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

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ASIA PACIFIC

The Silica National Strategic Plan 2024–2030

2024-11-30

The Silica National Strategic Plan 2024–2030 (SNSP) has been developed in response to the reemergence of silicosis and other silica-related diseases in Australia. The SNSP is based on a draft National Silicosis Prevention Strategy and associated National Action Plan10 developed by the Lung Foundation Australia for the Department of Health and Aged Care, under the guidance of an Expert Steering Committee across 2021 and 2022. It actions recommendation 3A in the National Dust Disease Taskforce's Final Report4 which called for finalisation of a strategy to drive coordinated national action to address increasing rates of silicosis. This recommendation is supported by all Australian governments.

Read More

Asbestos Safety, 30-11-24

https://www.asbestossafety.gov.au/sites/default/files/documents/2024-11/Silica%20National%20Strategic%20Plan%202024-30.PDF

Do not crush engineered stone — unless an exception applies

2024-12-13

Engineered stone benchtops, panels or slabs, must not be processed — unless an exception applies — into crushed rock. Processing engineered stone benchtops, panels or slabs into crushed rock for supply or recycling for other purposes is prohibited and is not an exception.

The manufacture, supply, processing or installation of engineered stone benchtops, panels or slabs is banned in Victoria.

The ban is to help protect employees from inhaling deadly crystalline silica dust.

There are limited exceptions to the ban. The exceptions include the disposal of engineered stone benchtops, panels and slabs.

Engineered stone cannot be processed unless an exception contained in regulation 319ZB of the Occupational Health and Safety Regulations 2017 applies.

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This means that engineered stone cannot be processed into crushed rock for the purpose of recycling and supply.

Read More

Work Safe Victoria, 13-12-24

https://www.worksafe.vic.gov.au/safety-alerts/do-not-crush-engineered-stone-unless-exception-applies

Do electric vehicles catch fire when submerged in salty sea water? We look at the facts

2024-10-11

As Hurricane Milton approached landfall in Florida earlier this week, electric vehicles (EVs) found themselves on trial.

Fears of EVs exploding when submerged in salt water raced ahead of the natural disaster, with town mayors and county sheriffs calling the cars "ticking time bombs" and urging owners to park them out of danger on elevated ground.

Social media, meanwhile, was awash with snarky memes mocking EV owners who'd have to evacuate areas without electricity.

Yet in Facebook groups such as the Florida Rivian Club, the story was very different. Owners of the Rivian large EV utes proudly posted photos of them skipping long queues for petrol or powering their homes with the cars' chunky batteries.

"I did feel like I was cheating when I drove past all of the people waiting in line to get gas and just pulled into a supercharger spot," Rob, an anaesthetist in Saint Petersburg, Florida, told the ABC.

"Most EV owners charge at home, so there's no scrambling to find gas when everybody starts evacuating."

These wildly diverging narratives are examples of the way "green" technologies intended to address the climate crisis, from EVs to wind turbines and solar panels, come under intense scrutiny during climate-charged disasters.

Read More

ABC, 11-10-24

https://www.abc.net.au/news/science/2024-10-11/electric-vehicles-evs-salt-water-fire-hurricane-milton/104455856

Agvet chemical voluntary recall: Gramoxone 360 Pro Herbicide

2025-01-06

Product name: Gramoxone 360 Pro Herbicide

APVMA registration number: 68577

APVMA approved label number: 137924

Batch numbers: 389865 and 389866

Sold by: Agricultural retailers nationwide between 01 October 2024 to 23 December 2024.

On 23 December 2024, Syngenta Australia Pty Ltd (ACN 002 933 717) initiated a voluntary recall under section 106 of the Agricultural and Veterinary Chemicals Code scheduled to the Agricultural and Veterinary Chemicals Code Act 1994 in relation to the chemical product described above.

Read More

APVMA, 06-01-25

https://www.apvma.gov.au/news-and-publications/publications/gazette/special-gazette-06-january-25

AMERICA

EPA Updates Guide to Help Translate Pesticide Safety Labels into Spanish

2024-12-26

The U.S. Environmental Protection Agency (EPA) is announcing updates to the Spanish Translation Guide for Pesticide Labeling(Spanish Translation Guide), a resource for the translation of the required human health and safety sections on pesticide labeling from English to Spanish.The Spanish

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translations ensure that workers have access to important information to protect themselves and others from pesticide exposure, protect the environment, and get appropriate help if exposed to a pesticide product.

EPA initially developed the Spanish Translation Guide in 2019 in response to feedback from stakeholders who believe that having bilingual pesticide labeling is critical to the wellbeing of pesticide handlers, applicators, and farmworkers, many of whom do not speak English as a first language. The Pesticide Registration Improvement Act of 2022 (PRIA 5), enacted on Dec. 29, 2022, amended the Federal, Insecticide, Fungicide, and Rodenticide Act (FIFRA) to require Spanish language translation for sections of the end use product labeling where translation examples are available in the Spanish Translation Guide. The Spanish Translation Guide is written in a universal form of Spanish to reach as many Spanish speakers as possible. It helps registrants maintain accurate, consistent translations on product labels and ease their burden when adding Spanish translations.

Drawing on stakeholder feedback, the 2024 version of the Spanish Translation Guide includes additional info on:

- Restricted use pesticides;
- Misuse statements;
- First aid and precautionary statement label language;
- Personal protective equipment (PPE) label statements;
- New sections on engineering controls, environmental hazards, and physical or chemical hazards; and
- Storage and pesticide container disposal instructions.

EPA generally allows pesticide registrants to translate their product labels into any language as long as there is an EPA-accepted English version of the label, and the translation is true and accurate. Registrants will need to translate all sections of the label contained in the Spanish Translation Guide beginning in 2025, as specified in PRIA 5. The guide includes several new sections required to be translated, such as environmental hazard statements. Registrants who have already translated the new sections into Spanish and verified that the translations are 'true and accurate' do not have to revise those sections of the label.

The revised Spanish Translation Guide is available for download from EPA's website and in docket EPA-HQ-OPP-2024-0521at www.regulations.gov. For more information on the PRIA 5 requirements and deadline to implement bilingual labeling visit EPA's bilingual labeling page.

Read More

US EPA, 26-12-24

https://www.epa.gov/pesticide-labels/spanish-translation-guide-pesticide-labeling

Test Your Knowledge of Climate Law

2024-12-24

How much do you really know about the law relating to climate change?

In case you're stressing out over the election –and you should be, whichever side you're — this little quiz could offer a welcome diversion. Climate change is inevitably a complex subject. Test your own knowledge of the legal aspects of the subject by answering a few quick questions.

Don't worry if you have trouble. Our audience isn't just people who live and breathe climate law. We do our best to make sure that you don't need to know the answers to any of these questions to understand Legal Planet posts.

On the other hand, if you're an environmental law student and you miss most of the answers, you might want to hit the books again.

Read More

Legal Planet, 24-12-24

https://legal-planet.org/2024/12/26/test-your-knowledge-of-climate-law/

EPA Reforms New Chemicals Review Process to Better Protect Public Health, Promote Efficiency and Consistency

2024-12-04

Final amendments will ensure that new PFAS and persistent, bioaccumulative and toxic (PBT) chemicals are subject to safety review process prior to manufacture

The U.S. Environmental Protection Agency (EPA) finalized amendments to the regulations that govern the Agency's review of new chemicals under the Toxic Substances Control Act (TSCA) to ensure that new per- and polyfluoroalkyl substances (PFAS) and persistent, bioaccumulative and toxic (PBT) chemicals with potential for human exposure are always

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subject to the full, robust safety review process prior to manufacture. Under TSCA, EPA plays an important role by reviewing the potential risks of new chemicals before they can enter U.S. commerce and, when necessary, putting safeguards in place to protect human health and the environment. Today's final rule also improves efficiency and aligns with the 2016 bipartisan TSCA amendments under the Frank R. Lautenberg Chemical Safety for the 21st Century Act, and is largely similar to the rule EPA proposed in May 2023.

"EPA's review of new chemicals should encourage innovation, while also making sure that new chemistries can be used safely before they are allowed to enter commerce," said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff. "Today, we've modernized our chemical reviews and continued to protect people from unsafe new PFAS."

Eliminate exemptions for PFAS and PBTs with potential for human exposure

Today's final rule ensures that new PFAS are always subject to the full, robust safety review process prior to manufacture by eliminating their eligibility for a low volume exemption (LVE) or low release and exposure exemption (LoREX). Existing regulations allow EPA to grant safety review exemptions for the manufacturing of chemicals with low production quantities, environmental releases or human exposures. These exemptions allow the chemicals (which historically have included some PFAS) to undergo a shorter review instead of the full, robust review prior to manufacture.

This action furthers the Biden-Harris Administration's commitment to address the impacts of these "forever chemicals" and advances EPA's PFAS Strategic Roadmap to confront the serious human health and environmental risks of PFAS. This final rule will help ensure that every community is protected from a potential range of severe health problems, including those that impact workers and children.

In April 2021, EPA announced new PFAS would be unlikely to qualify for these exemptions going forward given the complexity of PFAS chemistry, potential health effects, and their longevity and persistence in the environment. As the Agency then explained, it is challenging to complete a review of PFAS exemption submissions in the 30 days the regulations allow. This rule makes new PFAS categorically ineligible for the LVE and LoREX exemptions and makes PBT chemicals ineligible

when environmental releases are anticipated or there are potentially unreasonable exposures.

Read More

US EPA, 04-12-24

https://www.epa.gov/newsreleases/epa-reforms-new-chemicals-review-process-better-protect-public-health-promote

Biden-Harris Administration Announces Final Rule for Carbon Tetrachloride to Protect Workers

2024-12-11

The U.S. Environmental Protection Agency finalized a rule to protect workers from exposure to carbon tetrachloride (CTC), a chemical known to be toxic to the liver and cause liver cancer, brain tumors and adrenal gland tumors. This final rule will protect people from these risks through the requirement of robust worker safety programs and banning some uses. This risk management rule aligns with President Biden's Cancer Moonshot, a whole-of-government approach to end cancer as we know it. This is the fifth risk management rule to be finalized using the process created by the bipartisan 2016 Toxic Substances Control Act (TSCA) amendments, marking another major milestone for chemical safety since President Biden took office after decades of inadequate protections and serious delays.

"With this action, we're ensuring that the chemicals we need to power our economy are used safely," said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff. "This rule puts necessary protections in place for workers, while also ensuring that important uses of this chemical can continue safely without unreasonable risk."

"President Biden has championed actions that reduce Americans' exposure to known cancer-causing toxins, so that we can prevent more cancers before they start," said Deputy Assistant to the President for the Cancer Moonshot Danielle Carnival. "Today's announcement is a win for American workers. Thanks to protections like this one, many families will never have to face a cancer diagnosis."

CTC is a solvent used in commercial settings as a raw material for producing other chemicals like those used in refrigerants, aerosol propellants and foam-blowing agents. The U.S. Consumer Product Safety Commission banned the use of CTC in consumer products in 1970.

Requirements under the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) and the Clean Air Act phased out CTC production in the United States in 1996 for most domestic uses that did not involve manufacturing other chemicals.

The continued, safe use of CTC in the manufacture of low global warming potential chemicals used in refrigerants, aerosol propellants and foam-blowing agents is particularly important in the agency's efforts to support the American Innovation and Manufacturing Act of 2020 (AIM Act) and the Kigali Amendment to the Montreal Protocol.

Read More

US EPA, 11-12-24

https://www.epa.gov/newsreleases/biden-harris-administration-announces-final-rule-carbon-tetrachloride-protect-workers

EUROPE

2025 MAP: France's new clean air driving zones and their rules

2025-01-03

All areas with a population of 150,000 or more now have rules in place restricting certain vehicles from entering, and require all vehicles to have 'Crit'Air' stickers on their windscreen

All French urban areas with a population of 150,000 or more now have low-emission zones (zones à faibles émissions, ZFE) in place which can restrict the types of vehicles that can drive within their limits.

Many of these were introduced this January and have seen relatively minor changes to the vehicles which are authorised to access the zones.

However, all vehicles driving through these zones, including foreign-registered vehicles and two wheelers, must be equipped with a 'clean air' sticker.

This is known as a 'Crit'Air' vignette and must be placed on the vehicle's windscreen [or the front, such as fork or mudguard, of a motorbike], and show the pollution level of the vehicle.

Read More

The Connexion, 03-01-25

https://www.connexionfrance.com/news/2025-map-frances-new-clean-air-driving-zones-and-their-rules/602592

Upcoming EU active substance expiry date

2025-01-14

Biocidal products must be phased off the NI market

The active substance/product type combinations listed below are due to expire under the EU Biocidal Products Regulation (EU BPR) on the following date. This affects NI:

30 June 2025

- 1-(4-chlorophenyl)-4,4-dimethyl-3-(1,2,4-triazol-1-ylmethyl)pentan-3-ol (tebuconazole) (CAS 107534-96-3 EC 403-640-2) in product types 7 and 10

Once the approvals expire, the active substance will no longer be able to be used in biocidal products of the relevant product types in NI. In addition articles treated with such products will no longer be able to be placed on the market in NI.

If you hold an affected EU BPR product authorisation or Control of Pesticides Regulations (COPR) product approval, we will contact you about cancelling or revoking your authorisation or approval. You will have an opportunity to submit comments or additional information, and we will take account of these when finalising our decision.

Read More

UK HSE, 14-01-24

https://www.hse.gov.uk/

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EU active substance expiry dates postponed

2025-01-14

Active substance expiry dates postponed whilst the renewal evaluation is completed in the EU

For reasons beyond the control of the applicants, the approvals of the active substance/product type combinations listed below were likely to expire before a decision could be taken on their renewal under the EU BPR.

To allow sufficient time for the renewal evaluation to be completed, a decision has been taken to postpone the expiry dates of the following approvals. This affects NI:

From 31 January 2025 to 31 July 2026

- Dazomet (CAS 533-74-4 EC 208-576-7) in product type 8

From 31 January 2025 to 31 January 2027

- N,N-diethyl-meta-toluamide (CAS 134-62-3 EC 205-149-7) in product type 19

From 31 March 2025 to 30 September 2027

- Tralopyril (CAS 214710-34-6 EC 602-784-5) in product type 21

Read More

UK HSE, 14-01-24

https://www.hse.gov.uk/

Commission adopts ban of Bisphenol A in food contact materials

2024-11-29

The Commission has today adopted a ban on the use of Bisphenol A (BPA) in food contact materials, due to its potentially harmful health impact. BPA is a chemical substance used in the manufacture of certain plastics and resins.

The ban means that BPA will not be allowed in products that come into contact with food or drink, such as the coating on metal cans, reusable

plastic drink bottles, water distribution coolers and other kitchenware. The ban follows a positive vote by EU Member States earlier this year, and a scrutiny period by the Council and the European Parliament, and takes into account the latest scientific assessment from the European Food Safety Authority (EFSA). EFSA notably concluded that BPA had potentially harmful effects on the immune system, and the proposed ban followed both a public consultation and extensive discussions with all Member States.

BPA is already banned in the EU for infant bottles and similar products. For most products, there will be an 18-month phase out period, and very limited exceptions where no alternatives exist, to allow industry time to adapt and avoid disruption in the food chain. The ban also includes other bisphenols that are harmful to the reproductive and endocrine systems.

Oliver Várhelyi, Commissioner for Health & Animal Welfare, said: "Maintaining high food safety standards in the European Union and protecting citizens is one of the Commission's highest priorities. Today's ban, which is based on solid scientific advice, will protect our consumers against harmful chemicals where they can come into contact with their food and drink."

Details

Publication date

19 December 2024

Author

Directorate-General for Health and Food Safety

Read More

Europa EU, 29-11-2024

https://ec.europa.eu/newsroom/sante/items/859180/en

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INTERNATIONAL

Plastic pollution negotiations adjourn with new text and a follow-up session planned

2024-12-01

Countries negotiating an international legally binding instrument on plastic pollution, including in the marine environment, adjourned their fifth session today with agreement on a 'Chair's Text' that will serve as the starting point for negotiations at a resumed session in 2025.

Over 3,300 delegates – including Members representing more than 170 nations and Observers from more than 440 organizations – have been meeting in Busan, Republic of Korea, since 25 November for the fifth session of the Intergovernmental Negotiating Committee (INC-5). Through the week, Members negotiated two documents by the INC Chair, Ambassador Luis Vayas Valdivieso, before agreeing on the closing day to transmit the Chair's Text to the resumed session.

"The world's commitment to ending plastic pollution is clear and undeniable. Here in Busan, talks have moved us closer to agreeing on a global legally binding treaty that will protect our health, our environment, and our future from the onslaught of plastic pollution," said Inger Andersen, Executive Director of the UN Environment Programme (UNEP).

"This week's meeting has made good progress towards securing the deal the world demands. Through the Busan talks, negotiators have reached a greater degree of convergence on the structure and elements of the treaty text, as well as a better understanding of country positions and shared challenges. But it is clear there is persisting divergence in critical areas and more time is needed for these areas to be addressed."

Read More

UNEP, 01-12-24

https://www.unep.org/news-and-stories/press-release/plastic-pollution-negotiations-adjourn-new-text-and-follow-session

Industry using 'tobacco playbook' to fend off 'forever chemicals' regulation

2025-01-14

Efforts to restrict the production of plastic "forever chemicals" that could threaten public health have been met with a large-scale coordinated attack by the multibillion-pound industries that make and use them.

Industry-funded research and exaggerated claims litter the arguments made by the fluoropolymer industry against stricter regulation, a year-long investigation by the Forever Lobbying Project, a cross-border investigation involving 46 journalists and 18 experts across 16 countries can reveal.

Fluoropolymers are high performance plastics and a type of per- and polyfluoroalkyl substances (PFAS) – a group of more than 10,000 human-made chemicals that will not break down in the environment for tens of thousands of years, if ever, earning them the nickname "forever chemicals".

What are PFAS, how toxic are they and how do you become exposed?

The substances are durable non-stick coatings used in an enormous range of industrial processes and consumer products. They have been in production for decades and pollution is so widespread that some have been found in water, soils and air across the world. They have been detected in fish, birds, otters, seals and whales – and are likely to be in the blood of almost every human on the planet.

In a speech in 2023, Michael Regan, the then director of the US Environmental Protection Agency, said: "What began as a so-called 'miracle', groundbreaking technology meant for practicality and convenience, quickly devolved into one of the most pressing environmental and public health concerns of our modern world."

Read More

The Guardian, 14-01-24

https://www.theguardian.com/environment/2025/jan/14/industry-using-tobacco-playbook-to-fend-off-forever-chemicals-regulation

EAD issues new soil quality regulation

2025-01-20

The Environment Agency – Abu Dhabi (EAD) has announced the issuance of a new soil quality regulation in the emirate of Abu Dhabi.

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The edict was created to ensure sustainable soil management and to preserve the soil's basic functions and vital services as well as meet the requirements of current and future uses.

The regulation also aims to reduce the damage caused by soil pollution.

The regulation was prepared in accordance with the provisions of Law No. (16) of 2005 regarding the reorganisation of EAD and its amendments, which grants EAD the authority to issue regulations and executive decisions of the law.

The law is used to mitigate pollution and preserve the quality and safety of air, water, soil and natural resources while ensuring their optimal exploitation to protect humans and the environment.

The Agency coordinated and cooperated with the relevant authorities in Abu Dhabi during the regulation's preparation phase in accordance with the approved methodology for preparing legislation in the emirate.

Read More

Gulf Today, 20-01-25

https://www.gulftoday.ae/news/2025/01/19/ead-issues-new-soil-quality-regulation

40 hazardous chemicals added to PIC – exporters can start notifying authorities now

2025-01-07

From 1 March 2025, EU exporters are required to notify their intention to export 40 additional hazardous chemicals. This requirement follows the recent decision of the European Commission to add new chemicals to the EU's Prior Informed Consent (PIC) Regulation.

Helsinki, 7 January 2025 – The latest 40 chemicals added to the Annex I of PIC include 35 pesticides and five used as industrial chemicals. These include, for example, abamectin, difenacoum, fenpropimorph, dimethomorph, triadimenol and penflufen.

A chemical's inclusion in Annex I means that companies need to make an export notification to ECHA before starting their exports (chemicals in part 1 of Annex I). Most of the newly added substances (38) also need an explicit consent from importing countries before the export can take place, as they are included both in part 1 and 2 of Annex I.

The status of two substances, cyanamide and warfarin, already listed in Annex I, is updated. Once the amendment enters into force, their exports will need an explicit consent in addition to export notification.

A subgroup of PFAS, perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds, is added to Annex V of PIC which contains chemicals with an export ban. This update follows the listing of the group as persistent organic pollutant in the Stockholm convention.

ECHA's IT tool ePIC has been updated to reflect these changes and companies can now notify their exports of these chemicals.

Read More

ECHA, 07-01-25

https://echa.europa.eu/-/40-hazardous-chemicals-added-to-pic-exporters-can-start-notifying-authorities-now

ECHA adds five hazardous chemicals to the Candidate List and updates one entry

2024-01-21

The Candidate List of substances of very high concern (SVHC) now contains 247 entries for chemicals that can harm people or the

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environment. Companies are responsible for managing the risks of these chemicals and giving customers and consumers information on their safe use.

Helsinki, 21 January 2025 – Two newly added substances (octamethyltrisiloxane and perfluamine) are very persistent and very bioaccumulative. They are used in the manufacture of washing and cleaning products and in the manufacture of electrical, electronic and optical equipment.

Two substances have persistent, bioaccumulative and toxic properties. O,O,O-triphenyl phosphorothioate is used in lubricants and greases. The reaction mass of: triphenylthiophosphate and tertiary butylated phenyl derivatives is not registered under REACH. It was, however, identified as an SVHC to prevent regrettable substitution.

6-[(C10-C13)-alkyl-(branched, unsaturated)-2,5-dioxopyrrolidin-1-yl] hexanoic acid is toxic for reproduction and used in lubricants, greases and metal working fluids.

Tris(4-nonylphenyl, branched and linear) phosphite has endocrine disrupting properties affecting the environment and is used in polymers, adhesives, sealants and coatings. The entry for this substance is updated to reflect that it is an endocrine disrupter to the environment both due to its intrinsic properties and when it contains ≥ 0.1% w/w of 4-nonylphenol, branched and linear (4-NP).

Entries added to the Candidate List on 21 January 2025:

Substance name	EC number	CAS number	Reason for inclusion	Examples of uses
6-[(C10-C13)-alkyl-(branched, unsaturated)-	701-118-1	2156592-54-8	Toxic for reproduction (Article 57c)	Lubricants, greases, release products and metal working fluids
O,O,O-triphenyl	209-909-9	597-82-0	Persistent,	Lubricants and greases

Substance name	EC number	CAS number	Reason for inclusion	Examples of uses
	203-497-4	107-51-7	Very persistent,	Manufacture and/or formulation of: cosmetics, personal/ health care products,
Perfluamine	206-420-2	338-83-0	Very persistent,	Manufacture of electrical, electronic and optical equipment and machinery and vehicles
Reaction mass of:	421-820-9	192268-65-8	Persistent,	No active registrations
Updated entry:				
Tris(4-nonylphenyl, branched and linear) phosphite	-	-	Endocrine disrupting properties (Article 57(f) – environment)	Polymers,

ECHA's Member State Committee (MSC) has confirmed the addition of these substances to the Candidate List. The list now contains 247 entries – some of these entries cover groups of chemicals so the overall number of impacted chemicals is higher.

These substances may be placed on the Authorisation List in the future. If a substance is on this list, companies cannot use it unless they apply for authorisation and the European Commission authorises its continued use.

Consequences of inclusion on the Candidate List

Under REACH, companies have legal obligations when their substance is included – either on its own, in mixtures or in articles – in the Candidate List.

If an article contains a Candidate List substance above a concentration of 0.1 % (weight by weight), suppliers must give their customers and consumers information on how to use it safely. Consumers have the right

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to ask suppliers if the products they buy contain substances of very high concern.

Importers and producers of articles must notify ECHA if their article contains a Candidate List substance within six months from the date it has been included in the list (21 January 2025).

EU and EEA suppliers of substances on the Candidate List, supplied either on their own or in mixtures, must update the safety data sheet they provide to their customers.

Under the Waste Framework Directive, companies also have to notify ECHA if the articles they produce contain substances of very high concern in a concentration above 0.1 % (weight by weight). This notification is published in ECHA's database of substances of concern in products (SCIP).

Under the EU Ecolabel Regulation, products containing SVHCs cannot have the ecolabel award.

Read More

ECHA, 21-01-24

https://echa.europa.eu/-/echa-adds-five-hazardous-chemicals-to-the-candidate-list-and-updates-one-entry

Janet's Corner

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2025-01-31

https://i.pinimg.com/originals/5a/d0/15/5ad01514cc99a3105e8d837c3fcb76aa.jpg

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Hazard Alert

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Ethylene Oxide

2025-01-31

USES [2,3]

Ethylene oxide is found in the production of solvents, antifreeze, textiles, detergents, adhesives, polyurethane foam, and pharmaceuticals. Smaller amounts are present in fumigants, sterilants for spices and cosmetics, as well as during hospital sterilisation of surgical equipment.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

Sources of ethylene oxide emissions into the air include uncontrolled emissions or venting with other gases in industrial settings. Other sources of ethylene oxide air emissions include automobile exhaust and its release from commodity-fumigated materials, as well as its use as a steriliser of medical equipment. The general population may be exposed to ethylene oxide through breathing contaminated air or from smoking tobacco or being in the proximity to someone who is smoking. Certain occupational groups (e.g., workers in ethylene oxide manufacture or processing plants, sterilisation technicians, and workers involved in fumigation) may be exposed in the workplace.

Routes of Exposure

- **Inhalation:** Most ethylene oxide exposures occur by inhalation or skin contact. The gas is readily absorbed by the lungs. Odour is not a reliable indicator of ethylene oxide's presence and does not provide adequate warning of hazardous concentrations. The gas is heavier than air and can cause asphyxiation in enclosed, poorly ventilated, or low-lying areas. Children exposed to the same levels of ethylene oxide as adults may receive larger dose because they have greater lung surface area: body weight ratios and increased minute volumes: weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their short stature and the higher levels of ethylene oxide found nearer to the ground.
- **Skin/Eye Contact:** Skin contact with concentrated solutions of ethylene oxide, liquid ethylene oxide, or high vapour concentrations may cause chemical burns. Contact with liquefied ethylene oxide may result in frostbite. Exposure to high levels of the gas may cause corneal

Ethylene oxide, also called oxirane, is the organic compound with the formula C2H4O. It is a cyclic ether, which consists of an alkane with an oxygen atom bonded to two carbon atoms of the alkane, forming a ring. Ethylene oxide is a colourless flammable gas at room temperature, with a faintly sweet odour; it is the simplest epoxide: a three-membered ring consisting of one oxygen atom and two carbon atoms. [1,2]

burns and cataracts. Prolonged skin contact with dilute solutions of ethylene oxide (e.g., from contaminated clothing) can cause irritation and dermatitis. Children are more vulnerable to toxicants absorbed through the skin because of their relatively larger surface area: body weight ratio.

- **Ingestion:** Ingestion is unlikely to occur because ethylene oxide is a gas at room temperature.

HEALTH EFFECTS [4]

Acute Health Effects

Acute inhalation exposure of workers to high levels of ethylene oxide has resulted in nausea, vomiting, neurological disorders, bronchitis, pulmonary oedema, and emphysema at high concentrations. Dermal or ocular contact with solutions of ethylene oxide has caused irritation of the eyes and skin in humans. Tests involving acute exposure of animals have shown ethylene oxide to have high acute toxicity from oral and inhalation exposures.

Carcinogenicity

Human occupational studies have shown elevated cases of leukaemia, stomach and pancreatic cancer, and Hodgkin's disease in workers exposed to ethylene oxide by inhalation. However, the data are considered to be limited and inconclusive due to the small number of individuals studied and uncertainties about the exposure levels. Animal studies have shown lung, gland, and uterine tumours caused by inhalation exposure to ethylene oxide. EPA considers ethylene oxide to be a probable human carcinogen and has ranked it in EPA's Group B1. This classification has had some form of Agency review, but does not appear on IRIS. EPA uses mathematical models, based on human and animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA has calculated a provisional inhalation unit cancer risk estimate of 1.0 × 10-4 (µg/m3)-1.

Other Effects

Some evidence exists indicating that inhalation exposure to ethylene oxide can cause an increased rate of miscarriages in female workers. These effects could be seen from acute, as well as chronic, exposure. Various adverse reproductive effects have been noted in inhalation exposure studies of animals including decreased number of implantation sites,

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decreased testicular weights and sperm concentration, and testicular degeneration.

SAFETY

First Aid Measures [5]

- **General advice:** Consult a physician. Show this safety data sheet to the doctor in attendance.
- **If inhaled:** If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- **In case of skin contact:** Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
- **In case of eye contact:** Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
- **If swallowed:** Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Workplace Controls & Practices [4]

Control measures include:

- Ensure appropriate engineering controls are in place.
- Avoid contact with skin, eyes and clothing.
- Wash hands before breaks and immediately after handling the product.

Personal Protective Equipment [5]

- **Eye/face protection:** Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
- **Skin protection:** Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

REGULATION

United States

The following exposure limits are for Coal Tar Pitch Volatiles:

- **OSHA:** The Occupational Safety and Health Administration has established a PEL (permissible exposure limit) for ethylene oxide of 1 ppm (averaged over an 8-hour workshift)
- **OSHA:** The Occupational Safety and Health Administration has established a STEL (short-term exposure limit) for ethylene oxide of 5 ppm (15 minute exposure)
- **NIOSH:** The National Institute for Occupational Safety and Health has established a IDLH (immediately dangerous to life or health) concentration of 800 ppm
- **AIHA:** American Industrial Hygiene Association has established an ERPG-2 (emergency response planning guideline) (maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action) of 50 ppm

REFERENCES

1. https://en.wikipedia.org/wiki/Ethylene_oxide
2. http://www.osha.gov/OshDoc/data_General_Facts/ethylene-oxide-factsheet.pdf
3. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=733&tid=133
4. http://www.epa.gov/ttn/atw/hlthef/ethylene.html
5. http://www.atsdr.cdc.gov/mmg/mmg.asp?id=730&tid=133
6. http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=387614&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F387614%3Flang%3Den
7. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/639/Workplace_Exposure_Standards_for_Airborne_Contaminants.docx

Researchers Discover New Properties in Diamond Semiconductors

2025-01-20

Boron-doped diamonds exhibit plasmons, advancing quantum optics, biosensors and nanotechnology applications.

Diamond, often celebrated for its unmatched hardness and transparency, has emerged as an exceptional material for high-power electronics and next-generation quantum optics. Diamond can be engineered to be as electrically conductive as a metal, by introducing impurities such as the element boron.

Researchers from Case Western Reserve University and the University of Illinois Urbana-Champaign have now discovered another interesting property in diamonds with added boron, known as boron-doped diamonds. Their findings could pave the way for new types of biomedical and quantum optical devices—faster, more efficient, and capable of processing information in ways that classical technologies cannot. Their results are published recently in Nature Communications.

Potentional advancements in quantum devices, biosensors, solar cells

The researchers found that boron-doped diamonds exhibit plasmons—waves of electrons that move when light hits them—allowing electric fields to be controlled and enhanced on a nanometer scale. This is important for advanced biosensors, nanoscale optical devices, and for improving solar cells and quantum devices. Previously, boron-doped diamonds were known to conduct electricity and become superconductors, but not to have plasmonic properties. Unlike metals or even other doped semiconductors, boron-doped diamonds remain optically clear.

"Diamond continues to shine" said Giuseppe Strangi, professor of physics at Case Western Reserve, "both literally and as a beacon for scientific and technological innovation. As we step further into the era of quantum computing and communication, discoveries like this bring us closer to harnessing the full potential of materials at their most fundamental level."

"Understanding how doping affects the optical response of semiconductors like diamond changes our understanding of these materials," said Mohan Sankaran, professor of nuclear, plasma and radiological engineering at Illinois Grainger College of Engineering.

Plasmons create the colors of stained glass

Plasmonic materials, which affect light at the nanoscale, have captivated humans for centuries, even before their scientific principles were understood. The vibrant colors in medieval stained-glass windows result from metal nanoparticles embedded in the glass. When light passes through, these particles generate plasmons that produce specific colors. Gold nanoparticles appear ruby red, while silver nanoparticles display a vibrant yellow. This ancient art highlights the interaction between light and matter, inspiring modern advancements in nanotechnology and optics.

Diamonds, composed of transparent crystals of the element carbon, can be synthesized with small amounts of boron, adjacent to carbon on the periodic table. Boron contains one less electron than carbon, allowing it to accept electrons. Boron essentially opens up a periodic electronic "hole" in the material that has the effect of increasing the ability of the material to conduct current. The boron-doped diamond lattice remains transparent, with a blue hue. (The famous Hope Diamond is blue because it contains small amounts of boron).

Because of its other unique properties—it's also chemically inert and biologically compatible—boron-doped diamond could potentially be used in contexts that other materials could not, such as for medical imaging or high-sensitivity biochips or molecular sensors.

Synthetic diamonds pioneered at Case Western Reserve

Diamonds synthesized at low pressure were pioneered at Case Western Reserve (then Case Institute of Technology) in 1968 by faculty member John Angus, who died in 2023. Angus was also the first to report on the electrical conductivity of diamond doped with boron.

Technology Networks, 20 January 2025

https://technologynetworks.com

Researchers achieve high-rate and stable ammonia electrosynthesis from nitrate

2025—01-27

Ammonia (NH3) is traditionally produced through the energy-intensive Haber-Bosch process which converts nitrogen (N2) and hydrogen (H2) into NH3 at high temperatures (400–500) and pressures (10–30 MPa). This process consumes 1%–2% of global energy and contributes about 1% of global CO2 emissions.

Electrocatalytic nitrate reduction reaction (NO3−RR) is a renewable energy-driven process that uses nitrate (NO3−) from wastewater as N2 source and water as H2 source. This low-carbon route provides a sustainable solution for NH3 synthesis under mild conditions. However, its practical application has been limited by unsatisfactory electrocatalytic activity and poor long-term stability.

A research team led by Prof. Gao Dunfeng, Prof. Wang Guoxiong, and Prof. Bao Xinhe from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS), by introducing an amorphous/crystalline dual-phase Cu foam electrode with high performance, achieved high-rate and stable NH3 electrosynthesis from NO3−. The study was published in Nature Communications.

Researchers fabricated the electrode by thermal annealing commercial Cu foam in air, creating a unique dual-phase structure. With an alkaline membrane electrode assembly electrolyzer, they achieved an NH3 partial current density of 3.33 A/cm2 and an NH3 formation rate of 15.5 mmol/h/cm2 at a cell voltage of just 2.6 V. The electrode maintained stable NH3 production with a Faradaic efficiency of around 90% at an applied current density of 1.5 A/cm2 over 300 hours.

Furthermore, researchers identified that the stable amorphous Cu domains present during the reaction are key to the outstanding catalytic performance. This integrated Cu foam electrode performs better than conventional power electrodes, and the preparation protocols are facile and easy to scale up. In a scale-up demonstration using a 100 cm2 electrode, an NH3 formation rate of up to 11.9 g/h at an applied current of 160 A was achieved.

"Our work also underscores the importance of stabilizing metastable amorphous structures for improving electrocatalytic reactivity and long-term stability," said Prof. Wang.

Provided by Chinese Academy of Sciences

Phys Org, 27 January 2025

https://phys.org

Researchers invent a new tool to help lower the cost of tomorrow's medicine

2025-01-27

University of Missouri researchers and collaborators have developed a new chemical tool that could help lower the cost of prescription medications.

The tool, called AshPhos, is a ligand, or molecule, that makes it easier to create special carbon-nitrogen bonds. These bonds are the backbone of more than half of all medicines on the market today.

"What makes AshPhos special from other existing ligands is that it's made from inexpensive and easy-to-find materials, and it is far better in terms of activity and efficiency," said Sachin Handa, an associate professor of chemistry at Mizzou's College of Arts and Science.

That's by design.

The team, led by Handa and graduate student Ashish Dusunge, alongside Biohaven Pharmaceuticals, developed AshPhos with the goal of promoting sustainable chemistry.

"It's eco-friendly because it's made with less waste and uses materials from renewable sources," Handa said. "It will also make medicine production cheaper, helping more people afford the medications they need."

Handa, who grew up in India and was a first-generation high school student, knows firsthand the importance of providing affordable life-saving medication.

"Witnessing people in India struggle to access essential health care during my childhood continues to motivate me to use my expertise as a chemist to create solutions that benefit society as a whole," he said.

Other potential applications

Looking ahead, researchers plan to explore the use of AshPhos beyond pharmaceutical applications.

One idea is to use AshPhos to create nanomaterials that can facilitate hydrogen evolution. Hydrogen is considered a clean energy source, and efficient methods for its production are crucial for transitioning toward renewable energy sources.

Another idea is to investigate how AshPhos could help degrade PFAS, or "forever chemicals." By developing a catalyst using AshPhos and earth-

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abundant metals, Handa said they could provide a potential solution for breaking down these persistent pollutants.

While future applications are still under development, they showcase the versatility of AshPhos and highlight its potential to address critical challenges related to energy and environmental sustainability.

The mechanics of AshPhos

How does it work?

"Ligands such as AshPhos facilitate the formation of carbon-nitrogen bonds by stabilizing metal ions and guiding them in reactions, called Buchwald-Hartwig aminations," said Handa, who was hired through the university's MizzouForward initiative in 2023. "This is important for highly challenging bulky molecules that otherwise deactivate the catalyst in the absence of AshPhos."

AshPhos, named in part for Dusunge, the first author of the study, works by binding to a metal atom, transforming it into a catalyst. This catalyst is essential for the reaction to proceed. The metal catalyst then brings together a "highly challenging" molecule containing carbon and another containing nitrogen, facilitating the formation of a carbon-nitrogen bond between them, Handa said.

In the case of AshPhos, the ligand attaches to a metal -- palladium -- to help it speed up chemical reactions more effectively.

"It acts as a 'boss' by directing the metal what to do, ensuring the metal stays active and selective during the process," Handa said.

During this process, the ligand might temporarily detach from the metal, rendering it inactive. AshPhos can prevent this from happening by reattaching to the metal with a little heat, ensuring the catalyst remains active and the reaction continues.

"This reattachment ability is key to AshPhos' effectiveness and makes it superior to many existing ligands," Handa said. "Our ligand is very strong -- it's like locking a door with a key, ensuring it stays securely closed and won't open."

Innovations such as AshPhos are the hallmarks of Mizzou researchers, including Handa, whose work is powering the new Center for Energy Innovation.

Funding was provided by grants awarded to Handa from the U.S. National Science Foundation (CHE 2044778 and 2345856). AshPhos has received commercial interest from entities in both the U.S. and Europe.

Science Daily, 27 January 2024

https://sciencedaily.com

"Defects" Turn Graphene Into an Effective Ion Filter

2025-01-16

Scientists design graphene to selectively filter ions, paving the way for advanced water filtration and molecular sensing.

Graphene is an extremely thin, flexible and resistant material made of pure carbon. It forms layers that consist of virtually a single layer of carbon atoms. To make graphene as thick as a human hair, thousands of such layers would have to be stacked on top of each other.

Many researchers are working intensively on graphene. There is a good reason for this, as the special properties of the material promise new applications, for example in electronics or energy technology.

Making Graphene Permeable to Other Molecules

It is particularly interesting for scientists to be able to control the permeability of graphene for different substances: 'So-called defects can be created in the carbon lattice of graphene. These can be thought of as small holes that make the lattice permeable to gases,' says chemistry professor Frank Würthner from Julius-Maximilians-Universität (JMU) Würzburg in Bavaria, Germany.

Permeability to other substances, such as ions like fluoride, chloride or bromide, has not yet been observed. 'However, this would be of fundamental scientific interest for applications such as the desalination of water, the detection or purification of mixtures of substances,' explains the Würzburg professor.

Defect Allows Ions to Pass Through: Publication in Nature

For the first time, a team led by Frank Würthner has now created a model system with a defect that allows the halides fluoride, chloride and bromide to pass through, but not iodide. This was achieved in a stable double layer consisting of two nanographenes that encloses a cavity. The penetrated halide ions are bound in this cavity so that the time required for entry could be measured. The results have been published in the journal Nature.

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Chloride is a component of common salt, is found in seawater and plays an important role in life processes in all organisms. 'The proof of a high permeability for chloride by single-layer nanographene and a selective binding of halides in a double-layer nanographene brings some applications closer,' says Dr Kazutaka Shoyama, who initiated and led the project together with Frank Würthner. Such applications include water filtration membranes, artificial receptors and chloride channels.

Larger Stacks of Nanographenes are the Next Goal

In the next step, the Würzburg chemists want to build larger stacks of their nanographenes. They want to use them to investigate the flow of ions – and thus a process that also takes place in a similar form in biological ion channels.

Technology Networks, 16 January 2025

https://technologynetworks.com

21st-century chainmail uses molecular instead of metallic links

2025-01-17

In what they're calling the "highest density of mechanical bonds ever achieved," researchers created a super-strong flexible material that works very much like chainmail. The breakthrough has already demonstrated its ability to improve body armor.

In the world of chemistry, getting polymers (long chains of large molecules) to form mechanical bonds inside their structures has proven extremely challenging. Unlike chemical bonds, which involve the sharing of electrons by atoms or the effects of electrostatic forces among them, mechanical bonds involve molecules physically threading through one another.

Northwestern University (NU) has overcome the challenge. Researchers there made two-dimensional sheets out of X-shaped monomers, which are the building blocks of polymers. (In chemistry, two-dimensional objects are those consisting of just a single layer of atoms.) The monomers were made up of molecules holding four extended aromatic groups, which gave them their X shape.

Next, they layered these sheets in a crystalline structure and coaxed the ends of all the X's to attach to each other through the introduction of a chemical known as dialkyldichlorosilane. More layers caused more

monomers to spread and connect through the lattice, resulting in a series of loops all threaded together in a super-strong web akin to the metal links in chainmail.

The researchers say that the new material has 100 trillion mechanical bonds per every one square centimeter, making it the substance with the highest density of these bonds ever created.

"We made a completely new polymer structure," said Northwestern's William Dichtel, the study's corresponding author. "It's similar to chainmail in that it cannot easily rip because each of the mechanical bonds has a bit of freedom to slide around. If you pull it, it can dissipate the applied force in multiple directions. And if you want to rip it apart, you would have to break it in many, many different places. We are continuing to explore its properties and will probably be studying it for years."

Ultra Ultem

After experimenting with the material, the researchers found that, unlike previous mechanically bonded materials, it could be produced in larger quantities. In tests, they produced a kilogram of the material and believe even higher amounts are possible.

Investigating the practical nature of the new material, Dichtel's collaborators at Duke University added it to something known as Ultem, a very strong material similar to Kevlar that can resist impacts, caustic chemicals, and extreme temperatures. The Duke team found that adding just 2.5% of the new material to Ultem boosted a measure of strength known as its tensile modus by 45% .

"We have a lot more analysis to do, but we can tell that it improves the strength of these composite materials," Dichtel concluded. "Almost every property we have measured has been exceptional in some way." This, he says, might make the new material perfect for the development of new lightweight armor or other ballistic fabrics.

Dedication

The researchers dedicated their study, which has been published in the journal Science, to Sir Fraser Stoddart, a former fellow Northwestern chemist who won the Nobel Prize in Chemistry in 2016 for his work pioneering mechanical bonds.

"Molecules don't just thread themselves through each other on their own, so Fraser developed ingenious ways to template interlocked structures,"

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said Dichtel, who was a postdoctoral researcher in Stoddart's lab at UCLA. "But even these methods have stopped short of being practical enough to use in big molecules like polymers. In our present work, the molecules are held firmly in place in a crystal, which templates the formation of a mechanical bond around each one.

"So, these mechanical bonds have deep tradition at Northwestern, and we are excited to explore their possibilities in ways that have not yet been possible."

Source: Northwestern

New Atlas, 17 January 2025

https://newatlas.com

New Study: A Daily Multivitamin Could Slow Brain Aging by Almost 60%

2024-01-30

If you've heard multivitamins are pointless, Harvard-affiliated researchers suggest you think again thanks to fresh findings from longitudinal research.

The population is aging, with one in four Americans projected to be 65 years or older by 2060. This presents challenges across healthcare, and one particular concern is that this stage of life is when the greatest incidence of cognitive decline, dementia, and Alzheimer's disease are diagnosed.

Lifestyle choices and clinical interventions are continually being studied and tested for their roles in preventing issues with cognition. One such study has just published a final paper in a series that suggests a daily multivitamin might have a protective effect for individuals who are most likely to experience cognitive issues. In fact, at least one of the analyses saw an almost 60% slowdown in cognitive aging with the daily use of multivitamins.

COSMOS, which stands for the COcoa Supplement and Multivitamin Outcomes Study, was a series of studies led by researchers from Brigham and Women's Hospital, a teaching hospital of Harvard Medical School, and the Fred Hutchinson Cancer Research Center in Seattle. This research involved more than 20,000 Americans aged 60 years and older to analyze the benefits of cocoa extract and multivitamins on heart disease, cancer, and other health issues.

The third study in the series was published on January 18, 2024, in The American Journal of Clinical Nutrition. It took the previous research into account and added a study that included over 500 participants assigned to taking either a multivitamin or a placebo.

Examining the effects from over a two-year period, the final study found "that a daily multivitamin improved memory and slowed cognitive aging in three separate placebo-controlled studies," said JoAnn Manson, MD, MPH, DrPH, a leader of the study and chief of the Division of Preventive Medicine at Brigham and Women's Hospital.

In a press release, researchers were impressed by the findings. "Cognitive decline is among the top health concerns for most older adults, and a daily supplement of multivitamins has the potential as an appealing and accessible approach to slow cognitive aging," said the study's first author, Chirag Vyas, MBBS, MPH, an instructor at Massachusetts General Hospital and a founding member of the Mass General Brigham healthcare system.

The final study's finding on the role of a multivitamin supported two others in COSMOS, all of which showed that a multivitamin outperformed a placebo for cognitive protection. It provided "strong and consistent evidence that taking a daily multivitamin, containing more than 20 essential micronutrients, helps prevent memory loss and slow down cognitive aging," Vyas commented.

If you're looking to add a daily multivitamin, talk to your healthcare provider about which one is right for your needs.

The Healthy, 30 January 2024

https://thehealthy.com

Urine-based cancer test accurate even without the uncomfortable bit

2025—1-29

A test for pee-based markers of prostate cancer has previously relied on an uncomfortable first step. A new study has revealed that the now-available test remains just as accurate without it, paving the way from an easy in-home testing option.

After lung cancer, the number-one cause of cancer death in American men is prostate cancer, with about one in 44 men succumbing to the disease. Globally, the disease is the number one cancer for men in 118 different countries. If caught early, prostate cancer can usually be managed quite

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well. In fact, Johns Hopkins Medicine reports that about 80 to 85% of all prostate cancers are detected in the beginning stages, leading to disease-free status after five years.

In April last year, researchers at the Rogel Cancer Center at University of Michigan (UM) Health announced that they had developed a new urine-based test that could help with early detection. Specifically, their test, known as MyProstateScore2.0 or MPS2, was able to distinguish between positive tests for a slow-growing form of prostate cancer that's unlikely to cause harm and the more aggressive form of the disease, requiring rapid medical treatment. It works by screening for 18 different genes associated with aggressive prostate cancer.

However, when MPS2 was first tested and deployed, it involved the collection of urine after a digital rectal exam (DRE). This phase was necessary, it was believed, because pressure on the prostate through the rectum would release cellular debris from the walnut-shaped organ that could then be analyzed in the urine stream. The requirement for a DRE also meant that MPS2 needed to be conducted in a doctor's office.

However, in a new follow-up study, the UM researchers collected "first-catch" urine samples from 266 men who did not undergo a DRE first. They found that MPS2 was effective in detecting 94% of the problematic aggressive prostate cancer, which are those falling in a designation known as Grade Group 2, or GG2. That success rate places the test above those carried out on blood samples.

In further mathematical analysis, the team says that the test could have helped up to 53% of men avoid biopsies.

"These results show that MPS2 has promise as an at-home test," says study co-author Ganesh S. Palapattu, a UM professor of urology. "Its primary benefit is that the test can accurately predict your probability of developing aggressive prostate cancer, putting both the patient and physician at ease."

The MPS2 test is currently available through the UM spinoff, Lynx Dx, although currently it still must be administered in a physician's office. Still, says the company, the test can help many men avoid potentially painful biopsies, especially if they get a blood test showing elevated PSA levels.

"Fewer than 25% of men with elevated PSA would have a type of prostate cancer which needs immediate treatment," says the company. "The majority will show no prostate cancer, or in some cases a type that can

be safely monitored. That means more than 75% of men with elevated PSA would have a negative biopsy and could benefit from an MPS2 risk assessment."

UM is offering information for anyone who feels they could benefit from the test through its Cancer AnswerLine at 800-865-1125.

The study has been published in the Journal of Urology.

New Atlas, 29 January 2025

https://newatlas.com

New research leads to viable solution for polycotton textile waste recycling

2025-01-29

In a paper published in Nature Communications, researchers at the Industrial Sustainable Chemistry group of the University of Amsterdam (UvA) present a solution to the challenging problem of recycling polycotton textile waste.

The process, developed in cooperation with the company Avantium, starts with fully removing all cotton from the fabric using superconcentrated hydrochloric acid at room temperature. The cotton is converted into glucose, which can be used as a feedstock for biobased products such as renewable plastics. The remaining polyester fibers can be reprocessed using available polyester recycling methods.

The research was led by Prof. Gert-Jan Gruter, who heads the Industrial Sustainable Chemistry group at the UvA's Van 't Hoff Institute for Molecular Sciences (HIMS) as a part time professor. Gruter is Chief Technology Officer at Avantium where he leads the development of renewable and circular polymer materials and technologies that are key to transforming our fossil-based economy into a renewable, bio-based economy.

"Being able to recover glucose from the cotton in textile waste is a crucial contribution to this, as glucose is a key bio-based feedstock. Currently, it is produced from starch from corn and wheat. If and when we will be producing plastics from biomass on a large scale, the world will need a lot of non-food glucose."

Equally important, the process now presented in the paper provides a solution to the mammoth problem of recycling textile waste. According

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to Gruter, it is the first effective method for recycling both cotton and polyester components of polycotton with high efficiency.

Gruter's Ph.D. student Nienke Leenders, first author of the paper, performed many tests under the four-year MiWaTex project and is now about halfway. The project entails cooperation with textile sorting and recycling company Wieland, workwear producer Groenendijk Bedrijfskleding, Modint, the trade association for the Dutch clothing and textile industry, and CuRe, developer of advanced technology for chemical recycling of polyester.

Scalability and cost-effectiveness

The paper describes how Leenders performed experiments using Avantium's pilot plant for its proprietary Dawn Technology which was originally developed to convert non-food plant-based feedstock (e.g wood) into glucose and lignin. Its key feature is using highly concentrated hydrochloric acid (43% by weight) at room temperature.

Leenders tested batches of actual post-consumer polycotton waste textiles in Avantium's Dawn pilot plant. It turned out the cotton cellulose could be fully hydrolyzed into glucose under industrially relevant conditions. The polyester part of the fabric remained intact and could be easily separated. The trials demonstrated high glucose yields, indicating scalability and cost-effectiveness.

The cotton-derived glucose from the process can be used in a wide range of industrial applications, including polymers, resins and solvents. It can, for example, be used by Avantium to produce its lead product 2,5-furandicarboxylic acid (FDCA), a crucial component in the production of the biobased PEF polyester (polyethylene furanoate) that offers a renewable alternative to PET bottles.

The process also enables the complete recycling of polyester from polycotton. It can be chemically recycled to form new virgin polyester, as was established by tests performed by CuRe.

Favorable techno-economic analysis

According to Gruter, the research lays the foundation for actual industrial-scale recycling of polycotton textiles and the first commercial availability of non-food glucose.

"Many parties are trying to get either of these things done but no one has succeeded yet. Our techno-economic analysis looks rather favorable and Avantium has already invested substantially in this development.

"Our ambition is to advance this technology to the next phase of commercialization, together with partners. So we might very well be the first to market non-food glucose obtained through a bio-refinery approach."

Phys Org, 29 January 2025

https://phyd.org

Chemists discover common plastic pigment promotes depolymerization

2025-01-29

It turns out that the black plastic lid atop your coffee cup has a superpower. And the Stache Lab at Princeton Chemistry, which uncovered it, is exploiting that property to recycle at least two major types of plastic.

Their startling mechanism for promoting depolymerization relies on an additive that many plastics already contain: a pigment called carbon black that gives plastic its black color. Through a process called photothermal conversion, intense light is focused on plastic containing the pigment that jumpstarts the degradation.

So far, researchers have shown that carbon black can depolymerize polystyrene and polyvinyl chloride (PVC), two of the least recycled plastics in the planet's waste stream. Through a process called photothermal conversion, intense light is focused on plastic containing the pigment that jumpstarts the degradation.

Two recent papers highlight the potential. First, in ACS Central Science at the end of last year, there was a proof-of concept for the depolymerization of polystyrene using a common Fresnel lens to focus photonic energy. Then, earlier this month, the lab published their method to upcycle PVC in the Journal of the American Chemical Society.

In both cases, carbon black serves as the trigger of the breakdown, a quality Assistant Professor of Chemistry Erin Stache discovered recently and that even industrial partners she has spoken with were unaware of. The lab's method has since been tried out on such post-consumer waste as PVC pipes, black construction pipes, trash bags, credit cards, even those ubiquitous yellow rubber duckies.

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"The surprising thing, especially with the black polystyrene depolymerization, is that they've been manufacturing these materials for decades and it seems no one recognized that this was possible," said Stache. "Under ambient sunlight, the energy is not sufficient to break down these polymers. But if you increase the light intensity enough, then you start seeing the depolymerization.

"We can certainly change our habits to help alleviate the amount of plastic we use. But we're not going to get rid of our dependence on plastic. So can we think of it instead as a resource? Can we turn it into other commodity chemicals that we have to make anyway? We have found that we can."

In their ACS paper, researchers showed that unmodified post-consumer black polystyrene samples were successfully depolymerized to a styrene monomer without adding catalysts or solvent. Simple, focused radiation on the plastic provided monomer yields of up to 80% in just five minutes.

"I think this marriage between photothermal and depolymerization strategies is really groundbreaking. Black colored plastic accounts for ~15% of all plastics, and we found that 10-weight percent of black polystyrene in plastic mixture is enough to give good yield," said Hanning Jiang, co-first author on the paper.

"Carbon black absorbs all the way from UV to IR, and that's great because what we want is for this agent to take as much light as possible and transform light into heat."

Next, the lab adapted their method to PVC and received strong results. They extended the process by adding polystyrene into the PVC-carbon black mixture—"We basically spatula it in," said Stache—and were able to upcycle the material and then derivatize it into a couple of common consumer products.

Part of the challenge of recycling PVC is that the material has carbon-chlorine bonds that generates hydrochloric acid (HCl) whether it's being recycled mechanically or chemically. Hydrochloric acid is corrosive and highly toxic.

"We used carbon black to initiate the thermal degradation of PVC, generate HCl with an acceptor for HCl that reacts to make an adduct," Stache explained. "So you can basically access a new commodity chemical from the process. We take advantage of what is normally a bad process—the HCl—and add it to another commodity chemical, and then we get a new product."

Undergrad Erik Medina joins the team

For the JACS paper, Jiang's co-author was Princeton undergraduate Erik Medina '25, who joined the Stache Lab after seeing Stache present at an undergrad colloquium run by the Department of Chemistry.

He said the project was challenging in the beginning. Researchers knew the chemistry was feasible but early technical concerns with the reaction set-up slowed the work down. Medina persevered partly out of a determination to "not let the system win."

"There is a need to fully utilize the chemical resources present in the raw starting materials," said Medina. "I'd love to see people find more creative ways to leverage common additives like carbon black to do this.

"Thermoplastics are produced on such a large scale that to effectively manage them as waste there must be a simple strategy. I do think that our work with carbon black photothermal conversion has real potential to be implemented on an industrial level."

One of the challenges of photo-driven processes like photothermal conversion is scaling up so that it will work in an industrial setting. For example: can you get enough photons into the system—that will also penetrate layers of waste to infiltrate the entire mix—to drive the chemistry.

Stache is confident their method will continue to prove fruitful.

"We're using post-consumer waste and depolymerizing it just by shining light on it. That's the most applied thing you can do," she said.

"Now, we're trying to develop a lot of fundamental solutions and then we start to work with the engineers to figure out how to scale this. If the chemistry works, you're going to find a way to scale it."

Phys Org, 29 January 2025

https://phys.org

Is hydrogen the future for cars? Manufacturers haven't given up on it yet

2025-01-25

Announcing the 2028 launch of its first hydrogen-powered fuel-cell electric car (FCEV) – the iX5 Hydrogen – last year, BMW described hydrogen cars as the 'missing piece' in the sustainable mobility jigsaw. And

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it's easy to understand the excitement. On paper fuel cell cars have all the environmental benefits of battery electric vehicles (BEVs) with the added perk that they can be fuelled in three to four minutes.

But while BMW and several other car manufacturers remain optimistic that hydrogen will be the next big thing for greener motoring, others think that the race has already been run.

'Ten years ago, it was a reasonable question to ask would the future of decarbonised road transport involve hydrogen?' says Frank Hodgson, a senior energy analyst at Regen, who provides independent energy systems expertise to assist the UK's journey to net zero. '[But] we've proven since then that the powertrain of the future is battery electric,' he adds. 'We aren't seeing sales of hydrogen cars at all.'

A lot of the hydrogen produced today is from fossil fuels – potentially negating the environmental benefits of fuel cell cars – and the current infrastructure for refuelling hydrogen cars still leaves a lot to be desired. 'If the industry that builds the cars isn't behind [infrastructure] development, it's just not going anywhere,' says Robert Steinberger-Wilckens, an expert in fuel cells and hydrogen at the University of Birmingham.

How do hydrogen cars compare with battery electric cars?

A hydrogen FCEV is electrically driven, like a BEV and even has an identical electric motor. The main difference is the energy storage system. These cars have hydrogen stored in high-pressure tanks that is converted into electricity to power the vehicle by way of fuel cells. In some hydrogen cars, there is also a small battery containing energy to help the car accelerate quickly and recuperate energy when braking.

'Inside the fuel cell, hydrogen from the tanks reacts with oxygen from the atmosphere to produce electricity to power the motor,' explains Michael Rath, vice president of hydrogen vehicles at BMW.

The fuel cell in a hydrogen car is an electrochemical device consisting of an electrolyte membrane sandwiched between an anode and a cathode. Flow plates channel hydrogen to the anode where the electrons and protons are separated by a catalyst, usually platinum. The electrolyte membrane allows the protons to pass through to the cathode, leaving the electrons behind, giving the anode a negative charge. The voltage difference between the two terminals causes the electrons to flow through an external circuit to power the electric motor.

At the cathode, the electrons and protons combine with oxygen from the air in a chemical reaction that produces water in the form of steam or vapour; the only byproduct of the process.

The amount of power produced by a fuel cell depends on a range of factors such as fuel cell type and size but hydrogen cars will usually have more than one fuel cell stacked together in order to provide sufficient energy to power the car.

The reaction between hydrogen and oxygen produces heat, as well as electricity, which, Steinberger-Wilckens says, gives hydrogen cars an advantage over BEVs. Owners of BEVs will know that battery performance is significantly reduced in cold weather, but hydrogen technology has been found to perform just as well as a conventional combustion engine in extreme sub-zero temperatures.

It has also been highlighted that, as the lightest of all the energy carriers, hydrogen would be a better option for lorries with large loads travelling long distances. Although, when you factor in the storage vessel, fuel cell and vehicle, the difference in weight between a BEV and a FCEV is likely negligible.

However, the most significant advantage being flagged by manufacturers is the refuelling time. BEVs can take anywhere from 30 minutes to more than 12 hours to charge depending on the size of the battery and the charging point. However, with hydrogen cars the refuelling process is much like that of a standard petrol or diesel car and the whole thing takes less than five minutes. In addition, two tanks holding a total of 6kg hydrogen could provide a range of 310 miles which means hydrogen could be a better option for long-distance driving.

There are currently two hydrogen cars available to buy in the UK – the Toyota Mirai, which has been around for 10 years, and the Hyundai Nexo, which has been available since 2019. Both cars are only available by special order – with prices starting at around £60,000 – and waits of several months to receive your car.

At the release of the Mirai in 2014, Toyota was adamant its hydrogen vehicle would mark a 'turning point' for the automotive industry but, 10 years on, and after selling just 27,500 hydrogen cars, the chief technology officer at the company, Hiroki Nakajima, said he was no longer sure that hydrogen had a bright future. But Toyota is not planning to abandon it just yet. The Japanese giant still believes hydrogen will have a key role to

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play in decarbonising transport going forward and appears to be pivoting towards hydrogen-fuelled lorries, buses and vans.

Several other manufacturers are experimenting with hydrogen including BMW, Honda, Mercedes-Benz, Renault, Stellantis and Riversimple, so there could soon be some more affordable options available. However, figures show that sales of hydrogen vehicles are dwindling and much of this is to do with the downsides of using hydrogen as a fuel carrier.

The hurdles of hydrogen

Hydrogen may be the most abundant element in the universe but producing it on Earth is still tricky from an environmental point of view. Currently, most hydrogen is made from fossil fuels, mainly by steam reformation of methane or coal gasification, both of which release carbon dioxide. If combined with carbon capture utilisation and storage, hydrogen made this way is referred to as blue hydrogen.

In contrast, green hydrogen – the only type produced in a climate-neutral way – is made using renewable energy, such as solar or wind power, to split water. However, it'll be some time before this becomes cost-competitive with fossil-fuel hydrogen.

'If you use any type of fossil fuel to produce hydrogen and then put it into a hydrogen vehicle, you'll be producing more carbon dioxide than if you use the diesel or petrol vehicle,' says Steinberger-Wilckens. 'The one thing you don't produce is all the NOx, the volatile hydrocarbons, the particulate matter you get from an engine, but in the way of climate change, you're not making a difference.'

Some governments, such as the UK's, are investing heavily in carbon capture utilisation and storage and setting ambitious targets for green hydrogen production. However, Rath admits that the widespread use of hydrogen in passenger cars will depend on the future availability of green hydrogen.

'Hydrogen is an efficient option for storing and transporting renewable energy and will therefore play an important role in the energy transition,' he says. 'This applies, in particular, to countries and regions whose geography means they are unable to meet all their energy needs with renewable energies.'

But Hodgson disagrees, in fact he says one of the primary, and most talked about, reasons for hydrogen cars not taking off is that they are less efficient than BEVs. 'Firstly, you need to make the hydrogen – that's

inherently an inefficient process, whichever way you do it … you're losing energy on the way, and that adds cost,' he explains. 'Then, in the vehicle, you've got losses as well. A fuel cell is about 60% efficient at turning the hydrogen in the tank into power to use at the wheels – the theoretical maximum efficiency is 83% and no engineering is going to improve this. The laws of thermodynamics mean it's always going to be a relatively inefficient powertrain.'

He also points out that we are still a long way from having cheap, low-carbon (green or blue) hydrogen. 'This idea that in the future we're going to have super low-cost hydrogen that we're all going to be able to use is just not bearing fruit.'

However, efficiency alone is not enough to explain the lack of demand for hydrogen cars, he says. Ultimately, it comes down to the fact there is very limited refuelling infrastructure. 'The selling point is it's got a 400-mile range, [but] that's a bit pointless if you can't refuel it.'

Investing in infrastructure

Currently, there are just a handful of hydrogen refuelling stations across the UK and many others have been closed because of low demand.

Hodgson explains that there were hydrogen vehicle developers who realised this and focused on markets where that wasn't as much of a barrier – for example, for buses or recycling lorries where they're doing a known route with a hydrogen refueller at the base – with the idea that cars would come along later, 'but that didn't happen because of the inefficiency and higher running costs than battery–electric powertrains', he adds.

Steinberger-Wilckens likens the situation to that of mobile phones in the 1970s. 'Motorola … spent five years building up the networks … [before] they started selling the phones. You have to do exactly the same for the hydrogen car … if you are the manufacturer, you have to see to it that the infrastructure is built.'

He explains that big companies like Shell originally bought into the idea of hydrogen cars but are now seeing five or even 10 years of investment lying there with little or no use so are making the decision to close filling stations. He says it is down to governments to ensure that the infrastructure is built and people are incentivised to buy more environmentally-friendly vehicles. 'If you slap the environmental and health service impact of the petrol vehicle onto the price … driving a

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hydrogen car would be half the cost of driving a petrol car. Unless that is resolved, we're essentially going nowhere.'

With aggressive targets set to boost the uptake of zero emission vehicles – at the start of 2024 the UK set new laws mandating that, by 2035, all new cars and vans sold must be zero emission – vehicle manufacturers are now under pressure to sell electric cars. This, partnered with green hydrogen targets, could provide the perfect excuse for FCEVs to take on the future of climate-neutral driving.

'For people who travel a lot by car and need a high degree of flexibility, an FCEV may be the right solution,' says Rath. 'In addition, there are regions and cities where it will be difficult to provide electric charging stations for all BEVs – in these locations, hydrogen drive systems can help to diversify infrastructure.'

But Hodgson is not convinced. 'One of the things that I do at Regen is supporting electricity network companies like National Grid to forecast the future demand for [electric vehicle] charging at a geographic level,' he says. 'It turns out there's quite a lot of spare capacity in the local networks; the electricity networks are all now embarking on major upgrade plans so that the capacity is there before it's needed.'

He admits that there was a point where he was convinced of the promise of hydrogen cars over battery ones, while carrying out research on hydrogen electric powertrains at electric vehicle start-up Riversimple but says batteries have improved so much since then that this is no longer the case.

'That's part of it, people are not seeing the trajectory of batteries in terms of falling costs, but also improving energy density,' he explains. 'And whilst battery production always gets a lot of attention, manufacturers have been very effective in switching to chemistries such as LFP [lithium iron phosphate] which are cheaper and lower impact.'

'What's confusing is BMW are quite good at battery vehicles so I don't know why they feel that they need to continue pushing hydrogen cars … it's just not happening.'

Chemistry World, 21 January 2025

https://chemistryworld.com

Reusable Polymer Adhesive Outperforms Common Superglue

2025-01-17

Researchers develop a stronger, biodegradable adhesive using re-engineered P3HB, offering eco-friendly alternatives.

Researchers at Colorado State University have developed an adhesive polymer that is stronger than current commercially available options while also being biodegradable and reusable. The findings – described in Science – show how the common, naturally occurring polymer P3HB can be chemically re-engineered for use as a strong yet sustainable bonding agent.

Adhesives are commonly used in automotives, packaging, electronics, solar cells and construction, among many other areas. Together they make up a roughly $50 billion industry that supports much of our modern life but also contributes to the mounting issue of plastic waste. The paper describes the team's work using experimental, simulation and process modeling to develop a replacement polymer.

The project was led by University Distinguished Professor Eugene Chen in the Department of Chemistry. Other partners on the paper include Gregg Beckham at the National Renewable Energy Laboratory and Professor Ting Xu at the University of California, Berkley and researchers from their groups.

Chen said that poly(3-hydroxybutyrate), or P3HB, is a natural, biobased and biodegradable polymer that can be produced by microbes under the right biological conditions. While the polymer is not adhesive when made that way, his lab was able to chemically re-engineer its structure to now deliver stronger adhesion than the common petroleum-derived, nonbiodegradable options when used on various substrates or surfaces such as aluminum, glass and wood. The adhesion strength of the re-engineered P3HB can also be tuned to accommodate different application needs.

The findings are part of a larger goal by Chen's group to improve and expand our ability to tackle the global plastics pollution crisis. His team is involved in many efforts to develop chemically recyclable, biodegradable and, overall, more sustainable alternatives to today's plastic materials. He said that while many people inherently recognize the life cycle issues that come with a disposable water bottle, adhesives present more daunting issues with fewer potential solutions.

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"Petroleum-based thermoset adhesives such as Gorilla Glue and J-B Weld, along with thermoplastic hot melts, can be very difficult or even impossible to recycle or recover – primarily because of their strong bonds to other materials," he said. "Our approach instead offers a biodegradable material that can be used in a variety of industries with tunable or even higher strength compared to those options."

Ethan Quinn is a Ph.D. student at CSU and served as a co-lead author on the paper with postdoctoral researcher Zhen Zhang. Quinn said he and Zhang led work around the creation and testing of the material.

"We developed a sample P3HB glue stick and were able to use it with a commercially available glue gun to test its application in sealing cardboard boxes and other properties on steel plates," Quinn said. "I knew the data supported it being stronger than other options, but I was shocked that we were able to show that it far out-performs typical hot-melt options – holding up to 20 pounds in place compared to the 15 pounds an existing adhesive could not manage."

Chen said P3HB is biodegradable under a variety of instances, including managed and unmanaged environments. That means it will biodegrade naturally in landfills just as well as salty ocean water or soils, for example. That expands the range of possible options for dealing with the material at the end of its life cycle. The P3HB adhesive can also be recovered, reprocessed and reused.

The CSU team will now start work on ways to commercialize the polymer for broad use.

"We are working on two different approaches aiming for mass production, including ways to lower the overall cost and environmental impacts," Chen said. "The analysis performed by the NREL team has identified key areas where we could make improvements, and we will continue to work with the BOTTLE Consortium on those scaling efforts."

Technolgy Networks, 17 January 2025

https://technologynetworks.com

Medical professionals fear cases of B6 toxicity are under-reported

2025-01-28

A health practitioner, a businessman, an award-winning musician, a retiree, and a pregnant woman are among the growing list of Australians who have been poisoned by the synthetic form of vitamin B6.

There are at least 121 confirmed cases in which it has caused life-changing issues for those who have taken it regularly, Australia's medicines regulator has said.

Doctors believe the scale of the problem could be greater than what is currently known.

"My sense is that clinical B6 toxicity is under-reported," said GP and dietitian Terri-Lynne South, who has noticed a rise in the number of cases aligned with the increasing popularity of dietary supplements.

"People might be aware a multivitamin supplement could have B6 in it, but I think it would surprise them that something labelled as a magnesium supplement, for example, also has B6 in it."

'Paralysed' after taking multiple supplements

Keri McInerney's story is an example of that.

Her career as an award-winning singer-songwriter was put on hold after accidentally poisoning herself with B6.

"My legs went numb and I began getting numbness all the way up the top of my body, right to my neck," she told 7.30.

Four years prior, Ms McInerney started taking daily supplements as part of a weight loss regimen.

She didn't realise many of them contained B6 and feels the warnings on the labels weren't clear enough.

Ms McInerney is one of dozens of people who reached out to the ABC, detailing the pain and misery they have suffered from vitamin toxicity, after 7.30 reported the case of Dr Mary Buchanan in early January.

Ms McInerney said B6 was present in many products she was using.

"I started to lose weight and I thought I was feeling great, but this cramping and funny sensation in my legs started to get worse and worse."

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Like many others 7.30 spoke to, she had developed peripheral neuropathy — a condition that damages the nerve endings in limbs, with the worst cases considered irreparable.

"I was actually taking 12 times the daily safe amount," she said.

Why is B6 in so many products?

B6 is vital to cognitive function.

In Australia, the daily recommended intake for B6 is 1.3 to 1.7 mg for adults.

Most people who have a balanced diet consume enough of the vitamin in its natural form through a variety of foods including meats, fish, vegetables and cereals.

But like many other vitamins, B6 is also manufactured in a lab. The synthetic is added to thousands of products in Australia, including medicines, multivitamin and mineral supplements, energy drinks and weight loss shakes.

B6 is often listed on labels as pyridoxine, pyridoxal or pyridoxamine. Some supplements available in stores contain quantities up to 200mg.

Associate Professor Joanna Harnett, a complementary medicines researcher and an adviser to Australia's medicines regulator the Therapeutic Goods Administration (TGA), told 7.30 that B6 is added to medicines to help metabolise other minerals, including magnesium and zinc.

"When we exceed the amount that is required for that, we can overwhelm the body's normal metabolic processes, and it's in that overwhelming phase that we see the toxic effects, particularly with regular, high-dose consumption over a longer period of time," Associate Professor Harnett said.

Rippling skin

In 2020, as the COVID pandemic took off, businessman Paul Torrisi wanted to boost his immunity and turned to supplements. He didn't realise he was taking too much B6.

"I was taking a men's multivitamin — just one a day. I was also taking zinc plus and a magnesium [tablet], and the zinc plus is vitamin B6 again," he told 7.30.

He was a company CEO in the prime of his career. He ended up not being able to work.

"I was getting burning sensations, tingling, pins and needles," Mr Torrisi told 7.30.

"I got a blood test and found out I was seven times the normal range of vitamin B6."

Kellie Marie Donnelly found herself in a similar predicament, diagnosed with peripheral neuropathy in the middle of 2023.

"I couldn't work for 12 months, I lost heaps of weight, lost my hair, it was just horrendous," she told 7.30, conceding she had "no awareness" of what she was putting into her body.

"I was taking a Multi-B, high-dose magnesium, also a multivitamin, plus eating lots of high B6 foods."

Medical professionals fall victim

Bill Piggott AM is a retired physician who worked for the World Health Organization. He explained how he felt "embarrassed" after developing peripheral neuropathy symptoms from vitamin supplements.

"I think I was embarrassed that I, as a medical person, had not done due diligence on what I was taking," Dr Piggott told 7.30."

"I just believe that if it was a water-soluble vitamin and I was taking too much, I would pee it out, but I retained it."

Ellie Carew inadvertently took high doses of magnesium, which contained B6 while battling Parkinson's disease and suffered symptoms for two years before a GP discovered she had six times the safe level of B6 in her blood.

"I got a whole raft of symptoms, including burning sensation in my toes, my feet, burning at night, burning fingers, red nose, insomnia; five kilos just dropped off me. I felt really weak in my muscles, so I didn't know what it was," she said.

"I was taking some magnesium, not every night, but a few nights a week for some time — it turns out that also had 50 milligrams of vitamin B6 in it."

Karen Dalle-Nogare considers her case ironic, as she works in a pathology lab and would often see cases of B6 toxicity in the bloodwork of others.

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"After I found out I had it I went through all of my tablets, and there were so many that had B6 in them that you wouldn't have known unless you read the fine print," she explained."

TGA to consider limiting public access

In 2022 the TGA strengthened labelling requirements requiring a warning about peripheral neuropathy on products containing daily doses of more than 10 mg of B6.

It also reduced the maximum permitted daily dose of vitamin B6 in listed medicines from 200 mg to 100 mg.

"We don't really have any good numbers around what was happening before the TGA intervened, and what sort of response that has had," Dr South told 7.30.

"Having said that, I know there are some clinician bodies suggesting to the TGA that it needs to be lowered again," she said.

The TGA told 7.30 it is considering a proposal to tighten regulations, including changes to where and how B6 vitamins are sold.

Under the proposal, medicines containing between 5 mg and 200 mg of B6 (pyridoxine, pyridoxal or pyridoxamine) would be included in Pharmacist Only Medicines, "stored behind the counter to prevent physical access by the public, and only sold from a pharmacy," a TGA spokesperson stated.

An interim decision on the proposal is anticipated next month, "and following publication of this, a second public consultation will open," the statement said.

The supplements sector responds

Vitamin and mineral supplements account for most of Australia's multi-billion-dollar alternative medicines sector, with many of the large public companies represented by peak body Complementary Medicines Australia (CMA).

Their members include industry giants Blackmores Group, Carusos, Chemist Warehouse and Swisse.

CMA Chief Executive John O'Doherty told 7.30 safety is of "paramount importance" to the industry.

Mr O'Doherty said the sector adheres to the TGA's regulations, and the responsibility for taking any medicine falls back on the consumer.

"An important part of that is that consumers understand the product that they're taking and that they do so in accordance with what the label says in terms of directions for use."

Mr O'Doherty didn't give a clear answer when asked if the industry would consider making any changes ahead of advice from the regulator.

"We work really closely with the TGA when it comes to safety issues — just as they raise safety concerns with us, we raise safety concerns with the TGA as well," he said.

"We work together to try to achieve good safety outcomes for consumers, while also ensuring people have access to the products they want to improve their health and wellbeing.

"If consumers have any doubt at all they should reach out either to the company that produces the product, their healthcare professional or in particular, their pharmacist."

abc News, 28 January 2024

https://abc.net.au

CRISPR-Like Polymer Editing Upcycles Waste Into Higher-Performance Plastics

2025-01-20

Molecular editing could transform waste plastic upcycling to produce new macromolecules.

By editing the polymers of discarded plastics, chemists at the Department of Energy's Oak Ridge National Laboratory have found a way to generate new macromolecules with more valuable properties than those of the starting material. Upcycling may help remedy the roughly 450 million tons of plastic discarded worldwide annually, of which only 9% gets recycled; the rest is incinerated or winds up in landfills, oceans or elsewhere.

ORNL's invention may change plastic's environmental fate by rearranging polymeric building blocks to customize the properties of plastics. Molecular subunits link to produce polymer chains that can connect through their backbones and cross-linked molecules to form multipurpose

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plastics. The makeup of polymer chains determines how strong, rigid or heat-resistant those plastics will be.

Molecular editing is so promising that it has been the basis of two Nobel Prizes in Chemistry. In 2005, the prize went to developers of the metathesis reaction, which breaks and makes double bonds between carbon atoms in rings and chains so their subunits can swap to create new molecules limited only by imagination. Similarly, in 2020, the prize went to developers of CRISPR, "genetic scissors" for editing DNA strands, biopolymers made of nucleotide subunits that carry the code of life.

"This is CRISPR for editing polymers," said ORNL's Jeffrey Foster, who led a study that was published in Journal of the American Chemical Society. "However, instead of editing strands of genes, we are editing polymer chains. This isn't the typical plastic recycling 'melt and hope for the best' scenario."

The ORNL researchers precisely edited commodity polymers that significantly contribute to plastic waste. In some experiments, the researchers worked with soft polybutadiene, which is common in rubber tires. In other experiments, they worked with tough acrylonitrile butadiene styrene, the stuff of plastic toys, computer keyboards, ventilation pipes, protective headgear, vehicle trim and molding, and kitchen appliances.

"This is a waste stream that's really not recycled at all," Foster said. "We're addressing a significant component of the waste stream with this technology. That'd make a pretty big impact just from conservation of mass and energy from materials that are now going into landfills."

Dissolving the waste polymers is the first step in creating drop-in additives for polymer synthesis. The researchers shredded synthetic or commercial polybutadiene and acrylonitrile butadiene styrene and immersed the material in a solvent, dichloromethane, to conduct a chemical reaction at a low temperature (40 degrees Celsius) for less than two hours.

A ruthenium catalyst facilitated the polymerization, or polymer addition. Industrial firms have used this catalyst to make robust plastics and to convert biomass such as plant oils into fuels and other high-value organic compounds with no difficulty, highlighting the potential for its use in chemical upcycling.

The molecular building blocks of the polymer backbone contain functional groups, or clusters of atoms that serve as reactive sites for modification. Notably, the double bonds between carbons increase the chances for

chemical reactions that enable polymerization. A carbon ring opens at a double bond to create a polymer chain that grows as each functional polymer unit directly slips in, conserving the material. The plastic additive also helps control the molecular weight of the synthesized material and, in turn, its properties and performance.

If this material synthesis strategy could be expanded to a broader range of industrially important polymers, then it could prove an economically viable path for reusing manufacturing materials that today can only be used in a single product. The upcycled materials might be, for instance, softer and stretchier than the original polymers or, perhaps, easier to shape and harden into durable thermoset products.

The scientists upcycled plastic waste by employing two processes in tandem. Both are types of metathesis, which means a change of places. Double bonds break and form between carbon atoms, allowing polymer subunits to swap.

One process, called ring-opening metathesis polymerization, opens carbon rings and elongates them into chains. The other process, called cross metathesis, inserts chains of polymer subunits from one polymer chain into another.

Traditional recycling fails to capture the value in discarded plastics because it reuses polymers that become less valuable through degradation with each melt and reuse. By contrast, ORNL's innovative upcycling utilizes the existing building blocks to incorporate the mass and characteristics of the waste material and provide added functionality and value.

"The new process has high atom economy," Foster said. "That means that we can pretty much recover all the material that we put in."

The ORNL scientists demonstrated that the process, which uses less energy and produces fewer emissions than traditional recycling, efficiently integrates waste materials without compromising polymer quality. Foster, Ilja Popovs and Tomonori Saito conceptualized the paper's ideas. Nicholas Galan, Isaiah Dishner and Foster synthesized monomer subunits and optimized their polymerization. Joshua Damron performed nuclear magnetic resonance spectroscopy experiments to analyze reaction kinetics. Jackie Zheng, Chao Guan and Anisur Rahman characterized mechanical and thermal properties of final materials.

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"The vision is that this concept could be extended to any polymer that has some sort of backbone functional group to react with," Foster said. If scaled up and expanded to employ other additives, broader classes of waste could be mined for molecular building blocks, dramatically reducing the environmental impact of other difficult-to-process plastics. The circular economy — in which waste materials are repurposed rather than discarded — then becomes a more realistic goal.

Next, the researchers are interested in changing the types of subunits in the polymer chain and rearranging them to see whether they can create high-performance thermoset materials. Examples are epoxy resins, vulcanized rubber, polyurethane and silicone. Once cured, thermoset materials cannot be remelted or reshaped because their molecular structure is cross-linked. That makes their recycling a challenge.

The researchers are also interested in optimizing solvents for environmental sustainability during industrial processing.

"Some preprocessing is going to be required on these waste plastics that we still have to figure out," Foster said.

Technology Networks, 20 January 2025

https://technologynetworks.com

Trimetallic synergy and defects: A catalyst for climate action

2025-01-27

A study appearing in Proceedings of the National Academy of Sciences introduces a trimetallic catalyst—including nickel (Ni), copper (Cu), and zinc (Zn) nanoparticles supported on defective ceria (CeO2)—that achieves unprecedented

The catalyst demonstrated remarkable CO productivity of 49,279 mmol $g^{-1} h^{-1}$ at 650°C, a nine-fold increase over previously reported catalysts. It displayed CO selectivity of up to 99%, and maintained a stable performance for at least 100 hours without degradation.

The catalyst's extraordinary efficiency is attributed to the creation of a strong metal-support interaction (SMSI) between the trimetallic sites and the defective ceria. This unique interaction fine-tunes the electronic structure, enabling optimal performance.

The conversion of CO2 to CO is a critical step in transforming carbon dioxide into value-added chemicals and fuels. However, commercial viability has been hindered by low productivity, poor selectivity, and instability of existing catalysts. By leveraging SMSI and defect engineering, this study has overcome these barriers, setting new benchmarks in CO2 reduction catalysis.

This research relied heavily on advanced in-situ techniques and a multidisciplinary collaboration.

Dr. Pieter Glatzel and the team at the European Synchrotron Radiation Facility (ESRF), Grenoble, played a pivotal role in uncovering the electronic dynamics of the system. High-energy-resolution fluorescence-detection X-ray absorption spectroscopy (HERFD-XAS) revealed how SMSI alters oxidation states and electron density distribution across the catalyst.

Dr. Paul Paciok from the Ernst-Ruska Center, Germany, contributed critical insights through in-situ transmission electron microscopy (TEM) and electron energy loss spectroscopy (EELS). These studies visualized, for the first time, the growth and movement of trimetallic sites under catalytic conditions. Once SMSI was established, the movement ceased, preventing further diffusion or sintering.

Prof. Ojus Mohan's group at IIT Bombay utilized density functional theory (DFT) calculations to unravel the reaction mechanism. The studies highlighted how reaction intermediates form and convert into products, driven by a complex interplay of direct dissociation and redox pathways on different active sites.

This research not only provides a highly effective catalyst for CO2 conversion but also offers a blueprint for designing next-generation catalysts through precise electronic structure tuning and defect manipulation.

These findings open new avenues for the development of advanced catalysts for CO2 utilization and other critical chemical transformations.

Last author Prof. Polshettiwar states, "By combining traditional catalytic materials with cutting-edge defect engineering and SMSI, we've shown how to address fundamental limitations in catalysis. The study offers a roadmap for designing advanced catalysts and demonstrates the impact of integrating traditional materials with

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cutting-edge approaches, offering hope for a sustainable future."
Phys Org, 27 January 2025

https://phys.org

AI discovers new rare-earth-free magnet at 200 times the speed of man

2024-06-12

As some entities identify new (or at least overlooked) sources to meet the growing demand for rare earth materials, others are looking toward new tools. UK deep-tech company Materials Nexus announced on Tuesday that it has designed a new rare-earth-free permanent magnet with the help of its AI platform. It says the AI-driven discovery and development process was 200 times faster than the resource-intensive manual route, bringing new hope to an electrifying world with a growing appetite for powerful magnets.

With the world moving away from internal combustion engines and gradually embracing electric mobility, the demand for compact, high-power motors is rapidly rising. By far the most popular option in the automotive industry right now is the permanent magnet motor, which powers upward of 80% of modern electric vehicles.

Materials Nexus estimates that demand for permanent magnets will grow tenfold by 2030, in the EV industry alone. And it's not just electric cars and trucks, either. Permanent magnet motors are in demand for many applications, including robotics, drones, wind turbines and HVAC equipment.

The problem is, the rare earth materials used to create the most powerful magnets and most efficient, power-dense motors – materials like neodymium and dysprosium – require damaging mining and expensive, energy-intensive processing. With its world-largest EV market, China has emerged as a leader in both mining and processing of rare earths, pulling as much as 70% of the world's rare earths out of the ground while processing closer to 90%. That gives the country monopoly-like control over the essential materials, leaving other markets exposed to supply disruptions and pricing fluctuations.

The search for alternatives is on, and some automakers and suppliers are starting to develop and incorporate magnet-free motors. Others, including Tesla, are pursuing permanent magnet designs free from rare-earth materials.

Rare-earth-free magnets certainly sound like an intriguing solution, but they can be difficult to formulate and less powerful than traditional rare-earth magnets. Niron Magnetics has developed what it calls the world's first high-performance rare-earth-free magnets, using a mix of abundantly available iron and nitrogen, but it's been researching and developing it for over a decade and still isn't quite ready for mass production.

Materials Nexus is letting the world know it's here to help. It believes it has just what contemporary and future magnet startups need to identify and develop rare-earth-free magnetic materials, and by substituting AI for old-fashioned trial-and-error, it believes they can do so at a pace hundreds of times faster than has been traditionally possible. It says its AI platform can identify rare-earth-free magnetic materials in a matter of days or weeks, in contrast to the years and decades it's taken in the past.

Rather than simply spout impressive numbers, Materials Nexus has already used its AI platform to identify a rare-earth-free permanent magnet it's named MagNex. The AI analyzed more than 100 million rare-earth-free material compositions before it landed on MagNex, factoring in variables such as cost, supply chain security, performance and environmental impact.

After the AI did the heavy lifting, Materials Nexus synthesized and tested MagNex with help from the Henry Royce Institute at the University of Sheffield. In three months, the company had done work that would have taken years prior to its AI system.

Furthermore, Materials Nexus says MagNex can be produced at 20% the material cost of currently available rare earth magnets, with a 70% reduction in material carbon emissions.

"We're really excited that our first interaction with Materials Nexus has yielded such a hugely positive outcome," said professor Iain Todd, metallurgy and materials processing, University of Sheffield. "The combination of Materials Nexus' approach of using AI for materials discovery and the world-class facilities we have for manufacture of advanced alloys in the Henry Royce Institute here at Sheffield has allowed a novel magnetic material to be developed with breathtaking speed."

While a brand-new rare-earth-free magnet added some serious juice to this week's announcement, it's far from the only possible use case for Material Nexus' AI. The company says the AI will be useful for all kinds of industries, helping to identify and create the next generation of cutting-edge materials driving new technologies and CO2e emissions reductions.

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It plans to work with industrial partners toward accelerating the discovery of viable, cost-effective and sustainable next-gen materials.

"Our platform has already attracted widespread interest for various products with applications that include semiconductors, catalysts and coatings," said Materials Nexus CEO Dr. Jonathan Bean. "I look forward to seeing the role it will play in supporting market demand for the creation of novel materials to help address increasingly pressing supply chain and environmental issues."

As do we. We also look forward to seeing if MagNex becomes a viable magnet alternative for permanent magnet motors, whether aimed at electric mobility or one of the other applications for which such motors will remain in high demand.

Source: Materials Nexus

New Atlas, 12 June 2024

https://newatlas.com

Researchers discover new way to store hydrogen using lignin jet fuel

2025-01-27

An international team of scientists has discovered a way to store and release volatile hydrogen using lignin-based jet fuel that could open new pathways for sustainable energy production.

In a new study in the International Journal of Hydrogen Energy, Washington State University Professor Bin Yang and colleagues demonstrated that a type of lignin-based jet fuel they developed can chemically bind hydrogen in a stable liquid form. The research has many potential applications in fuels and transportation and could ultimately make it easier to harness hydrogen's potential as a high energy and zero emissions fuel source.

"This new, lignin jet fuel-based technology could enable efficient, high-density hydrogen storage in an easy-to-handle sustainable aviation fuel, eliminating the need for pressurized tanks for storage and transport," Yang said.

For the study, researchers at WSU, Pacific Northwest National Laboratory, the University of New Haven, and Natural Resources Canada set out to address one of the major challenges with using hydrogen as a fuel source.

The lightest element's low density and explosive nature make storage and transport technically challenging, inefficient, and expensive.

The January article details how the research team discovered the new hydrogen-storing process using chemical reactions that produced aromatic carbons and hydrogen from lignin jet fuel -- an experimental fuel developed by Yang's lab based on lignin, an organic polymer found in plants.

"Hydrogen is a versatile energy carrier that could help the U.S. meet its targets for zero-emission mobility, integration of renewables, and decarbonization of industry," Yang said.

The discovery points to new uses for the lignin jet fuel developed at WSU by Yang, who previously tested a new continuous process that creates the fuel from agricultural waste. Experiments have shown that the sustainably produced fuel could increase engine performance and efficiency while dispensing with aromatics, the pollution-causing compounds found in conventional fuels.

"This innovation offers promising opportunities for compatibility with existing infrastructure and economic viability for scalable production," Yang said. "It could help create a synergistic system that enhances the efficiency, safety, and ecological benefits of both sustainable aviation fuel and hydrogen technologies."

Next, WSU researchers will collaborate with scientists at the University of New Haven to design an AI-driven catalyst that enhances and completes the reactions, making them more efficient and cost-effective.

Science Daily, 27 January 2025

https://sciencedaily.com

A new chemical tool to create efficient carbon-nitrogen bonds, lowering the cost of tomorrow's medicine

2025-01-27

University of Missouri researchers and collaborators have developed a new chemical tool that could help lower the cost of prescription medications. The tool, called AshPhos, is a ligand, or molecule, that makes it easier to create special carbon-nitrogen bonds. These bonds are the backbone of more than half of all medicines on the market today.

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"What makes AshPhos special from other existing ligands is that it's made from inexpensive and easy-to-find materials, and it is far better in terms of activity and efficiency," said Sachin Handa, an associate professor of chemistry at Mizzou's College of Arts and Science.

That's by design.

The team, led by Handa and graduate student Ashish Dusunge, alongside Biohaven Pharmaceuticals, developed AshPhos with the goal of promoting sustainable chemistry. The work is published in the journal JACS Au.

"It's eco-friendly because it's made with less waste and uses materials from renewable sources," Handa said. "It will also make medicine production cheaper, helping more people afford the medications they need."

Handa, who grew up in India and was a first-generation high school student, knows firsthand the importance of providing affordable life-saving medication.

"Witnessing people in India struggle to access essential health care during my childhood continues to motivate me to use my expertise as a chemist to create solutions that benefit society as a whole," he said.

Other potential applications

Looking ahead, researchers plan to explore the use of AshPhos beyond pharmaceutical applications.

One idea is to use AshPhos to create nanomaterials that can facilitate hydrogen evolution. Hydrogen is considered a clean energy source, and efficient methods for its production are crucial for transitioning toward renewable energy sources.

Another idea is to investigate how AshPhos could help degrade PFAS, or "forever chemicals." By developing a catalyst using AshPhos and earth-abundant metals, Handa said they could provide a potential solution for breaking down these persistent pollutants.

While future applications are still under development, they showcase the versatility of AshPhos and highlight its potential to address critical challenges related to energy and environmental sustainability.

The mechanics of AshPhos

How does it work?

"Ligands such as AshPhos facilitate the formation of carbon-nitrogen bonds by stabilizing metal ions and guiding them in reactions, called Buchwald–Hartwig aminations," said Handa, who was hired through the university's MizzouForward initiative in 2023. "This is important for highly challenging bulky molecules that otherwise deactivate the catalyst in the absence of AshPhos."

AshPhos, named in part for Dusunge, the first author of the study, works by binding to a metal atom, transforming it into a catalyst. This catalyst is essential for the reaction to proceed. The metal catalyst then brings together a "highly challenging" molecule containing carbon and another containing nitrogen, facilitating the formation of a carbon-nitrogen bond between them, Handa said.

In the case of AshPhos, the ligand attaches to a metal—palladium—to help it speed up chemical reactions more effectively.

"It acts as a 'boss' by directing the metal what to do, ensuring the metal stays active and selective during the process," Handa said.

During this process, the ligand might temporarily detach from the metal, rendering it inactive. AshPhos can prevent this from happening by reattaching to the metal with a little heat, ensuring the catalyst remains active and the reaction continues.

"This reattachment ability is key to AshPhos' effectiveness and makes it superior to many existing ligands," Handa said. "Our ligand is very strong—it's like locking a door with a key, ensuring it stays securely closed and won't open."

Phys Org, 27 January 2025

https://phys.org

Dehumidifying material could boost indoor comfort by sucking up moisture

2025-01-25

"It's not the heat, it's the humidity." That adage applies indoors as well as out, which is where an experimental new material comes in. It absorbs humidity within rooms, reducing the need to run power-hungry ventilation systems.

As people exhale and perspire, they release moisture into the air. Therefore, if a number of people are present in a room with little or

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no ventilation, all of that airborne moisture can cause the room to feel uncomfortably stuffy and humid.

To keep that from happening – particularly in hot climates – electric ventilation systems are often used throughout the day, continuously moving the moist air out of the room. Needless to say, this arrangement uses a lot of electricity.

In an effort to address that problem, Prof. Guillaume Habert and colleagues at Switzerland's ETH Zurich university have developed a hygroscopic material that passively absorbs moisture from the air throughout the day. That moisture is released back into the air when the room cools at night, at which point the ventilation system only has to run briefly in order to get the moist air out.

The material consists mainly of finely ground marble, obtained as an otherwise-unwanted waste product from quarries. In a binder jet 3D-printing process, a print head moves through a bed of that powder, depositing a liquid geopolymer made up of a mineral known as metakaolin and an alkaline solution.

That geopolymer instantly sets as it's deposited, binding the powder to which it was applied. By repeating this process over and over, three-dimensional objects can be built up in successive layers.

For the purposes of the study, the scientists printed a 20 x 20-cm (7.9 x 7.9-inch) tile of the material that was 4 cm thick (1.6 in).

Instead of just taking the form of a solid slab, though, the tile has a very porous structure. As a result, the object has nearly four times as much moisture-absorbing surface area as it would it if it were completely solid, while using a 60% lower volume of material in the process.

After measuring the performance of the tile in lab tests, the scientists calculated what would happen if the walls and ceiling of an existing Portuguese library's reading room were lined with the material. For this model, the room would be occupied by 15 people throughout its opening hours, during which time it would not be ventilated.

It was ultimately determined that the occupants' discomfort index would be reduced by 75% as compared to if the tiles weren't present. That figure climbed to 85% if the tiles were an additional 1 cm (0.4 in) thicker than the 4-cm test sample.

"We were able to demonstrate with numerical simulations that the building components can significantly reduce humidity in heavily used indoor spaces," says Asst. Prof. Magda Posani, who led the study of the material's moisture-binding properties.

A paper on the research was recently published in the journal Nature Communications.

New Atlas, 25 January 2025

https://newatlas.com

Martin Karplus, Chemist Who Made Early Computers a Tool, Dies at 94

2025-01-13

Martin Karplus, a Nobel Prize-winning theoretical chemist who used computers to model how complex systems change during chemical reactions, a process that has led to advances in the understanding of biological processes, died on Dec. 28 at his home in Cambridge, Mass. He was 94.

His wife, Marci Karplus, said he died while recovering from a fall in which he broke a femur.

Over his long career, Dr. Karplus had crossed paths with some of the most important scientists of the 20th century, including Linus Pauling and J. Robert Oppenheimer.

Scientists can control the chemicals in a reaction, and they can measure and evaluate the results, but what happens in between is a mystery.

As Sven Lidin, chairman of the Nobel selection committee explained when announcing the 2013 winners in chemistry: "It's like seeing all the actors before Hamlet and all the dead bodies after, and then you wonder what happened in the middle. And actually, there is some interesting action there, and this is what theoretical chemistry provides us with — the whole drama."

Beginning in the 1960s, when computers were only a fraction as powerful as today's smartphones, Dr. Karplus and his fellow Nobel laureates — Michael Levitt, originally from South Africa, and Arieh Warshel, who was born in Israel — began to build virtual models of molecules to understand what happens to them during complex reactions like photosynthesis and combustion.

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The models used classical Newtonian physics to predict how multitudes of atoms and molecules move during reactions, and they used quantum physics to describe how chemical bonds are broken and formed during those reactions. This type of analysis proved particularly useful in understanding biological reactions involving enzymes, the proteins that govern chemical responses in living organisms.

There was initial resistance to the scientists' work because it was difficult for others to accept that computer models could be accurate enough or could sufficiently account for the many variables in some reactions. But by the time the Nobel Prize was awarded in 2013, that skepticism was gone.

"Today, the computer is just as important a tool for chemists as the test tube," the academy wrote in its announcement. "Simulations are so realistic that they predict the outcome of traditional experiments."

At Harvard University, where Dr. Karplus spent most of his career, he and his research team in 1983 created a program for simulating molecular interaction, calling it Chemistry at Harvard Macromolecular Mechanics (CHARMM). The program is available to researchers worldwide.

In the late 1950s, Dr. Karplus made another important contribution to chemistry: He developed what is known as the Karplus equation. It makes it possible to calculate the magnitude and orientation of protons in organic compounds involved in nuclear magnetic resonance spectroscopy, allowing chemists to study the arrangements of atoms in molecules. It is now a basic part of chemistry education.

Martin Karplus was born on March 15, 1930, in Vienna into a well-off and intellectually accomplished Jewish family. He was the second son of Johann Karplus, a banker, and Isabella (Goldstern) Karplus, a hospital dietitian.

His paternal grandfather, Johann Paul Karplus, was a neurologist who discovered the functions of the hypothalamus, the crucial brain region that controls body temperature, hunger, heart rate and other vital activities. An uncle, Eduard Karplus, was an engineer and inventor. And Martin's older brother, Robert, became a theoretical physicist at the University of California, Berkeley.

In the face of rising antisemitism in the 1930s and a few days after Nazi Germany annexed Austria in the Anschluss of March 1938, Martin, his brother, and his mother fled to Zurich and then to France, eventually arriving in Le Havre.

Martin's father was initially imprisoned in Vienna, but he was able to join the family before they set sail for New York. They arrived on Oct. 8, 1938, and soon after moved to Newton, Mass.

At Newton High School, Martin discovered that his older brother had made such a mark there that many teachers doubted Martin's ability to do as well, he recalled in a Nobel biography. One teacher, who was in charge of the Westinghouse Science competition, the nation's top talent search in the sciences, told Martin that it would be a waste of his time to enter.

But he found another teacher who was willing to proctor his test for the competition. He went on to qualify as one of the country's 40 finalists. Martin's project on alcids, an aquatic bird, was chosen as the co-winner of the competition, after which he met President Harry S. Truman in Washington.

Accepted to Harvard University, he concentrated on chemistry and physics. As he was finishing his undergraduate degree in 1950, both at Berkeley and the California Institute of Technology, known as Caltech, accepted him for graduate studies.

Unsure where to go, he visited his brother, Robert, who by then was working at the Institute for Advanced Study in Princeton, N.J. Robert showed him around, introducing him to Albert Einstein and J. Robert Oppenheimer, who had led the Manhattan Project that developed the atomic bomb and who had become the institute's director. Dr. Oppenheimer recommended Caltech, where he had been a professor, calling it "a shining light in a sea of darkness," according to Dr. Karplus's biography. Decision made.

At Caltech he focused on biophysics, joining a graduate group led by Max Delbrück, who, along with Salvador E. Luria, had proved that Darwin's theory of evolution also applied to bacteria. They, along with Alfred D. Hersey, would be awarded the Nobel Prize in Physiology or Medicine in 1969 for their work.

As Dr. Karplus wrote in his Nobel biography, a turning point in his life came two months after he started at Caltech. Dr. Delbrück suggested that Dr. Karplus present a seminar on his intended area of research: how vision works.

He began his presentation, but after 10 minutes Dr. Delbrück interrupted him to say that he did not understand what Dr. Karplus was saying. Dr. Karplus began anew, and Dr. Delbrück interrupted again, saying he still did

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not understand. Dr. Karplus began again, and Dr. Delbrück interrupted a third time.

At this point, Dr. Richard Feynman, who was awarded the Nobel Prize in Physics in 1965 and who was sitting in the audience, turned around and said to Dr. Delbrück: "I can understand, Max. It is perfectly clear to me." Dr. Delbrück turned red and stormed out. Later that day, he called Dr. Karplus to his office and told him that he could no longer work with him.

Dr. Karplus switched to chemistry.

In the chemistry department, Dr. Karplus initially worked with Prof. John Kirkwood, but then Dr. Kirkwood left for Yale University. His graduate students were given the chance to switch to working with Linus Pauling. Only Dr. Karplus accepted.

Dr. Pauling was on the short list of the greatest scientists of the 20th century. He was one of only five people to receive two Nobel Prizes: the first in 1954 for chemistry, for determining how atoms are chemically bound in molecules; and the second, the Nobel Peace Prize, in 1962, for promoting nuclear disarmament. His scientific work led to the founding of quantum chemistry and molecular biology.

Dr. Karplus's time with Dr. Pauling proved fruitful: He finished his doctoral dissertation just before Dr. Pauling departed on a trip in late 1953. Dr. Karplus, who had received a National Science Foundation postdoctoral fellowship, then left to spend two years at Oxford University.

In 1955, he was hired by the University of Illinois, which was doing advanced work on nuclear magnetic resonance (NMR) spectroscopy. It was during his five years in Illinois that he put together his Karplus equation.

In 1960, Dr. Karplus was hired to be a researcher at the IBM Watson Scientific Laboratory and to teach at Columbia University. With access to state-of-the-art computing power, he continued his research on NMR and also began to investigate creating models to explain chemical reactions.

Dr. Karplus changed jobs again in 1966, returning to Harvard. There he started to concentrate on biological reactions, which are the most complex. The work would lead to the creation of CHARMM and to his Nobel Prize.

In the 1990s, Dr. Karplus was appointed a professor at Louis Pasteur University, later renamed the University of Strasbourg, in France. He spent the next 20 years going back and forth between there and Harvard.

Dr. Karplus met Marci Hazard at Harvard, where she has worked for 51 years. They married in 1981. His first wife was Susan Karplus; their marriage ended in divorce.

In addition to his wife, he is survived by two children from the earlier marriage, Reba and Tammy; one child from his second marriage, Mischa; and one grandchild. (Susan Karplus died in 1982. His brother, Robert, died in 1990.)

In 2020, Dr. Karplus published his autobiography, "Spinach on the Ceiling: The Multifaceted Life of a Theoretical Chemist." The title referred to the landing spot of a launched spoonful of spinach that he had been ordered to eat as a boy.

Over his career, Dr. Karplus supervised close to 250 graduate and doctoral students, most of whom have gone on to successful academic careers. They are collectively known as Karplusians.

The New York Times, 13 January 2024

https://nytimes.com

Plastic Pollution Revolution: New Catalyst Technology Converts Waste Into Valuable Fuels

2025-01-23

Water plays a crucial role in boosting the conversion of polyolefins into valuable fuels when paired with ruthenium catalysts, presenting a promising approach to addressing global plastic waste.

Plastics are incredibly versatile materials that have become integral to nearly every aspect of modern life. However, with global plastic production now exceeding 400 million tons annually, the environmental impact of plastic waste has reached critical levels. The majority of plastic waste—nearly 90%—is not recycled, amplifying the pollution crisis. To address this growing challenge, innovative technologies are urgently needed.

Catalytic recycling techniques, such as hydrogenolysis and hydrocracking, offer a promising solution. These advanced chemical processes use catalysts to break down plastic waste into simpler, high-value components like chemicals and fuels. Unlike traditional recycling, which involves melting and remolding plastics into lower-quality products, catalytic recycling enables more efficient and sustainable reuse by creating materials with greater economic and environmental value.

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While catalytic recycling shows significant potential, further development and refinement are necessary before it can be implemented on a large industrial scale.

A Breakthrough in Polyolefin Recycling

In a recent study published in Nature Communications, a research team led by Professor Insoo Ro of Seoul National University of Science and Technology, Korea, recently made a breakthrough discovery in the catalytic recycling of polyolefins, which comprise 55% of global plastic waste. As explained in their article, the researchers revealed the surprising benefits of adding water during polyolefin depolymerization when using ruthenium (Ru)-based catalysts.

After synthesizing and experimenting on various Ru-based catalysts on different supports, the team found that catalysts with both metal and acid sites exhibit dramatically improved conversion rates when water is added to the reaction mixture. "The addition of water alters the reaction mechanisms, promoting pathways that enhance catalytic activity while suppressing coke formation," explains Dr. Ro, "This dual role improves process efficiency, extends catalyst lifespan, and reduces operational costs."

The researchers investigated the reaction mechanisms in detail, shedding light on the effect of Ru content and the proximity and balance between metal and acid sites. Under optimal conditions, Ru/zeolite-Y catalysts showcased a 96.9% conversion rate for polyolefins.

A Viable Alternative to Conventional Waste Management

Finally, to explore the viability of this type of catalytic recycling, the team conducted a techno-economic analysis and a life cycle assessment of the proposed approach. The results clearly underscored the potential of implementing a real commercial-scale process using Ru/zeolite-Y catalyst.

"The addition of water not only enhances carbon efficiency, it improves economic and environmental performance, also increases the conversion of polyolefins to valuable fuels like gasoline and diesel," highlights Dr. Ro. Adding further, he says, "This approach thus represents a viable alternative to conventional waste management practices and offers a solution to reduce landfill and ocean pollution caused by polyolefins—the largest contributor to plastic waste."

Overall, this breakthrough in catalytic depolymerization could revolutionize how we deal with plastic pollution and help us efficiently

deal with this serious environmental threat. The research team has high hopes that this technology will evolve over the next few years to the point that mixed plastic waste can be processed without pre-sorting, making recycling efforts more cost-effective and simpler to implement.

"By demonstrating a sustainable and economic approach to transforming plastic waste into valuable resources, our research could help drive policy changes, inspire investment in advanced recycling infrastructure, and foster international collaborations to address the global plastic waste crisis. Over time, these advancements promise cleaner environments, reduced pollution, and a more sustainable future," concludes Dr. Ro on an optimistic note.

Sci Tech Daily, 23 January 2025

https://scitechdaily.com

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CHEMICAL EFFECTS

Pollution profiles, pathogenicity, and toxicity of bioaerosols in the atmospheric environment of urban general hospital in China

Higher potential leaching of inorganic and organic additives from biodegradable compared to conventional agricultural plastic mulch film

Potential emission risks of organic compounds from cement kilns

ENVIRONMENTAL RESEARCH

Ambient coarse particulate matter pollution and hospital admissions for schizophrenia

Long-term exposure to air pollution and greenness in association with respiratory emergency room visits and hospitalizations: The Life-GAP project

The hypercapnic environment on the International Space Station (ISS): A potential contributing factor to ocular surface symptoms in astronauts

PHARMACEUTICAL/TOXICOLOGY

Encorafenib, cetuximab and chemotherapy in BRAF-mutant colorectal cancer: a randomized phase 3 trial

Groundwater flowpath characteristics drive variability in per- and polyfluoroalkyl substances (PFAS) loading across a stream-wetland system

OCCUPATIONAL

Health effects of occupational exposure to jet fuels used in the military: A systematic review of the epidemiologic literature

Prenatal metal(loid) exposure and preterm birth: a systematic review of the epidemiologic evidence