracted, they then made new composites that exhibited more than twice the strength-to-weight ratio of steel.

Not only is the cost of rCF predicted to be quite low compared to virgin fiber, with a price of just $1.50 per kilogram, but the energy consumption is also practically zero when factoring in the recovered epoxy building blocks. The process is not limited to CFC only—glass fiber composites like those found in turbine blades, boat hulls, or automobile bumpers and hoods could also be treated.

"Long-term, this technology could be used to create value from challenging composite waste streams that are currently piling up in landfills," said BOTTLE CEO Gregg Beckham, the senior author of the study and a senior research fellow at NREL. "Current technologies are not yet able to make a dent in that waste stream, but we think that this process could be useful for this application as well."

The discovery holds the potential to energize the U.S. composite manufacturing industry.

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"If we can scale this process and deploy it in the real world, we see no reason that whole panels on cars or trains couldn't be made of rCF composites instead of steel or aluminum," Dempsey said.

Technology Networks, 27 June 2025

https://technologynetworks.com

Lasers capture the invisible dance of wind and waves

2025-07-10

The international team, led by Dr. Marc Buckley from the Hereon Institute of Coastal Ocean Dynamics, has achieved a breakthrough in high-resolution imaging of the ocean surface. Using a specially developed laser measurement system aboard the research platform FLIP (Floating Instrument Platform) in the Pacific Ocean, they were able to capture high-resolution images of airflow just a few millimeters to one meter above the ocean surface. They identified two wind-wave coupling mechanisms that occur simultaneously but act differently.

Short waves, about one meter in length, move slower than the wind. This causes a separation of the airflow: the wave crest blocks the wind, creating a pressure difference that transfers energy to the wave. Long waves, on the other hand -- up to 100 meters in length -- move faster than the wind and generate different airflow patterns through their motion. These mechanisms operate simultaneously in different parts of the wave field -- a crucial insight for advancing atmospheric and oceanic models.

Relevance for Weather, Climate, and Marine Biochemistry

The interactions between wind and waves are a central component of the Earth's climate and weather systems. While it is largely accepted that these complex interactions control the exchange of energy, heat, and greenhouse gases between the atmosphere and the ocean -- affecting sea state, weather, and currents, the mechanisms remain, until today, largely unknown. The research team plans to further develop the system to also capture movements below the water surface with greater precision.

"Until now, no one has measured the airflow this close to the ocean surface, let alone mapped the mechanisms of energy exchange at such a fine scale," says lead author Buckley. "Our observations shed light on a physical frontier. This will enable us to advance the theoretical framework and develop more accurate descriptions of air-sea exchange processes, which have so far been only partially understood."

Unique Imaging Above the Open Ocean

The imagery is based on a laser that passes through both air and water: the green beam hits water droplets introduced into the air -- similar to mist illuminated by sunlight. These droplets follow the motion of the airflow, scatter the laser light, and make even the smallest movements in the air visible. At the same time, the laser penetrates the water surface. At the wind-driven surface, the light is refracted -- revealing the structure of the water surface. This combination allows both the air and water sides to be visualized. The method is based on Particle Image Velocimetry (PIV), an established technique in fluid dynamics. PIV provides precise information about flow structure and wind speeds. This marks the first time the technique has been used over the open ocean.

Cutting-edge research for a changing world

Helmholtz-Zentrum Hereon`s scientific research aims at preserving a world worth living in. To this end, around 1000 employees generate knowledge and research new technologies for greater resilience and sustainability -- for the benefit of the climate, the coast and people. The path from idea to innovation leads through a continuous interplay between experimental studies, modeling and AI to digital twins that map the diverse parameters of climate and coast or human biology in the computer. This is an interdisciplinary approach that spans from the fundamental scientific understanding of complex systems to scenarios and practical applications. As an active member of national and international research networks and the Helmholtz Association, Hereon supports politics, business and society in shaping a sustainable future by transferring the expertise it has gained.

Science Daily, 10 July 2025

https://sciencedaily.com

Scientists repurpose old solar panels to convert CO_2 exhaust into valuable chemicals

2025-07-17

Centuries ago, alchemists worked furiously to convert the common metal lead to valuable gold. Today, chemists are repurposing discarded solar panels to create valuable organic compounds from carbon dioxide (CO2), a common greenhouse gas.

Significantly reducing greenhouse gases in the atmosphere to mitigate the most devastating effects of climate change will require a large reduction

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in emissions as well as strategies designed to sequester emitted CO2 and other offending gases. While simply sequestering greenhouse gases would fulfill this goal, creating useful organic chemicals from waste CO2 is akin to generating valuable materials from trash.

A team of chemists from Yokohama National University, Electric Power Development Co., Ltd. and the Renewable Energy Research Center at the National Institute of Advanced Industrial Science and Technology (AIST) recently decided to tackle two waste problems—excess CO2 emissions and decommissioned solar panels—in the pursuit of creating value-added organic chemicals. The team designed a study to determine if recycled components of discarded solar panels could be used to efficiently convert CO2 into useful, carbon-based compounds.

The researchers published their study in the July 14 issue of the journal ACS Sustainable Resource Management.

"In this study, we combined the recycling of waste silicon wafers from end-of-life solar panels with the conversion of CO2 in the exhaust gas from a thermal power plant. The waste silicon wafer acts as a reducing agent of CO2 to organic compounds," said Ken Motokura, professor in the Department of Chemistry and Life Science at YOKOHAMA National University in Yokohama, Japan and first author of the research paper.

The silicon wafers in solar panels can be separated from discarded panels in the panel recycling process. Importantly, the silicon wafers are effective at donating electrons to carbon compounds, including CO2, which can be used to create larger, more valuable chemicals. While the reaction to create value-added organic chemicals from CO2 and metallic silicon, which is present in silicon wafers of solar panels, is energetically favorable, few studies have examined the effectiveness of the reaction.

The team took crushed and milled silicon wafers from discarded solar panels and added a chemical catalyst to speed the production of organic compounds from waste CO2. Initially, the research team had variable success creating formic acid, an organic chemical, from the milled silicon wafers. The researchers were able to overcome this limitation by pretreating the milled silicon wafers with hydrochloric acid (HCl), which removed aluminum (Al) from the surface of the wafer powder and increased the yield of the reaction.

"We directly converted CO2 in the exhaust gas, which contained 14% CO2 by volume, from a thermal power plant into formic acid and formamide through a reaction with waste silicon powder, water, and

tetrabutylammonium fluoride, a catalyst. No separation and purification of CO2 from the exhaust gas is necessary. The contaminated Al in the waste silicon powder decreases the reaction rate, and appropriate pretreatment with HCl enables enhanced reactivity of the waste silicon," said Motokura.

Ultimately, the reaction produced formic acid at high yields, reaching as high as 73%. Formamide, another value-added organic chemical, was also generated using the silicon powder in the presence of amines, which are organic chemicals containing nitrogen atom. The researchers were also successful in directly connecting their silicon-wafer reactor to the exhaust gas port of a thermal power plant, demonstrating the practicality of generating valuable formic acid from waste silicon wafers and emitted CO2.

The International Renewable Energy Agency (IRENA) estimates that 60–78 MT of global photovoltaic (PV) panels will reach end of life by 2050. The research team hopes that this study will spur additional research into ways that recycled materials, like silicon wafers, can be used to sequester and convert waste and greenhouse gases into other useful and valuable compounds, turning society's waste into something more akin to treasure.

Phys Org, 17 July 2025

https://phys.org

US federal basic research support would fall 34% under Trump proposal

2025-07-16

US federal government funding for basic research would fall by more than a third, or approximately 34%, from $45 billion (£33.5 billion) to $30 billion under President Trump's budget proposal for the 2026 financial year, according to new analysis by the American Association for the Advancement of Science (AAAS). Further, if Congress enacts the plan, the AAAS found that it would decrease science funding more broadly – including basic and applied work, as well as at R&D facilities – by about 22%, from $198 billion to $154 billion.

'The administration's proposed cuts for research and development are unprecedented – its funding levels would bring basic and applied research back to levels not seen since the late 1990s, when taking inflation into account,' stated Joanne Padrón Carney, the AAAS's chief government relations officer. 'If adopted by Congress, it would curtail the US's capabilities to compete with countries like China on biomedicine,

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quantum computer and artificial intelligence, and run the risk of not reaping the economic benefits from the science and engineering that leads to innovations.'

Neal Lane, a physicist who served as science adviser to former president Bill Clinton and previously as director of the NSF, agrees that these funding cuts in science are 'unprecedented'. But he says they are no surprise 'given the many other ways [Trump's] polices are likely to set the US back by decades'. If Congress sustains these reductions, Lane warns that the US 'will cede to China, in a single year' its position of global scientific and technical leadership that the US has held for 80 years, since the end of the second world war.

John Holdren, an environmental and climate scientist who was science adviser to former president Barack Obama, says these cuts would be 'terrible' for US scientific progress, which underpins the US economy, public health, environmental quality and national security. 'It must be hoped that the bipartisan character of those values will lead the Congress to reject resoundingly these indefensible Trump proposals,' Holdren tells Chemistry World.

Back in May, the White House released a skinny version of its budget request for the 2026 financial year. Then in June, the administration released more details of the proposal, which indicated that funding for chemistry within the NSF's maths and physical sciences programme would plummet by 75%, and materials research would be cut by 71%.

Chemistry World, 16 July 2025

https://chemistryworld.com

Discovery in Quantum Materials Could Make Electronics 1,000 Times Faster

2025-07-01

Researchers at Northeastern University have discovered how to change the electronic state of matter on demand, a breakthrough that could make electronics 1,000 times faster and more efficient.

By switching from insulating to conducting and vice versa, the discovery creates the potential to replace silicon components in electronics with exponentially smaller and faster quantum materials.

"Processors work in gigahertz right now," said Alberto de la Torre, assistant professor of physics and lead author of the research. "The speed of change that this would enable would allow you to go to terahertz."

Via controlled heating and cooling, a technique they call "thermal quenching," researchers are able to make a quantum material switch between a metal conductive state and an insulating state. These states can be reversed instantly using the same technique.

Published in the journal Nature Physics, the research findings represent a breakthrough for materials scientists and the future of electronics: instant control over whether a material conducts or insulates electricity.

The effect is like a transistor switching electronic signals. And just as transistors allowed computers to become smaller — from the huge machines the size of rooms to the phone in your pocket — control over quantum materials has the potential to transform electronics, says Gregory Fiete, a professor of physics at Northeastern who worked with de la Torre to interpret the findings.

"Everyone who has ever used a computer encounters a point where they wish something would load faster," says Fiete. "There's nothing faster than light, and we're using light to control material properties at essentially the fastest possible speed that's allowed by physics."

By shining light on a quantum material called 1T-TaS_2 at close to room temperature, researchers achieved a "hidden metallic state" that had so far only been stable at cryogenically cold temperatures. Now researchers have created that conductive metallic state at more practical temperatures, says de la Torre. The material maintains its programmed state for months — something that has never been accomplished before.

"One of the grand challenges is, how do you control material properties at will?" says Fiete. "What we're shooting for is the highest level of control over material properties. We want it to do something very fast, with a very certain outcome, because that's the sort of thing that can be then exploited in a device."

So far, electronic devices have needed both conductive and insulating materials, plus a well-engineered interface between the two. This discovery makes it possible to use just one material that can be controlled with light to conduct and then insulate.

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"We eliminate one of the engineering challenges by putting it all into one material," Fiete says. "And we replace the interface with light within a wider range of temperatures."

The research expands upon previous work that used ultra-fast laser pulses to temporarily change the way materials conduct electricity. But those changes only lasted tiny fractions of a second and usually at extremely cold temperatures.

Stable conductivity switching at higher temperatures is a significant advance for quantum mechanics, Fiete says, and for the long game of supplementing or replacing silicon-based technology. Semiconductors, he says, are so dense with logic components that engineers are now stacking them in three dimensions. But this approach has limitations, he said, which make tiny quantum materials more important for electronics design.

"We're at a point where in order to get amazing enhancements in information storage or the speed of operation, we need a new paradigm," Fiete says. "Quantum computing is one route for handling this and another is to innovate in materials. That's what this work is really about."

Technology Networks, 1 July 2025

https://technologynetworks.com

Heat and smart mixing boost enzymatic recycling of unsortable polyester plastics

2025-07-17

Polyester plastics, commonly found in synthetic textiles and plastic components of home appliances, are notoriously difficult to recycle. In a study recently published in the Proceedings of the National Academy of Sciences, researchers from France unveiled a clever method for breaking down polyester waste into reusable building blocks using heat and leveraging the residual catalysts embedded within the plastic during the manufacturing process, eliminating the need for tedious sorting.

Sorting plastic waste is recommended before disposal in order to make the recycling process easier. Recycling of PET or polyethylene terephthalate, which is widely used in bottles, textiles, packaging, and engineering plastics, significantly benefits from this practice. Recyclers simply need to collect, separate it from other waste, and break it down via enzyme-catalyzed depolymerization into monomers, which can then be used for the next batch of PET products.

This form of recycling becomes particularly challenging with polyesters, such as polytrimethylene terephthalate (PTT) and polybutylene terephthalate (PBT), as well as PET fibers. When used in consumer products, these plastics often contain a mix of different monomers and additives such as dyes or plasticizers, making the waste difficult to sort and separate. Additionally, their rigid crystalline structures prevent the enzymes used in recycling from breaking down the plastic, as the polymer chains are packed too tightly and cannot be accessed.

In this study, researchers reported a new technique for degrading such plastic waste, which includes intentionally mixing various types of polyester waste in controlled proportions and then melting it by raising the temperature to 270°C. The residual catalysts, such as antimony trioxide, left over from the polyester manufacturing process, enabled transesterification —a chemical reaction in which the alkoxy group of an ester compound is replaced by an alcohol—leading to copolymers with random network structures.

For polyester wastes rich in fast-crystallizing polymers like PBT, melt transesterification alone failed to provide the desired results. To counter this, the researchers introduced vitrimerization—the addition of an epoxy cross-linking agent to the mix—to further slow down the crystallization time. These processes yielded a reactive mixture that crystallized at a slower rate when cooled in ice baths, resulting in a polymer structure susceptible to enzymatic attack.

The solid material obtained after the cooling process was ground up and treated with the same enzymes used for recycling semi-crystalline PET bottles. The result was high-quality monomeric building blocks suitable for manufacturing new polyester products.

The researchers highlighted that mixing PET nonwoven waste with PBT increased the enzymatic depolymerization yield from 20% for PET and 1% for PBT to 90% as a mixture. Although counterintuitive, this study establishes that blending rather than sorting might be a more viable and less tedious approach to recycling polyester waste.

Phys Org, 17 July 2025

https://phys.org

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First-of-its-kind crystal laser could power safer sensors and smarter tech

2025-07-12

In a first for the field, researchers from The Grainger College of Engineering at the University of Illinois Urbana-Champaign have reported a photopumped lasing from a buried dielectric photonic-crystal surface-emitting laser emitting at room temperature and an eye-safe wavelength. Their findings, published in IEEE Photonics Journal, improve upon current laser design and open new avenues for defense applications.

For decades, the lab of Kent Choquette, professor of electrical and computer engineering, have explored VCSELs, a type of surface-emitting laser used in common technology like smartphones, laser printers, barcode scanners, and even vehicles. But in early 2020, the Choquette lab became interested in groundbreaking research from a Japanese group that introduced a new type of laser called photonic-crystal surface-emitting lasers, or PCSELs.

PCSELs are a newer field of semiconductor lasers that use a photonic crystal layer to produce a laser beam with highly desirable characteristics such as high brightness and narrow, round spot sizes. This type of laser is useful for defense applications such as LiDAR, a remote sensing technology used in battlefield mapping, navigation, and target tracking. With funding from the Air Force Research Laboratory, Choquette's group wanted to examine this new technology and make their own advancements in the growing field.

"We believe PCSELs will be extremely important in the future," said Erin Raftery, a graduate student in electrical and computer engineering and the lead author of the paper. "They just haven't reached industrial maturity yet, and we wanted to contribute to that."

PCSELs are typically fabricated using air holes, which become embedded inside the device after semiconductor material regrows around the perimeter. However, atoms of the semiconductor tend to rearrange themselves and fill in these holes, compromising the integrity and uniformity of the photonic crystal structure. To combat this problem, the Illinois Grainger engineers swapped the air holes for a solid dielectric material to prevent the photonic crystal from deforming during regrowth. By embedding silicon dioxide inside the semiconductor regrowth as part of the photonic crystal layer, researchers were able to show the first proof of concept design of a PCSEL with buried dielectric features.

"The first time we tried to regrow the dielectric, we didn't know if it was even possible," Raftery said. "Ideally, for semiconductor growth, you want to maintain that very pure crystal structure all the way up from the base layer, which is difficult to achieve with an amorphous material like silicon dioxide. But we were actually able to grow laterally around the dielectric material and coalesce on top."

Members of the field anticipate that in the next 20 years, these new and improved lasers will be used in autonomous vehicles, laser cutting, welding, and free space communication. In the meantime, Illinois engineers will improve on their current design, recreating the same device with electrical contacts allowing the laser to be plugged into a current source for power.

"The combined expertise of Erin and members of the Minjoo Larry Lee group, as well as the facilities and expertise at the Air Force Research Laboratory on Wright-Patterson Air Force Base were necessary to accomplish this result," Choquette said. "We look forward to diode PCSEL operation."

Kent Choquette is an Illinois Grainger Engineering professor of electrical & computer engineering and is affiliated with the Holonyak Micro & Nanotechnology Laboratory. Choquette holds the Abel Bliss Professorship in Engineering.

Minjoo Larry Lee is an Illinois Grainger Engineering professor of electrical & computer engineering and is the director of the Holonyak Micro & Nanotechnology Laboratory. Lee is an Intel Alumni Endowed Faculty Scholar.

Science Daily, 12 July 2025

https://sciencedaily.com

A Safer, Eco-Friendly Polymer for Implantable Medical Devices

2025-07-02

An innovative polymer, PHOx, could significantly improve the safety of implantable medical devices while also being more environmentally friendly.

Every year, millions of patients receive medical devices inserted or implanted in the cardiovascular system: arterial and venous catheters, cardiac devices, pacemaker leads, artificial hearts, vascular prostheses,

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etc. These devices, often made from polyurethane (PU), perform vital functions, but are not without defects. PU production relies on toxic chemicals called isocyanates, and PU is also partly responsible for serious complications in patients, such as blood clots and infections.

Faced with these limitations, a team from the GIGA (Cardiology Laboratory) and the CESAM (Centre de recherche sur les macromolécules - CERM) at the University of Liège has come up with a promising alternative: PHOx, a thermoplastic elastomer without isocyanate PU (NIPU), which is therefore less toxic to produce and much better tolerated by the human body.

"PHOx (Poly Hydroxy-Oxazolidone) is a flexible, transformable plastic that can be moulded, pressed, spun into fibres or 3D printed," explain Anna Pierrard, chemist, and Christine Jérôme, Director of CERM. It can thus be used to produce a variety of personalised medical devices. Better still, its manufacture is based on 'greener' raw materials, derived in particular from carbon dioxide, reducing the environmental impact of the process.

"Extensive laboratory tests have shown that PHOx outperforms PU in several key respects," enthuse Sofia Melo, bioengineer, and Cécile Oury, FNRS Research Director and Head of the Cardiology Laboratory at the GIGA. PHOx is more compatible with blood. In particular, it reduces the adhesion of platelets (essential cells in the formation of blood clots) and the activation of coagulation, limiting the risks of clot formation. It is also thought to inhibit the adhesion of bacteria such as staphylococcus aureus, which is often implicated in implant infections. No toxicity was observed, either for human cells or during implantation, and the material did not cause excessive inflammation, degradation or rejection.

3D printable implants

Another major advantage of PHOx is that it can be easily 3D printed. "This means that we could eventually produce custom-made devices for each patient, reducing waste and at lower cost," explains Patrizio Lancellotti, Head of Cardiology at Liège University Hospital." Tailor-made implants, heart valves adapted to the anatomy of each individual: the applications are numerous.

Thanks to its mechanical (flexibility, strength) and biological (biocompatibility, compatibility with blood, stability) properties, PHOx could well replace PUs in many medical applications. This is a major step towards medical devices that are safer for patients, more environmentally friendly, and potentially more economical thanks to customised

manufacturing and reduced healthcare costs associated with fewer complications.

The researchers stress that this is the first time that a NIPU (non-isocyanate polyurethane) material has demonstrated such performance in critical medical applications.

This major advance has been published in the scientific journal Advanced Healthcare Materials, and an international patent application (WO2025082761) has already been filed.

Technology Networks, 2 July 2025

https://technologynetworks.com

Nickel catalyst opens door to sustainable, branched hydrocarbon fuels

2025-07-17

A research team led by Associate Professor Boon Siang Yeo from the Department of Chemistry at National University of Singapore (NUS) has developed a new way to turn carbon dioxide, a greenhouse gas, into valuable liquid hydrocarbons, which are the main components of fuels like gasoline and jet fuel.

The research was conducted in collaboration with Professor Núria López, an expert in computational simulation from the Institute of Chemical Research of Catalonia, Spain, and Professor Javier Pérez-Ramírez from ETH Zürich, Switzerland, who brings extensive expertise in electro- and thermocatalytic fuel synthesis. The study is published in Nature Catalysis.

For years, scientists have searched for efficient ways to recycle carbon dioxide into energy-rich molecules, with the twin goals of cutting harmful emissions and creating sustainable fuels. Most efforts have focused on using copper as the catalytic material, as it has been shown to convert carbon dioxide into simpler products like ethylene or ethanol. However, copper has consistently fallen short in producing longer, branched hydrocarbon chains, which are key components of high-quality fuels.

The team explored a different path in green fuel production by using a nickel-based material to catalyze the electrochemical reduction of carbon dioxide. By introducing a small amount of fluoride ions into the nickel structure as well as by applying pulsed potential electrolysis, they found that they could fine-tune the catalytic process.

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These strategies allowed them to have unprecedented control over the types of hydrocarbons produced, especially in determining whether the molecules are straight chains or have branches. Branched hydrocarbons are particularly valuable because they enable fuels to burn more efficiently and with higher performance, making them ideal for use in vehicles and aircraft.

The study showcases new strategies to selectively promote the production of branched hydrocarbons. By applying a technique called pulsed potential electrolysis, where the electrical bias is varied in periodic cycles, the team was able to markedly increase the branch-to-linear ratio of hydrocarbons with five or more carbon atoms, achieving an over 400% improvement compared to standard methods. In addition, fluoride doping in the nickel catalyst helped maintain its oxidation state under reducing conditions, a key factor in promoting the formation of longer hydrocarbon chains.

Despite being extensively studied and modified over the last decade, a known limitation of copper-based catalysts is the inability to reduce carbon dioxide to appreciable amounts of long-chain hydrocarbons. A key insight from this study was understanding how nickel and copper catalysts behave differently at the molecular level.

The team showed that nickel-based catalysts promote the removal of oxygen from reaction intermediates and favor asymmetric coupling between adsorbed carbon monoxide (*CO) intermediates and unsaturated hydrocarbon species. This contrasts with copper-based catalysts, which tend to convert oxygen-containing intermediates into alcohols, which halts the growth of longer hydrocarbon chains.

These distinct properties mean that on nickel catalysts, the building blocks needed for longer and more complex hydrocarbons are more likely to form and link together, resulting in products that more closely resemble those made through traditional, high-temperature industrial processes such as Fischer-Tropsch synthesis.

Prof. Yeo said, “This work brings together complementary expertise in catalyst synthesis, mechanistic investigation and computational modeling, which allows us to uncover new mechanisms and design strategies for carbon dioxide reduction to long-chain hydrocarbons. This work would not have been possible if not for the intense collaboration between experimentalists and theoreticians.”

Prof. Lopez stated, "None of our techniques individually is able to univocally identify key mechanistic steps—it is only by a combination of experimental and computational results."

The impact of this study goes beyond advancing the fundamental understanding of carbon dioxide electroreduction mechanisms. By developing ways to precisely control the structure of hydrocarbons produced from carbon dioxide using electricity, this research opens new pathways for the development of on-demand, sustainable aviation fuels and chemical precursors. Such advances are crucial for supporting the global shift towards cleaner technologies.

Phys Org, 17 July 2025

https://phys.org

Cheap Catalyst Turns Acids Into Pharmaceutical Gold

2025-07-11

Photoactivated ketones show strong potential as hydrogen atom transfer photocatalysts, enabling the activation of carboxylic acids and the formation of new C–C, C–S, and C–Cl bonds.

Carboxylic acids are common components in bioactive compounds and serve as widely available building blocks in organic synthesis. When transformed into carboxy radicals, these acids can initiate the formation of valuable carbon-carbon and carbon-heteroatom bonds, a key step in the creation of new materials and pharmaceutical agents. Despite their utility, few existing methods rely on cost-effective catalysts.

Addressing this gap, a team from WPI-ICReDD and the University of Shizuoka developed a straightforward hydrogen atom transfer (HAT) strategy that selectively converts carboxylic acids into carboxy radicals. This method employs xanthone, a commercially available and inexpensive organic ketone, as the photocatalyst. The study was recently published in the Journal of the American Chemical Society.

HAT functions by extracting a hydrogen atom from a substrate, generating a reactive radical. Ketones are particularly well suited for this process due to their affordability and established role in HAT photocatalysis. However, targeting the O–H bond in carboxylic acids presents a challenge, as it is generally stronger than the neighboring C–H bonds.

To overcome this, the researchers utilized the artificial force induced reaction (AFIR) method, a computational tool developed at ICReDD.

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This analysis revealed that xanthone could efficiently facilitate selective O–H bond activation, making it a strong candidate for precise radical generation in these systems.

Hydrogen bonding enhances selectivity

Computational analysis showed that xanthone exhibits nearly equal energy barriers for activating either O–H or C–H bonds in carboxylic acid molecules. This balance suggests that hydrogen bonding could play a key role in directing which bond is preferentially activated. Hydrogen bonding refers to the attraction between hydrogen and oxygen atoms (as illustrated above) and does not occur between hydrogen and carbon atoms. It is distinct from a covalent bond.

Experimental results confirmed the AFIR-based predictions, highlighting the importance of hydrogen bonding in achieving selective O–H bond activation.

The method produced a high selectivity ratio, exceeding 10:1 in favor of O–H bond cleavage. Depending on the specific substrate, the reaction followed either a decarboxylation pathway or benzylic functionalization. Xanthone showed broad substrate tolerance and enabled a variety of bond formations (C–C, C–Cl, and C–S), demonstrating its versatility across more than 40 different reaction examples.

Researchers highlight AFIR's predictive success

"Collaborating with the team in Shizuoka to explore a new activation mode of carboxylic acids through computational approaches was an excellent experience. It's especially meaningful to me that the AFIR method has demonstrated its "I'm deeply honored to have collaborated with Associate Professor Hiroki Hayashi on this work. By integrating both experimental and computational approaches, we successfully revealed a novel photocatalysis of ketones. This project made me truly appreciate the power of the AFIR method in predicting reaction pathways. I hope our findings will open new avenues for controlling highly reactive radical species," said Assistant Professor Kenji Yamashita from the University of Shizuoka.

This new methodology is inexpensive and generates minimal reaction waste making it highly accessible for developing pharmaceuticals and materials. Moreover, the photocatalytic mechanism of this method is promising for broader radical generation applications besides carboxy radicals.utility as a predictive tool beyond ICReDD. I hope this

computational strategy will continue to drive new advances in reaction development," said Associate Professor Hiroki Hayashi from WPI-ICReDD at Hokkaido University.

Sci Tech Daily, 11 July 2025

https://scitechdaily.com

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Artificial Sweeteners Leave Bitter Taste for the Environment

2025-07-14

Artificial sweeteners, widely used in soft drinks, processed foods and sugar-free products such as toothpaste, are increasingly turning up far from supermarket shelves – in our rivers, waterways and natural ecosystems.

Sugar substitutes have faced controversy for potential negative health effects, including links to type-2 diabetes, heart disease and cancer. Some also pose toxicity risks to aquatic animals. In zebrafish, sucralose causes birth defects and high levels of saccharin are neurotoxic.

In a systematic review, researchers from the University of Technology Sydney (UTS) examined the type and prevalence of artificial sweeteners in wastewater treatment plants across 24 countries, changes in concentration, and how The study was led by Dr Xuan Li, from the UTS Centre for Technology in Water and Wastewater, and UTS Professor of Environmental Engineering Qilin Wang, and was recently published in the Journal of Hazardous Materials.

It finds that globally, sucralose, acesulfame, saccharin and cyclamate are the most prevalent artificial sweeteners. The highest concentrations of these chemicals were found in the USA, Spain, India and Germany.

Concentrations were 10-30% higher in summer for most countries, however in China they were highest in winter. Other artificial sweeteners found in wastewater include neotame, stevia, acesulfame-K and neo hesperidin dihydrochalcone (NHDC).

Unlike natural sugars, artificial sweeteners are designed to resist digestion, meaning they often pass through the human body largely unchanged. As a result, they enter wastewater systems where standard treatment processes aren't always equipped to deal with them.

The researchers found that while saccharin and cyclamate were easily removed from wastewater, other artificial sweeteners such as sucrose and acesulfame were harder to remove and were released into the wider environment.

There is a lot of attention on per- and polyfluoroalkyl substances (PFAS) at the moment because these "forever chemicals" can accumulate in the environment and in drinking water, affecting living organisms. It is

a similar pathway for artificial sweeteners, which also accumulate in the environment.

"Sweeteners such as sucralose are incredibly persistent. Its chemical stability means it can survive both conventional and advanced treatment processes, so it eventually makes its way into rivers, lakes and coastal waters where it can affect aquatic ecosystems," Professor Wang said.

The findings are likely to be of interest to environmental protection agencies, water authorities and public health experts due to the potential ecological impacts of these chemicals, and as a marker of human-derived pollution.

"We are also looking at using wastewater analysis to measure the consumption of artificial sweeteners at a population level. People are often not aware that the product they are consuming, such as a protein shake, contains artificial sweeteners," said Dr Li.

The study calls for ongoing monitoring, tighter regulations, and improved treatment technologies to reduce the environmental risks posed by artificial sweeteners effectively they are removed.

Technology Networks, 14 July 2025

https://technologynetworks.com

64 widely available "mood-boosting" supplements are put to the test

2025-07-14

From St John's wort to vitamin D, the range of over-the-counter supplements for mental health support and wellbeing continues to expand at a rate faster than scientists can validate their efficacy. Now, a new metastudy has assessed 64 different products reviewed in hundreds of studies to shed light on how useful they are in relieving depression.

An international team of researchers reviewed 23,933 study records and 1,367 papers, homing in on 209 clinical trials that analyzed the efficacy of 64 common over-the-counter (OTC) supplements aimed at treating depression when taken consistently for more than a week. The collective data covered adults aged 18-60 years with either depression symptoms or an official diagnosis.

"Studies were not always straightforward – some tested multiple doses or products, some were in addition to antidepressants and in some trials

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people had a range of physical conditions in addition to depression," said study co-author Rachael Frost, a senior lecturer at Liverpool John Moores University. "We grouped our findings into products with substantive evidence (more than 10 trials), emerging evidence (between two and nine trials), and single trials only."

The most comprehensively studied products were omega-3s (39 trials), St John's wort (38), prebiotics (18) and vitamin D (14) – as well as saffron (18), which is popular in the Middle East and Asia.

As far as relieving depression symptoms, there was little conclusive evidence that omega-3 supplements had any impact; the scientists found more studies produced no effects than those that showed some, compared to a placebo. In 2021, we covered one such study that failed to show omega-3 supplements played any role in treating depression.

St John's wort and saffron had the strongest positive outcomes, with studies showing these two distinct supplements worked, compared to a placebo, and were on par with existing prescription antidepressants. And gut-health probiotics, as well as vitamin D, reduced depressive symptoms to some degree in their respective controlled trials.

But overall, the researchers found a distinct lack of multiple trials for many emerging OTC products, which shows how far the science is lagging behind as the wellbeing supplements market continues to grow. More than 40 of the 64 products had only a single clinical study completed on them to date.

"Out of a range of products with promising evidence, those most commonly used and so warranting further research were lavender, lemon balm, chamomile and echium," the scientists noted.

As for the emerging supplements with little research, some showed the most promise in early studies: Folic acid, lavender, zinc, tryptophan, rhodiola and lemon balm. Lemon balm (Melissa officinalis L.) has been growing in popularity over the last 12 months, touted as an effective sleep aid and anti-anxiety mood booster.

Elsewhere, this research identified that, when looking at depression relief, bitter orange, Persian lavender and chamomile tea – featuring in two trials each – had positive outcomes.

Meanwhile, some of the most hyped supplements in 2025 – melatonin, magnesium, and curcumin – returned mixed results when focused on depression, and this was consistent for each across multiple clinical trials.

The same inconclusive evidence was found for cinnamon, echium, vitamin C, and a vitamin D-calcium combo.

There's currently a lot of research into gut flora and mental health, but prebiotics, at this stage, were not significantly more effective for depression than a placebo. However, the microbiome is a complex system, and we don't yet fully understand how different levels of beneficial bugs can help or hinder physical and mental health.

"Products with limited but promising evidence included folic acid, lavender, zinc, tryptophan, rhodiola and lemon balm, and future research should focus on these products," Frost advised. "There is a need for further evaluation of herbal medical products as adjuncts to antidepressants, as well as a need to explore the benefits of products adjunctively to psychological therapies for a more integrative approach. Safety reporting needs to be further improved in these trials."

There are many reasons for the uptick in sales of such OTC supplements – and it's reflected in market value. In 2025, global sales of products classed as mental well-being supplements is estimated to be US$11.488 billion. It's projected to grow to $17.366 billion by 2030.

"It's good news that very few safety concerns arose from any of these products, whether they were taken alone or in combination with antidepressants," Frost noted. "However, a healthcare professional should always be consulted on whether a product might interact with something else you are taking. A higher standard of safety reporting in trials is essential – only 145 (69%) of the examined studies fully reported any side effects from the products."

Whether you're for or against OTC supplements, consumers and scientists should agree that much more robust and comparative data is needed in order to justify the financial outlay. Meanwhile, many medical professionals remain skeptical about the efficacy of OTC "brain drugs," which don't need to go through the same rigorous Food and Drug Administration (FDA) vetting to be stocked on shelves.

The study was published in the journal Frontiers in Pharmacology.

New Atlas, 14 July 2025

https://newatlas.com

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New study reveals how to stabilize cobalt catalysts for green hydrogen production

2025-07-16

Scientists have taken a major step toward solving one of the biggest challenges facing green hydrogen: the scarcity of iridium, a rare and expensive metal crucial to current production methods.

"Right now, the most advanced technology for sustainable hydrogen production uses iridium-based catalysts in proton-exchange membrane water electrolysers," said lead study author Associate Professor Alexandr N. Simonov from the Monash University School of Chemistry.

"But there simply isn't enough iridium mined to build the scale of electrolysers needed for green hydrogen to truly decarbonize our energy and chemical industries."

The global push for green hydrogen as a clean fuel has highlighted an uncomfortable truth: While iridium works extremely well, its availability is an order of magnitude too low for the multi-gigawatt installations required worldwide.

To tackle this problem, researchers have been looking for effective anode catalysts made from cheaper and more abundant materials. Cobalt-based catalysts have shown promise, including previous breakthroughs by the Monash team, but until now, their limited stability has been a roadblock to real-world use.

"Cobalt is much cheaper than iridium, but the challenge has always been making cobalt-based catalysts stable enough to survive the harsh conditions inside these electrolysers," said study contributor Monash Ph.D. alumnus Dr. Darcy Simondson.

A paper published in Nature Energy, and led by the Monash University School of Chemistry with collaborators from the Max Planck Institute for Chemical Energy Conversion, Swinburne University of Technology, Los Alamos National Laboratory, Helmholtz-Zentrum Berlin for Materials and Energy, Cambridge University, and synchrotron facilities in Australia and Germany explores exactly why cobalt catalysts degrade and how to fix it.

"This was more than three years of research using some of the world's most advanced spectroscopic, electrochemical, and computational techniques," said Dr. Marc Tesch, from the Max Planck Institute for Chemical Energy Conversion.

"We discovered that the major catalytic functions of these cobalt-based anodes, and their degradation, actually occur independently of each other. That wasn't what was expected from the previous research."

This new understanding could revolutionize how catalysts are designed. By showing that degradation and catalytic activity are decoupled, scientists can now focus on engineering cobalt materials to maximize their performance while separately tackling stability issues.

"Essentially, we've uncovered that these processes run in parallel rather than being directly linked. That gives us a clear pathway to making cobalt-based anodes robust and economically viable for green hydrogen production. There is also a potential to apply the same synchrotron methods to other catalysts, providing critical insights across a range of systems," said study contributor Associate Professor Rosalie Hocking from the Swinburne University of Technology.

The team's findings bring the vision of cheaper, large-scale green hydrogen a step closer. If cobalt-based catalysts can be stabilized for long-term use, it could remove a major barrier in the multi-GW application of this technology worldwide.

"This research is critical for the development of new anodes that don't rely on scarce materials," said Associate Professor Simonov.

"Green hydrogen can be a major tool in decarbonizing our economy but only if we can make its production truly sustainable and scalable."

Phys Org, 16 July 2025

https://phys.org

Long-Acting Injectable Provides a Steady Dose of Parkinson's Medication

2025-07-14

Scientists from the University of South Australia (UniSA) have developed a long-acting injectable formulation that delivers a steady dose of levodopa and carbidopa – two key medications for Parkinson's – over an entire week.

Their findings have been reported in the journal Drug Delivery and Translational Research.

The biodegradable formulation is injected under the skin or into muscle tissue, where it gradually releases the medication over seven days.

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Parkinson's disease is the second most common neurological disorder, affecting more than 8.5 million people worldwide. Currently there is no cure and the symptoms – tremors, rigidity and slow movement – are managed with oral medications that must be taken several times a day.

The frequent dosing is a burden, especially for elderly patients or those with swallowing difficulties, leading to inconsistent medication levels, more side effects, and reduced effectiveness.

Lead researcher Professor Sanjay Garg, from UniSA's Centre for Pharmaceutical Innovation, says the newly developed injectable could significantly improve treatment outcomes and patient adherence.

"Our goal was to create a formulation that simplifies treatment, improves patient compliance, and maintains consistent therapeutic levels of medication. This weekly injection could be a game-changer for Parkinson's care," Prof Garg says.

"Levodopa is the gold-standard therapy for Parkinson's, but its short life span means it must be taken several times a day."

UniSA PhD student Deepa Nakmode says the in-situ implant is designed to release both levodopa and carbidopa steadily over one week, maintaining consistent plasma levels and reducing the risks associated with fluctuating drug concentrations.

"After years of focused research, it's incredibly rewarding to see our innovation in long-acting injectables for Parkinson's disease reach this stage. Our invention has now been filed for an Australian patent," Nakmode says.

The injectable gel combines an FDA-approved biodegradable polymer PLGA with Eudragit L-100, a pH-sensitive polymer, to achieve a controlled and sustained drug release.

Extensive lab tests confirmed the system's effectiveness and safety:

- More than 90% of the levodopa dose and more than 81% of the carbidopa dose was released over seven days.
- The implant degraded by over 80% within a week and showed no significant toxicity in cell viability tests.
- The formulation can be easily administered through a fine 22-gauge needle, minimising discomfort and eliminating the need for surgical implant.

"The implications of this research are profound," Prof Garg says. "By reducing the frequency of dosing from multiple times a day to a weekly injection is a major step forward in Parkinson's therapy. We're not just improving how the drug is delivered; we're improving patients' lives."

Prof Garg says the technology could also be adapted for other chronic conditions such as cancer, diabetes, neurodegenerative disorders, pain management, and chronic infections that require long-term drug delivery.

The system can be tuned to release drugs over a period ranging from a few days to several weeks depending on therapeutic needs.

UniSA scientists hope to start clinical trials in the near future and are exploring commercialisation opportunities.

Technology Networks, 14 July 2025

https://technologynetworks.com

This AI-powered lab runs itself—and discovers new materials 10x faster

2025-07-14

Self-driving laboratories are robotic platforms that combine machine learning and automation with chemical and materials sciences to discover materials more quickly. The automated process allows machine-learning algorithms to make use of data from each experiment when predicting which experiment to conduct next to achieve whatever goal was programmed into the system.

"Imagine if scientists could discover breakthrough materials for clean energy, new electronics, or sustainable chemicals in days instead of years, using just a fraction of the materials and generating far less waste than the status quo," says Milad Abolhasani, corresponding author of a paper on the work and ALCOA Professor of Chemical and Biomolecular Engineering at North Carolina State University. "This work brings that future one step closer."

Until now, self-driving labs utilizing continuous flow reactors have relied on steady-state flow experiments. In these experiments, different precursors are mixed together and chemical reactions take place, while continuously flowing in a microchannel. The resulting product is then characterized by a suite of sensors once the reaction is complete.

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"This established approach to self-driving labs has had a dramatic impact on materials discovery," Abolhasani says. "It allows us to identify promising material candidates for specific applications in a few months or weeks, rather than years, while reducing both costs and the environmental impact of the work. However, there was still room for improvement."

Steady-state flow experiments require the self-driving lab to wait for the chemical reaction to take place before characterizing the resulting material. That means the system sits idle while the reactions take place, which can take up to an hour per experiment.

"We've now created a self-driving lab that makes use of dynamic flow experiments, where chemical mixtures are continuously varied through the system and are monitored in real time," Abolhasani says. "In other words, rather than running separate samples through the system and testing them one at a time after reaching steady-state, we've created a system that essentially never stops running. The sample is moving continuously through the system and, because the system never stops characterizing the sample, we can capture data on what is taking place in the sample every half second.

"For example, instead of having one data point about what the experiment produces after 10 seconds of reaction time, we have 20 data points - one after 0.5 seconds of reaction time, one after 1 second of reaction time, and so on. It's like switching from a single snapshot to a full movie of the reaction as it happens. Instead of waiting around for each experiment to finish, our system is always running, always learning."

Collecting this much additional data has a big impact on the performance of the self-driving lab.

"The most important part of any self-driving lab is the machine-learning algorithm the system uses to predict which experiment it should conduct next," Abolhasani says. "This streaming-data approach allows the self-driving lab's machine-learning brain to make smarter, faster decisions, honing in on optimal materials and processes in a fraction of the time. That's because the more high-quality experimental data the algorithm receives, the more accurate its predictions become, and the faster it can solve a problem. This has the added benefit of reducing the amount of chemicals needed to arrive at a solution."

In this work, the researchers found the self-driving lab that incorporated a dynamic flow system generated at least 10 times more data than self-driving labs that used steady-state flow experiments over the same period

of time, and was able to identify the best material candidates on the very first try after training.

"This breakthrough isn't just about speed," Abolhasani says. "By reducing the number of experiments needed, the system dramatically cuts down on chemical use and waste, advancing more sustainable research practices.

"The future of materials discovery is not just about how fast we can go, it's also about how responsibly we get there," Abolhasani says. "Our approach means fewer chemicals, less waste, and faster solutions for society's toughest challenges."

The paper, "Flow-Driven Data Intensification to Accelerate Autonomous Materials Discovery," will be published July 14 in the journal Nature Chemical Engineering. Co-lead authors of the paper are Fernando Delgado-Licona, a Ph.D. student at NC State; Abdulrahman Alsaiari, a master's student at NC State; and Hannah Dickerson, a former undergraduate at NC State. The paper was co-authored by Philip Klem, an undergraduate at NC State; Arup Ghorai, a former postdoctoral researcher at NC State; Richard Canty and Jeffrey Bennett, current postdoctoral researchers at NC State; Pragyan Jha, Nikolai Mukhin, Junbin Li and Sina Sadeghi, Ph.D. students at NC State; Fazel Bateni, a former Ph.D. student at NC State; and Enrique A. López-Guajardo of Tecnologico de Monterrey.

Science Daily, 14 July 2025

https://sciencedaily.com

MIT Gave Photosynthesis a Speed Boost – Here's What That Could Mean for Food and Climate

2025-07-15

Using a cutting-edge technique called continuous directed evolution, they boosted the enzyme's efficiency by up to 25%. This lab-evolved rubisco resists oxygen interference and could pave the way for faster-growing crops, more efficient plants, and a potential leap in agricultural productivity worldwide.

Supercharging Rubisco via Directed Evolution

During photosynthesis, an enzyme called rubisco catalyzes a key reaction — the incorporation of carbon dioxide into organic compounds to create sugars. However, rubisco, which is believed to be the most abundant enzyme on Earth, is very inefficient compared to the other enzymes involved in photosynthesis.

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MIT chemists have now shown that they can greatly enhance a version of rubisco found in bacteria from a low-oxygen environment. Using a process known as directed evolution, they identified mutations that could boost rubisco's catalytic efficiency by up to 25 percent.

The researchers now plan to apply their technique to forms of rubisco that could be used in plants to help boost their rates of photosynthesis, which could potentially improve crop yields.

"This is, I think, a compelling demonstration of successful improvement of a rubisco's enzymatic properties, holding out a lot of hope for engineering other forms of rubisco," says Matthew Shoulders, the Class of 1942 Professor of Chemistry at MIT.

Shoulders and Robert Wilson, a research scientist in the Department of Chemistry, are the senior authors of the new study, which was published in the Proceedings of the National Academy of Sciences. MIT graduate student Julie McDonald is the paper's lead author.

Evolution of Efficiency

When plants or photosynthetic bacteria absorb energy from the sun, they first convert it into energy-storing molecules such as ATP. In the next phase of photosynthesis, cells use that energy to transform a molecule known as ribulose bisphosphate into glucose, which requires several additional reactions. Rubisco catalyzes the first of those reactions, known as carboxylation. During that reaction, carbon from CO2 is added to ribulose bisphosphate.

Compared to the other enzymes involved in photosynthesis, rubisco is very slow, catalyzing only one to 10 reactions per second. Additionally, rubisco can also interact with oxygen, leading to a competing reaction that incorporates oxygen instead of carbon — a process that wastes some of the energy absorbed from sunlight.

"For protein engineers, that's a really attractive set of problems because those traits seem like things that you could hopefully make better by making changes to the enzyme's amino acid sequence," McDonald says.

Previous research has led to improvement in rubisco's stability and solubility, which resulted in small gains in enzyme efficiency. Most of those studies used directed evolution — a technique in which a naturally occurring protein is randomly mutated and then screened for the emergence of new, desirable features.

A Better Way to Mutate and Screen

This process is usually done using error-prone PCR, a technique that first generates mutations in vitro (outside of the cell), typically introducing only one or two mutations in the target gene. In past studies on rubisco, this library of mutations was then introduced into bacteria that grow at a rate relative to rubisco activity. Limitations in error-prone PCR and in the efficiency of introducing new genes restrict the total number of mutations that can be generated and screened using this approach. Manual mutagenesis and selection steps also add more time to the process over multiple rounds of evolution.

The MIT team instead used a newer mutagenesis technique that the Shoulders Lab previously developed, called MutaT7. This technique allows the researchers to perform both mutagenesis and screening in living cells, which dramatically speeds up the process. Their technique also enables them to mutate the target gene at a higher rate.

"Our continuous directed evolution technique allows you to look at a lot more mutations in the enzyme than has been done in the past," McDonald says.

From Bacteria to Better Biochemistry

For this study, the researchers began with a version of rubisco, isolated from a family of semi-anaerobic bacteria known as Gallionellaceae, that is one of the fastest rubisco found in nature. During the directed evolution experiments, which were conducted in E. coli, the researchers kept the microbes in an environment with atmospheric levels of oxygen, creating evolutionary pressure to adapt to oxygen.

After six rounds of directed evolution, the researchers identified three different mutations that improved the rubisco's resistance to oxygen. Each of these mutations are located near the enzyme's active site (where it performs carboxylation or oxygenation). The researchers believe that these mutations improve the enzyme's ability to preferentially interact with carbon dioxide over oxygen, which leads to an overall increase in carboxylation efficiency.

Oxygen Resistance and Enzyme Preference

"The underlying question here is: Can you alter and improve the kinetic properties of rubisco to operate better in environments where you want it to operate better?" Shoulders says. "What changed through the directed evolution process was that rubisco began to like to react with oxygen less.

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That allows this rubisco to function well in an oxygen-rich environment, where normally it would constantly get distracted and react with oxygen, which you don't want it to do."

In ongoing work, the researchers are applying this approach to other forms of rubisco, including rubisco from plants. Plants are believed to lose about 30 percent of the energy from the sunlight they absorb through a process called photorespiration, which occurs when rubisco acts on oxygen instead of carbon dioxide.

Agricultural Potential and the Road Ahead

"This really opens the door to a lot of exciting new research, and it's a step beyond the types of engineering that have dominated rubisco engineering in the past," Wilson says. "There are definite benefits to agricultural productivity that could be leveraged through a better rubisco."

Sci Tech Daily, 15 July 2025

https://scitechdaily.com

Chemistry 'deserts' threaten to push poorer undergraduates out

2025-07-18

The UK is facing a drought. I'm not talking about the paucity of rainfall this summer but the way in which undergraduate chemistry provision across the country is starting to dry up. With cash-strapped universities discontinuing courses or closing departments altogether, new chemistry 'deserts' are now opening up across the UK – areas where the nearest institute teaching the subject is over an hour's drive away. This development could worsen the problem of falling numbers of chemistry students and hit the poorest in society hardest.

The causes of higher education's financial problems are multi-faceted but what matters is that chemistry departments – as one of the most expensive subjects thanks to their teaching commitments and labs – have been squeezed hard. This has led to closures of chemistry departments such as those at Hull and Bangor that have left would-be chemistry students in the Humber and East Yorkshire and in North Wales with no local provision. The financial pressures that precipitated these tough decisions by universities haven't gone away and further course and departmental closures in chemistry are a distinct possibility in the coming years, threatening further desertification.

The students who will miss out as chemistry becomes concentrated in fewer institutions will be the poorest. A 2018 report from the Sutton Trust found that a quarter of students were living at their family home a short commute from their university. However, the poorest students were around three times more likely to be living at home (45%) than the wealthiest (13%), as the cost of accommodation puts moving further away beyond the reach of many. The harder it becomes for students from lower socio-economic backgrounds to stay at home while studying chemistry, the less likely it is that they will choose to study it.

If those students are deprived of the opportunity to pursue chemistry, then the field as a whole is deprived of a large pool of potential talent. This would be a loss to the field at a time when the Royal Society of Chemistry is projecting that chemistry jobs are set to grow faster than those in other sectors. Providing an even geographic spread of chemistry provision is exceptionally difficult – if not practically impossible. At this stage, the problem of chemistry deserts or 'cold spots' is being identified, and that is the first step to tackling this important issue.

Chemistry World, 18 July 2025

https://chemistryworld.com

Holographic precision, super-resolution vision: Scientists reveal hidden world of vital cellular structures

2025-07-16

A team of NYU chemists and physicists are using cutting-edge tools—holographic microscopy and super-resolution imaging—to unlock how cells build and grow tiny, dynamic droplets known as biomolecular condensates.

For the first time, scientists measured the protein content and growth dynamics of individual biomolecular condensates without disturbing them, gaining insights that may shape future drug development and disease modeling.

Biomolecular condensates manage vital cellular functions, from regulating genes to responding to stress. Until now, studying them has involved distorting them.

"It's been the elephant in the room for scientists," said Saumya Saurabh, assistant professor of chemical biology at NYU and the senior author of the new study, published in the Journal of the American Chemical

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Society. "Our research provides a precise and noninvasive way to study biomolecular condensates."

"Being able to see 'under the hood' for the first time has revealed some big surprises about this important class of systems," said study author David Grier, professor of physics and director of the Center for Soft Matter Research at NYU.

Peering into the unknown

Biomolecular condensates are microscopic structures that concentrate specific molecules, like proteins and nucleic acids, without being enclosed by a membrane. This process, known as phase separation, is crucial for organizing cellular biochemistry. While the NYU study focuses on these dynamic droplets in vitro—in a controlled laboratory setting—the fundamental principles they uncover are directly applicable to understanding their behavior within living cells.

"Often compared to oil-and-water droplets, the intricate reality of biomolecular condensates, as revealed by our findings, goes far beyond simple liquid-liquid phase separation," noted Saurabh.

To study biomolecular condensates under the microscope, researchers have traditionally been limited to using fluorescent tags or two-dimensional surfaces, both of which can significantly disturb the droplets' behavior. This is a critical challenge, as these condensates are remarkably sensitive to their environment.

"I was surprised by their complex and incredibly sensitive response to different ionic species. Even a small change in ionic valency drastically altered both condensate concentration and dynamics," said Julian von Hofe, a Ph.D. candidate in Saurabh's group, who is the first author on the study.

To overcome these issues, the researchers sought a way to examine condensates in real time to gather information without damaging them. Their solution: a system that slowly flows thousands of droplets through a holographic microscope.

Holographic precision meets single-molecule resolution

Grier's lab has pioneered the use of holographic microscopy, which uses lasers and lenses to create three-dimensional images, or holograms, of particles that are captured on video for analysis. This technique allows scientists to flow particles in a solution so that they can be clearly seen

and individually characterized—without the need for fluorescent labels or attachment to a surface.

Applying this novel, label-free method to condensates formed by PopZ, a bacterial protein crucial for cell growth, the researchers first aimed to precisely measure the concentration of proteins within condensates. Inspired by Benjamin Franklin's eighteenth-century experiment, which used an oil slick to infer a single molecule's length, the team measured the volume of a single protein to determine the protein concentration inside condensates.

Using this idea, they found that relevant biomolecules could concentrate proteins more than tenfold inside condensates. However, the way that the observed condensates grew was unexpected and defied classical models of growth, leading them to pursue single-molecule imaging.

To unravel the complex internal architecture and dynamics, the team utilized super-resolution imaging—a Nobel Prize-winning technology and a main forte for Saurabh's research. These data revealed that condensates were not simple uniform droplets but exhibited intricate nanoscale organization, a realm 1,000 to 100,000 times smaller than the width of a human hair. The findings were strongly supported by molecular dynamics simulations, which provided atomic-level insights into these enigmatic assemblies.

"Our collaboration has introduced fast, precise, and effective methods for measuring the composition and dynamics of macromolecular condensates," said Grier.

From droplets to diseases and drug delivery

Understanding how biomolecular condensates are organized and grow may hold clues for treating a range of illnesses, from cancer and infectious diseases to neurological disorders.

"In a disease like ALS, the proteins that form plaques in disease are fluid condensates in good health. Understanding how a spherical condensate forms into a deadly plaque is an opportunity to better understand ALS," said Saurabh.

In addition, scientists recently discovered that many drug molecules end up inside biomolecular condensates in the cells. This sequestering of drugs within condensates may help explain why drugs that are made to target a specific protein still cause side effects.

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With this new approach to analyzing condensates, scientists can now measure small differences in condensate composition and architecture as new molecules partition inside them.

"For example, we can now explore the chemical space of drug modifications to precisely control their partitioning, achieving the specificity needed to prevent them from entering condensates," said Saurabh. "This opens new avenues for how we think about designing drugs and their potential side effects."

Other study authors include Jatin Abacousnac, Mechi Chen, Moeka Sasazawa, and Ida Javér Kristiansen of NYU, as well as Soren Westrey of Carnegie Mellon University.

Phys Org, 16 July 2025

https://phys.org

First-of-its-kind crystal laser could power safer sensors and smarter tech

2025-07-12

In a first for the field, researchers from The Grainger College of Engineering at the University of Illinois Urbana-Champaign have reported a photopumped lasing from a buried dielectric photonic-crystal surface-emitting laser emitting at room temperature and an eye-safe wavelength. Their findings, published in IEEE Photonics Journal, improve upon current laser design and open new avenues for defense applications.

For decades, the lab of Kent Choquette, professor of electrical and computer engineering, have explored VCSELs, a type of surface-emitting laser used in common technology like smartphones, laser printers, barcode scanners, and even vehicles. But in early 2020, the Choquette lab became interested in groundbreaking research from a Japanese group that introduced a new type of laser called photonic-crystal surface-emitting lasers, or PCSELs.

PCSELs are a newer field of semiconductor lasers that use a photonic crystal layer to produce a laser beam with highly desirable characteristics such as high brightness and narrow, round spot sizes. This type of laser is useful for defense applications such as LiDAR, a remote sensing technology used in battlefield mapping, navigation, and target tracking. With funding from the Air Force Research Laboratory, Choquette's

group wanted to examine this new technology and make their own advancements in the growing field.

"We believe PCSELs will be extremely important in the future," said Erin Raftery, a graduate student in electrical and computer engineering and the lead author of the paper. "They just haven't reached industrial maturity yet, and we wanted to contribute to that."

PCSELs are typically fabricated using air holes, which become embedded inside the device after semiconductor material regrows around the perimeter. However, atoms of the semiconductor tend to rearrange themselves and fill in these holes, compromising the integrity and uniformity of the photonic crystal structure. To combat this problem, the Illinois Grainger engineers swapped the air holes for a solid dielectric material to prevent the photonic crystal from deforming during regrowth. By embedding silicon dioxide inside the semiconductor regrowth as part of the photonic crystal layer, researchers were able to show the first proof of concept design of a PCSEL with buried dielectric features.

"The first time we tried to regrow the dielectric, we didn't know if it was even possible," Raftery said. "Ideally, for semiconductor growth, you want to maintain that very pure crystal structure all the way up from the base layer, which is difficult to achieve with an amorphous material like silicon dioxide. But we were actually able to grow laterally around the dielectric material and coalesce on top."

Members of the field anticipate that in the next 20 years, these new and improved lasers will be used in autonomous vehicles, laser cutting, welding, and free space communication. In the meantime, Illinois engineers will improve on their current design, recreating the same device with electrical contacts allowing the laser to be plugged into a current source for power.

"The combined expertise of Erin and members of the Minjoo Larry Lee group, as well as the facilities and expertise at the Air Force Research Laboratory on Wright-Patterson Air Force Base were necessary to accomplish this result," Choquette said. "We look forward to diode PCSEL operation."

Kent Choquette is an Illinois Grainger Engineering professor of electrical & computer engineering and is affiliated with the Holonyak Micro & Nanotechnology Laboratory. Choquette holds the Abel Bliss Professorship in Engineering.

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Minjoo Larry Lee is an Illinois Grainger Engineering professor of electrical & computer engineering and is the director of the Holonyak Micro & Nanotechnology Laboratory. Lee is an Intel Alumni Endowed Faculty Scholar.

Science Daily, 12 July 2025

https://sciencedaily.com

Smarter silicone bonding enables engineering of stronger soft devices

2025-07-16

In a step forward for soft robotics and biomedical devices, Rice University engineers have uncovered a powerful new way to boost the strength and durability of silicone-based soft devices without changing the materials themselves. Their study, published in a special issue of Science Advances, focuses on printed and musculoskeletal robotics and offers a predictive framework that connects silicone curing conditions with adhesion strength, enabling dramatic improvements in performance for both molded and 3D-printed elastomer components.

We found that the extent to which a silicone elastomer is cured at the time of bonding directly impacts how well it adheres," said Daniel J. Preston, corresponding author of the paper and assistant professor of mechanical engineering. "By understanding and controlling this variable, we can significantly enhance device reliability without introducing new chemicals or treatments."

Silicone's sticky situation

Silicone elastomers are prized across industries—from surgical implants to kitchen tools to soft robots—thanks to their flexibility, chemical stability and biocompatibility. But bonding silicone components together during manufacturing has long posed a challenge. Poor adhesion can lead to delamination, leaks or catastrophic device failure, especially in soft robots where flexible chambers must withstand repeated inflation and deformation.

"Strong, consistent bonding is absolutely crucial in these applications," said Te Faye Yap, first author of the paper, who received her doctorate at Rice and is now an assistant professor of mechanical engineering at the University of Hawaii. "Consistently achieving this level of strong bonding,

however, has been difficult, especially as devices become more complex and rely on multilayered or hybrid designs."

The issue stems from how silicone cures: During processing, liquid prepolymers gradually transform into solids through a sol-gel reaction. If bonding occurs too late (after the material is fully cured), the interface lacks the chemical cohesion needed for a strong joint. Until now, predicting when that transition occurs under real-world conditions has been difficult.

A predictive 'clock'

To tackle this, the Rice engineering team developed a novel framework that ties the curing process to a "reaction coordinate"—a dimensionless value that accounts for both time and temperature during curing. This metric allowed the researchers to precisely track the degree of curing, even under variable thermal conditions like those found in industrial ovens or 3D printers.

"Our reaction coordinate gives us a kind of clock," Preston said. "It tells us when the material has partially cured enough to be handled but is still fresh enough to form strong chemical bonds with an adhesive layer."

This discovery not only clarifies when adhesion is most effective but also helps predict when it will fail. Using peel tests, the team showed that adhesion strength plummets once the reaction coordinate crosses a critical threshold. At that point, newly applied silicone no longer forms robust covalent bonds with the underlying layer, and the interface fails under stress.

Real-world validation

To prove their model in practice, the team fabricated soft pneumatic actuators (common components in soft robots) by joining precured silicone components using fresh silicone as an adhesive. Devices bonded within the optimal reaction window withstood higher pressures and bent with 50% greater curvature than their overcured counterparts.

In another experiment, the team used a 3D bioprinter to fabricate silicone structures layer by layer. Guided by their reaction coordinate, they precisely controlled the time between printing each layer and achieved more than 200% improvement in interlayer adhesion compared to traditional printing methods.

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"We were able to tune the curing conditions to dial in adhesion exactly where we wanted it," Preston said. "This capability opens the door to stronger, more reliable 3D-printed silicone devices with intricate geometries."

The implications of this work are broad. Manufacturers of medical implants, wearable electronics and flexible robots could fabricate more durable devices without relying on chemical surface treatments or costly plasma bonding techniques. Additive manufacturing of soft devices, which is an area gaining traction in the medical and wearable tech industries, can particularly benefit from this approach.

"Our framework is simple, generalizable and doesn't require any new materials," Preston said. "It's a guide that engineers can begin using immediately to make better products."

Phys Org, 16 July 2025

https://phys.org

Technical Notes

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

CHEMICAL EFFECTS

Effect-directed analysis of hazardous organic chemicals released from ship hull hydroblasting effluents and their emission to marine environments

Soil to Synapse: Molecular Insights into the Neurotoxicity of Common Gardening Chemicals in Alzheimer's and Parkinson's Disease

Optimization of the Organic Matter Content and Temperature in a Bioreactor to Enhance Carbon Monoxide Production During the Initial Phase of Food Waste Composting

ENVIRONMENTAL RESEARCH

Injectable microenvironment-responsive hydrogels encapsulating engineered NF-κB-targeting circular RNA for osteoarthritis therapy

Microplastic surge in the Ariyankuppam river, Puducherry, India: A study on abundance, characterization, and pollution load index

PHARMACEUTICAL/TOXICOLOGY

Oncologist and General Practitioner Perspectives of Shared Care for Colorectal Cancer Survivors: A Qualitative Study

Reforming Food, Drug, and Nutraceutical Regulations to Improve Public Health and Reduce Healthcare Costs

Paternal and maternal exposures to per- and polyfluoroalkyl substances (PFAS) and birth outcomes: a multi-country cohort study

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Assessing the effectiveness of an occupational musculoskeletal ınjury prevention program for paramedic students: A quasi-experimental, pretest-posttest study

Effectiveness of an app-delivered, self-management exercise program in public safety workers with chronic low back pain: a randomized controlled trial