CHEMWATCH

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ASIA PACIFIC

Have your say: changes to categorisation, reporting and record keeping

2023-09-29

We invite public comments on a suite of regulatory proposals relating to categorisation, reporting and record-keeping obligations. Consultation closes on 9 November 2023.

We've explored possible solutions to address stakeholder advice that certain requirements of the General Rules are challenging to comply with. AICIS has also identified aspects of the General Rules that we think should be strengthened to ensure protection of human health and the environment or clarify the intent of certain requirements.

These proposals were developed using an evidence- and risk-based approach to regulation that is appropriate to each circumstance. Some key proposals in this consultation:

- Replacing written undertakings with records that will make compliance easier.
- Greater acceptance of International Nomenclature of Cosmetic Ingredients (INCI) names for reporting and record keeping.
- Changes to the categorisation criteria to benefit:

O soap makers

O introducers of chemicals in flavour and fragrance blends

O introducers of hazardous chemicals where introduction and use are controlled.

- Strengthening criteria and/or reporting requirements for health and environmental protection, for example, to prevent persistent organic pollutants (POPs) from being categorised as exempted or reported Introductions.

None of the proposals involve changes to the Industrial Chemicals Act 2019. Proposals that would benefit introducers are based on mechanisms that may lower regulatory burden while maintaining regulatory intent.
Read More
AICIS, 29 September 2023

https://www.industrialchemicals.gov.au/news-and-notices/have-your-say-changes-categorisation-reporting-and-record-keeping

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Register for webinars - details of proposals on categorisation, reporting and record keeping

2023-09-29

In our 2nd and 3rd webinars, we'll go into more details of the proposals currently open for public comments that we covered in overview in our first webinar on 21 September. Our October webinars will give examples of what the proposed changes would mean in practice.

You can register to attend one or both webinars, depending on your preference.

Read More

AICIS, 29 September 2023

https://www.industrialchemicals.gov.au/news-and-notices/register-webinars-details-proposals-categorisation-reporting-and-record-keeping

Draft evaluations - have your say - closes 27 November 2023

2023-09-29

What is this about?

We have published **20** draft evaluation statements on **1996** industrial chemicals and welcome your comments.

Please note: the draft evaluation statement for 2-methoxyethyl methacrylate and 2-ethoxyethyl methacrylate (EVA00127) proposes an Inventory listing variation under

Section 86 of the *Industrial Chemicals Act 2019*.

Read More

AICIS, 29 September 2023

https://www.industrialchemicals.gov.au/consultations/draft-evaluations-have-your-say-closes-27-november-2023

Temporary record-keeping provisions for NICNAS introducers extended to 1 April 2024

2023-09-29

Record-keeping provisions for introducers that transitioned from NICNAS to AICIS will continue to be available **until 1 April 2024**. These arrangements only apply to eligible introducers who are still importing or manufacturing chemicals that were previously on the NICNAS Inventory.

What is the temporary record-keeping arrangement for introducers who transitioned from NICNAS to AICIS?

See Records you can keep for listed introductions if you introduced chemicals under NICNAS. These arrangements were originally set to end on 30 November 2023, but will be extended to 1 April 2024.

Who is eligible to use this record keeping provision until 1 April 2024?

You must meet **all 3** below:

1. You imported or manufactured (introduced) a chemical under NICNAS (before 1 July 2020)
2. The chemical you introduced was listed on the NICNAS Inventory and you continued to introduce the same chemical under AICIS after 1 July 2020.
3. You don't know your chemical's CAS name or CAS number.

Why are we extending these arrangements?

We've been exploring ways to resolve challenges that businesses said they faced when complying with AICIS record-keeping obligations under the Industrial Chemicals (General) Rules 2019 (the Rules). As a result, we have developed a suite of proposed changes to the Rules around record-keeping requirements. We will soon announce a public consultation on these proposed changes, along with others relating to AICIS categorisation and reporting obligations.

Our upcoming consultation on changes to record-keeping obligations for listed introductions will be relevant to anyone currently introducing chemicals that were previously on the NICNAS Inventory.

For this reason, we've extended these administrative arrangements to:

- provide enough time to consult with stakeholders on these proposals
- enable the Rules to be considered by the Minister following the end of the public comment period.

Read More
AICIS, 29 September 2023

https://www.industrialchemicals.gov.au/news-and-notices/temporary-record-keeping-provisions-nicnas-introducers-extended-1-april-2024

AMERICA

NC budget contains millions to clean up PFAS, limits to emissions regulations

2023-09-23

North Carolina's recently finalized budget includes more than $61 million to address PFAS, commonly known as forever chemicals.

North Carolina's finalized budget includes more than $61 million to address substances commonly known as forever chemicals.

While many are celebrating resources to address a problem that has plagued the state for decades, some critics say the polluters — not the taxpayers — should be footing the bill.

PFAS, an acronym for per- and polyfluoroalkyl substances — the toxic forever chemicals — have been seeping into the Cape Fear River for decades, contaminating the drinking water supply for 1.5 million people. Many of those chemicals were dumped from a Chemours Co. plant in Fayetteville, formerly owned by DuPont.

"The scale of contamination is a lot more widespread than I think people realize," said Melanie Benesh, who provides provides legislative and regulatory analysis for the Washington, D.C.-based nonprofit Environmental Working Group. "We are slowly learning about the full scale of contamination in drinking water."

Ratepayers in Wilmington recently saw hikes in bills to fund a $43 million filter to remove PFAS from drinking water at the Sweeney treatment plant. The utility is in an ongoing lawsuit with Chemours to attempt to recoup funds.

Read More

WRAL News, 23 September 2023

https://www.wral.com/story/nc-budget-contains-millions-to-clean-up-pfas-limits-to-emissions-regulations/21062396/

December deadline looms as US FDA gears up to trial MOCRA submission system

2023-08-09

The US Food and Drug Administration (FDA) has invited businesses to trial an electronic system for listing products and registering facilities under recently enacted cosmetics legislation.

Alongside the agency's release of new draft guidance, the action marks progress towards realising mandates in the 2022 Modernization of Cosmetics Regulation Act (MOCRA). The law set a 29 December 2023 cutoff for cosmetic manufacturers and processors to prepare product listings – including ingredients – and facility registrations, among other requirements.

The agency plans to launch the online tool in October after testing, replacing the Voluntary Cosmetic Registration Program (VCRP) that ended in March.

The FDA's Office of Cosmetics and Colors (OCAC) and the Office of the Chief Scientist (OCS) is looking for applicants for the pilot project "to conduct user acceptance testing", the agency said in a Federal Register notice published today. The resulting input will aid in making the portal "usable and functional to ensure industry will be able to meet its statutory obligations", the agency said.

The FDA wants up to nine covered entities for the roughly two-week trial, which is slated for the second half of September. Those chosen will "reflect a broad spectrum of cosmetic product manufacturers and processors, including companies that range in size and develop a range of products", it added.

Read More

Chemical Watch, 9 August 2023

https://chemicalwatch.com/827119/december-deadline-looms-as-us-fda-gears-up-to-trial-mocra-submission-system

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EPA Finalizes Rule to Require Reporting of PFAS Data to Better Protect Communities from Forever Chemicals

2023-09-23

Today, the U.S. Environmental Protection Agency (EPA) finalized a rule that will provide EPA, its partners, and the public with the largest-ever dataset of per- and polyfluoroalkyl substances (PFAS) manufactured and used in the United States. This rule builds on over two years of progress on the Biden-Harris Administration's action plan to combat PFAS pollution, safeguarding public health and advancing environmental justice, and is a key action in EPA's PFAS Strategic Roadmap.

PFAS are a category of manufactured chemicals that have been used in industry and consumer products since the 1940s. PFAS have characteristics that make them useful in a variety of products, including nonstick cookware, waterproof clothing, and firefighting foam, as well as in certain manufacturing processes.

The reporting rule under the Toxic Substances Control Act (TSCA) is a statutory requirement under the FY2020 National Defense Authorization Act (NDAA) that requires all manufacturers (including importers) of PFAS and PFAS-containing articles in any year since 2011 to report information related to chemical identity, uses, volumes made and processed, byproducts, environmental and health effects, worker exposure, and disposal to EPA.

"The data we'll receive from this rule will be a game-changer in advancing our ability to understand and effectively protect people from PFAS," **said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff**. "Today we take another important step under EPA's PFAS Strategic Roadmap to deliver on President Biden's clear direction to finally address this legacy pollution endangering people across America."

In order to effectively research, monitor, and regulate PFAS, EPA is taking action to better understand who is using PFAS, how they are being used, and in what quantities. This rule will produce actionable data that can be used by EPA, as well as state, local, and Tribal governments to craft policies and laws that protect people from dangerous "forever chemicals."

Read More

US EPA, 28 September 2023

https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/tsca-section-8a7-reporting-and-recordkeeping

Regulatory Requirements for New HAP Additions

2023-09-26

Proposed rule - The U.S. Environmental Protection Agency (EPA) is proposing to amend the General Provisions for National Emission Standards for Hazardous Air Pollutants (NESHAP) to address applicability and compliance issues resulting from the addition of a compound to the list of hazardous air pollutants (HAP) under the Clean Air Act (CAA). This action focuses on issues related to newly applicable standards for sources that become major sources solely from the addition of a compound to the CAA HAP list. This action also includes a discussion of the impacts of a newly listed HAP on the federal operating permit program.

Read More

CHEMYCAL, 26 September 2023

https://chemycal.com/news/e609873c-0423-4023-80c6-8d865e0c343c/United_States_of_America__Regulatory_Requirements_for_New_Hazardous_Air_Pollutants_Additions

EUROPE

Cleaning up failures in water and sewage regulation: Industry and Regulators Committee report

2023-09-22

On 16 October 2023, the House of Lords is due to debate a motion in the name of Lord Hollick (Labour), the chair of the House of Lords Industry and Regulators Committee, to take note of the committee's report 'The affluent and the effluent: Cleaning up failures in water and sewage regulation', published in March 2023.

The report is the outcome of the committee's inquiry into the work of the water regulator, Ofwat, which was launched in May 2022. A short follow-up inquiry was conducted in the summer of 2023.

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1. Conclusions and recommendations from the committee's March 2023 report

The House of Lords Industry and Regulators Committee's 2023 report stated that since the water industry's privatisation in 1989 there had been some positive improvements in the sector, including "the supply of good quality drinking water, investment in wastewater treatment, and protecting homes from sewer flooding". However, the committee noted that demands on water supply and the sewage network had increased due to factors including "population growth, property development and climate change". The committee said that the result was a "network unable to cope" and one which relied on "releasing polluted water into the environment".

Under existing law, sewage can be released into the water network during "storm overflows" in the sewer system, which protect properties from overloaded sewers during heavy storm events. Overflows are used to spill excess wastewater and rainwater into inland waters and the sea. Water companies are permitted to allow some storm overflows, but only within conditions regulated by Ofwat and the Environment Agency.

In its evidence to the committee, the Environment Agency said that in 2021 the environmental performance of water companies was "at its lowest ever level" and the performance of most companies was declining. The Environment Agency also told the committee that, without sufficient investment and reform, in 20 years the UK would "not have enough water to match demand". The committee said that the investment needed to fully update the water and sewage systems to reduce leaks and storm overflows could cost "tens or hundreds of billions of pounds over multiple decades".

The committee's main conclusions and recommendations were:

The government and Ofwat must set "stretching targets" to reduce storm overflows across the water network.

- Ofwat and the Environment Agency "must go further" to hold water companies to account for environmental pollution through penalties and prosecution.
- Ofwat has "failed to ensure companies invest sufficiently" in water infrastructure, instead "choosing to keep bills low" at the expense of investment.

- Water companies have been "overly focused on maximising financial returns" at the expense of operational performance and protecting the environment.
- Ofwat should ensure that water company executives cannot receive substantial bonuses if their companies have missed performance and pollution targets.

The committee's recommendations to the government included:

- Set "stretching targets" for reducing sewage overflows. The committee noted that in 2022 the government had published its storm overflows discharge reduction plan (for more information see the House of Lords Library briefing on the plan). The committee said the plan "lacks bite" and that the government must use the mandatory review of the plan in 2027 to set "stretching targets" for Ofwat to reduce storm overflows.
- Legislate to introduce a single social tariff for water bills. The committee said that customers' bills "will likely increase" in the future. The report said the government should legislate to "protect vulnerable customers from bill increases".
- Consider banning the sale of wet wipes that are not biodegradable.
- Publish a national water strategy. This should set clear benchmarks for water quality and resilience of water supplies and which facilitates a "joined-up approach" between regulators for meeting those benchmarks.
- Provide adequate funding to the Environment Agency. The funding would ensure the inspection and enforcement of environmental offences by water companies.
- Accelerate the planning process for new reservoirs. The report stated that no major new reservoir has been built in the UK since 1991. The government should set out plans to "accelerate the planning process" for reservoirs, including by amending the national policy statement for water resources infrastructure, if necessary.
- Make water metering compulsory for all households and businesses, where it is possible to do so.

Read More

UK Parliament, 22 September 2023

https://lordslibrary.parliament.uk/cleaning-up-failures-in-water-and-sewage-regulation-industry-and-regulators-committee-report/

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Pharma lobby says EU ban on 'forever chemicals' would halt drug production

2023-09-27

FRANKFURT, Sept 27 (Reuters) - European drugmakers warned that a proposed complete ban on substances known as PFAS or "forever chemicals" would render medicine production in the region impossible, part of a high-stakes wrangle between manufacturers and environmental regulators.

The European Union started to consider in February a ban of the widely used but potentially harmful substances, in what could become the bloc's most extensive piece of regulation of the chemical industry.

A six-month consultation period to give impacted companies and industries an opportunity to put their views forward ended on Monday, with the European Chemicals Agency (ECHA) registering 5,600 comments.

"The entire pharmaceutical industry would no longer be able to manufacture active pharmaceutical ingredients ... or associated medicinal products in the EEA," if no exemptions, or derogations, are included in the draft, the European Federation of Pharmaceutical Industries and Associations (EFPIA) said in a statement.

The EEA, or European Economic Area, includes 27 EU member states plus Liechtenstein, Iceland and Norway.

"A total ban would see medicines' manufacturing in the EU grind to a halt in under three years," said EFPIA's director general, Nathalie Moll.

The group, which counts pharmaceutical majors with European operations including Pfizer, Roche and Novartis as members, said that PFAS are used in drug production, and some PFAS with no or low identified risks go directly into medicines.

Read More

Reuters, 27 September 2023

https://www.reuters.com/business/healthcare-pharmaceuticals/pharma-lobby-says-eu-ban-forever-chemicals-would-halt-drug-production-2023-09-27/

Updated risk assessment highlights the need for stricter regulation on MOH in food

2023-09-19

European Food Safety Authority (EFSA) updates risk assessment on mineral oil hydrocarbons (MOH) in food; highest MOH levels found in vegetable oils; notes that data gaps exist, especially in mineral oil aromatic hydrocarbons (MOAH) impact on toddlers; "extremely likely" that dietary exposure to MOAH is a concern for toddlers; *EFSA* recommendations aim to guide EU policy on allowable MOH levels in food.

On September 13, 2023, the *European Food Safety Authority (EFSA)* released an updated risk assessment on mineral oil hydrocarbons (MOHs) in food.

MOHs are mainly categorized into mineral oil-saturated hydrocarbon (MOSH) and mineral oil aromatic hydrocarbon (MOAH). The primary findings were that MOSH "very likely… does not raise concerns for human health" while it is "extremely likely" that MOAH is a health concern. According to EFSA, MOH, often derived from crude oil but also from other sources like coal and gas, can enter the food supply through various means such as environmental contaminants and food production machinery.

EFSA's Scientific Panel on Contaminants in the Food Chain (CONTAM Panel) had indicated in 2012 that MOH poses various health risks depending on its type (FPF reported). MOSH can accumulate in human tissues and potentially harm the liver, while MOAH may cause DNA damage and possibly lead to cancer (FPF reported). EFSA was mandated by the *European Commission (EC)* in 2017 to start monitoring MOHs in food and food contact materials (FPF reported). Following that, in 2020 EFSA was tasked with updating its 2012 scientific opinion, focusing on state-of-the-art research and occurrence data to assess the risk posed by MOHs. According to the FCCmigex, MOHs have been measured most often in paper and board-based food contact articles.

Despite the update, uncertainties remain due to the complex chemical makeup of MOH. For instance, insufficient data exist to draw conclusive evidence on the oral toxicity of MOAH with three or more aromatic rings. However, based on what is available, "it is extremely likely (99-100% certain)" that dietary exposure to MOAH is a concern for toddlers, and "likely (more than 66% certain) for other age groups."

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Read More

FPF, 19 September 2023

https://www.foodpackagingforum.org/news/updated-risk-assessment-highlights-the-need-for-stricter-regulation-on-moh-in-food

INTERNATIONAL

A novel concept for improved safety assessment of FCMs guided by public health concerns

2023-09-26

Over 20 scientists present a vision for safer food contact materials (FCMs); propose new approach to test all chemicals that migrate from final product for their contribution to highly prevalent chronic diseases.

On September 26, 2023, an international team of over 20 scientists, led by *Food Packaging Forum (FPF)* director Jane Muncke shared a new vision to work toward a world where food contact materials are free from hazardous and untested chemicals. Published in the peer-reviewed journal *Environment International*, the collaborative effort from scientists of FPF, its Scientific Advisory Board, and other academics propose a new conceptual approach to move beyond current risk assessment procedures for food contact materials. At present, assessments focus on one chemical at a time, particularly cancer-causing chemicals that are genotoxic (i.e., damage DNA). In the future, the authors envision assessing the whole cocktail of chemicals that migrate from finished food contact articles (FCAs) and testing their effects with respect to multiple growing health concerns including cardiovascular disease and metabolic disorders.

The authors highlight that current safety evaluations focus primarily on the substances used in the manufacturing of food contact articles, overlooking compounds that emerge during production. As a result, many chemicals in food packaging and cookware remain untested, especially the interactions with non-intentionally added substances (NIAS), despite the fact that these chemicals are relevant for human exposure.

To address these gaps, Muncke et al. suggest (1) testing the whole cocktail of chemicals that migrate from the final food contact article, including (unknown) NIAS, and (2) broadening toxicological evaluations to cover a variety of non-communicable diseases, beyond just genotoxic effects.

Six Clusters of Disease framework

The researchers developed the six clusters of disease (SCOD) concept, highlighting prevalent and increasingly concerning non-communicable diseases (NCDs) linked to chemical exposures: cancers, cardiovascular diseases, as well as reproductive, brain-related, immunological, and metabolic disorders. For instance, widely used food contact chemicals (FCCs) like PFAS, bisphenol A, and phthalates have ties to conditions like kidney cancer, infertility, and ADHD, respectively (FPF reported, also here and here).

Read More

FPF, 26 September 2023

https://www.foodpackagingforum.org/news/a-novel-concept-for-improved-safety-assessment-of-fcms-guided-by-public-health-concerns

This map shows where 600 animal species are testing positive for forever chemicals

2023-09-28

PFAS, also called forever chemicals, are in everything from our cooking pans to our cosmetics to our clothing. They've made their way into our drinking water and our environment and our own bodies. And a new map makes clear just how pervasive these chemicals are, showing how they've been documented in more than 600 wildlife species around the world.

The map is a project from the Environmental Working Group, and it uses more than 200 peer-reviewed studies to plot the locations where PFAS—per- and polyfluoroalkyl substances, a class of synthetic chemicals that stick around for thousands of years—have been detected in animals, including fish, birds, polar bears, tigers, and more. When you click on a point on the map, you'll see the species location, types of PFAS detected, and the source of that research. There are studies showing PFAS exposure in more than 625 wildlife species.

"Contamination is really global," says David Andrews, a senior scientist at the Environmental Working Group who works on chemical regulation in the U.S., including PFAS contamination. "That's part of what comes out from looking at our map is just, from one end of the earth to the other, where wildlife species have been tested, PFAS have been detected." And the absence of a point on the map doesn't necessarily mean species in

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that area are free from PFAS contamination, he notes, just that they likely haven't been tested yet.

Some of these species that have been exposed to these forever chemicals are already endangered or threatened, and PFAS could pose even more risks. Research on alligators in North Carolina found that when they had high levels of these chemicals in their blood, they also had more skin lesions and wounds that wouldn't heal properly. Scientists also say PFAS exposure may be harmful to birds' reproduction. In lab animals, PFAS have been associated with liver, thyroid, and reproductive diseases, along with developmental effects and damage to immune systems.

This is admittedly a small body of research, but "what really stood out to us," Andrews says, "is how those health impacts documented in wildlife align very well with the health impacts that have been documented in people." In humans, PFAS have been linked to decreased fertility and increased risk of cancer and developmental delays.

Read More

Fast Company, 28 September 2023

https://www.fastcompany.com/90958279/map-pfas-forever-chemicals-wild-animals

Janet's Corner

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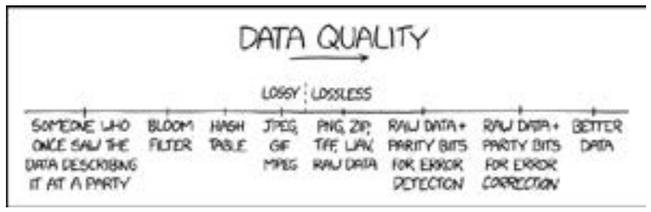
Data Quality

2023-10-06



https://xkcd.com/2739/

Hazard Alert

OCT. 06, 2023

Carbon Tetrachloride

2023-10-06

USES [2,3]

Carbon tetrachloride has been produced in large quantities to make refrigeration fluid and propellants for aerosol cans. Since many refrigerants and aerosol propellants have been found to affect the earth's ozone layer, the production of these chemicals is being phased out. Consequently, the manufacture and use of carbon tetrachloride has declined a great deal. In the past, carbon tetrachloride was widely used as a cleaning fluid (in industry and dry cleaning establishments as a degreasing agent, and in households as a spot remover for clothing, furniture, and carpeting). Carbon tetrachloride was also used in fire extinguishers and as a fumigant to kill insects in grain. Most of these uses were discontinued in the mid-1960s. Until recently, carbon tetrachloride was used as a pesticide, but this was stopped in 1986.

Carbon tetrachloride is an inorganic compound with the formula CCl_4.[1] It is a clear liquid with a sweet odour that evaporates very easily. Carbon tetrachloride does not easily burn and is almost insoluble in water. It is a manufactured chemical and does not occur naturally in the environment. [1,2]

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

General Populations

- Carbon tetrachloride is found in air, water and soil. Inhalation of contaminated air and ingestion of contaminated drinking water are the primary routes of exposure.
- The general public is not likely to be exposed to large amounts of carbon tetrachloride. Populations living close to waste sites or areas of heavy carbon tetrachloride use may have increased risk of exposure.
- Exposure may occur through volatisation of carbon tetrachloride from tap water during showering, bathing or cooking.
- Carbon tetrachloride is currently banned from use in commercial products.

Occupational Populations

- Inhalation of contaminated air is the primary route of exposure in occupational settings.
- Workers involved in the manufacture of carbon tetrachloride are most likely to be exposed than the general public.

Routes of Exposure

- Inhalation – Predominant route of exposure for general population.
- Oral – Major route of exposure for the general population through ingestion of contaminated drinking water.
- Dermal – Minor route of exposure through dermal contact with contaminated soil.

HEALTH EFFECTS [4]

Acute Health Effects

- Acute inhalation and oral exposures to high levels of carbon tetrachloride have been observed primarily to damage the liver (swollen, tender liver, changes in enzyme levels, and jaundice) and kidneys (nephritis, nephrosis, proteinurea) of humans. Depression of the central nervous system has also been reported. Symptoms of acute exposure in humans include headache, weakness, lethargy, nausea, and vomiting.
- Delayed pulmonary oedema (fluid in lungs) has been observed in humans exposed to high levels of carbon tetrachloride by inhalation and ingestion, but this is believed to be due to injury to the kidney rather than direct action of carbon tetrachloride on the lung.
- Acute animal exposure tests in rats, mice, rabbits, and guinea pigs have demonstrated carbon tetrachloride to have low toxicity from inhalation exposure, low-to-moderate toxicity from ingestion, and moderate toxicity from dermal exposure.

Carcinogenicity

- Occasional reports have noted the occurrence of liver cancer in workers who had been exposed to carbon tetrachloride by inhalation exposure; however, the data are not sufficient to establish a cause-and-effect relationship.
- Liver tumours have developed in rats and mice exposed to carbon tetrachloride by gavage (experimentally placing the chemical in their stomachs).
- EPA has classified carbon tetrachloride as a Group B2, probable human carcinogen.

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Other Effects

- No information is available on the reproductive effects of carbon tetrachloride in humans. Limited epidemiological data have indicated a possible association between certain birth outcomes (e.g., birth weight, cleft palate) and drinking water exposure. However, as the water contained multiple chemicals, the role of carbon tetrachloride is unclear.
- Decreased fertility and degenerative changes in the testes have been observed in animals exposed to carbon tetrachloride by inhalation.
- Birth defects have not been observed in animals exposed to carbon tetrachloride by inhalation or ingestion.

SAFETY

First Aid Measures [5]

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Workplace Controls & Practices [4]

Control measures include:

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling carbon tetrachloride:

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

Personal Protection in Case of a Large Spill:

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

REGULATION

United States

EPA: The Environmental Protection Agency has set a limit for carbon tetrachloride in drinking water of 5 parts of carbon tetrachloride per billion parts of water (5 ppb). The EPA has also set limits on how much carbon tetrachloride can be released from an industrial plant into waste water and is preparing to set limits on how much carbon tetrachloride can escape from an industrial plant into outside air.

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OSHA: The United State Occupational Safety & Health Administration has set the following Permissible Exposure Limits (PEL):

General Industry: 29 CFR 1910.1000 Z-2 Table -- 10 ppm TWA; 25 ppm Ceiling for 5 minutes in any 3 hours; 200 ppm Peak

Construction Industry: 29 CFR 1926.55 Appendix A -- 10 ppm, 65 mg/m3 TWA; Skin

Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 10 ppm, 65 mg/m3 TWA; Skin

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for carbon tetrachloride is 5 ppm, 31 mg/m3 TWA; 10 ppm, 63 mg/m3 STEL; Skin; Appendix A2 - Suspected Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health has established a Recommended Exposure Limit (REL) for carbon tetrachloride of 2 ppm, 12.6 mg/m3 STEL (60 Minutes); Appendix A - NIOSH Potential Occupational Carcinogens

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration (TWA) for carbon tetrachloride of 0.1ppm/ 0.63mg/ m3 for a 40-hour workweek.

REFERENCES

1. http://en.wikipedia.org/wiki/Carbon_tetrachloride
2. http://www.atsdr.cdc.gov/phs/phs.asp?id=194&tid=35
3. http://www.epa.gov/ttn/atw/hlthef/carbonte.html
4. http://www.atsdr.cdc.gov/toxguides/toxguide-30.pdf
5. http://www.sciencelab.com/msds.php?msdsId=9927342
6. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=195&tid=35
7. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx

Important flu-fighting immune cells go M.I.A.

2023-09-29

Killer T cells (also known as CD8+ T cells) are specialised lymphocytes that seek and destroy other cells that are infected with a virus or become cancerous.

Once a problem cell is sighted, the killer binds to specific receptors on the target and destroys it.

But the effectiveness of this immune process appears to shift as we age, with changes in killer T cell efficiency now described in a multi-institutional study led by researchers from the Doherty Institute and UNSW published in Nature Immunology.

Their analysis investigated how killer T cells from newborns, school children, adults and people over 60 years recognise and respond to influenza viruses.

While children and adults have efficient immune responses, the process is less efficient once people turn about 60 years old.

The scientists have uncovered a surprising "clonal reset" of such cells in some people aged over 60. These primed killer T cells seemingly disappear, leaving remaining, less specialised T cells available to do the job.

"The specific T cell receptor – basically the molecule that allows the T cell to bind to the antigen – is actually most similar to the one from young, young children," says Associate Professor Fabio Luciani from the School of Medical Sciences at UNSW Sydney, one of the senior researchers on the study.

"Those T cells that we found in aged population, they do recognise the viruses, and they have specific receptors that allowed them to recognize the pathogen… they are functional.

"The problem is that they don't work as well as we observed in the younger [school-aged child and adult] population."

The Doherty Institute's Dr Carolien van de Sandt led the study investigating this peculiarity.

"We don't know where they've gone, we just don't detect them anymore," she says.

One of the body's most important disease fighters retires and scientists don't know why.

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To understand her research, one needs to dive into the nature of these T cells.

"You have a whole bunch of different [T] cells with slightly different receptors on the surface," van de Sandt says.

"So when you first 'see' that infection, the best one gets selected."

This is our prize fighter – tailor-made to take on influenza-infected opponents.

"They multiply, so the second time you see that [pathogen], these will respond really quicky."

The other T cells in your body, the ones that weren't selected to take on the threat, basically sit on the bench waiting for a call-up. That's decades of waiting in reserve. In older people who lose their first-choice fighters, that leaves these suboptimal ones as the body's next resort for battle.

"The second best gets selected, then the third best… and that's what's been happening here," van de Sandt says.

"So, they've been sitting there waiting, and then once all the good ones are gone, they're like 'Okay, now it's my turn'… but they're not even close to what the best one is. Probably they've been around since childhood, but they've never been recruited."

The end of the story is the beginning

Van de Sandt is less interested in solving the disappearance of certain cells in certain people, as she is in applying her findings to solving immunity issues.

The discovery suggests new possibilities for developing next-generation therapies that could prime or replenish the body's immune response throughout the aging process.

"If you think of boosting these optimal cells at a younger age, and we can find a way to maintain them so they don't disappear, we can maybe maintain [immunity] until very old age so that you're protected for longer," she says.

To identify optimal cells for future vaccines, the research team relied on the use of machine learning and single-cell genomics to analyse individual T cells at the molecular and proteomic – or protein – level.

With such granular analysis, they've built a substantial data profile of the nature of killer T cells within the body, which could be valuable in identifying candidates for recharging human immunity through new vaccines.

"We are using a lot of technology, which basically allows us to measure the molecular and proteomic makeup of individual T cells, but in each single cell we will measure the genes and the proteins that they express," says Luciani. ~swebsite, 23 September 2023

https://cosmosmagazine.com

New pipeline makes valuable organic acid from plants—saving money and emissions

2023-10-03

The team of University of Illinois and Princeton University researchers created a cost-effective, end-to-end pipeline for this valuable organic acid by engineering a tough, acid-tolerant yeast as the fermenting agent, avoiding costly steps in downstream processing. Succinic acid is a widely used additive for food and beverages and has diverse applications in agricultural and pharmaceutical products.

This same pipeline can be used to produce other industrially important organic acids targeted by CABBI in its work to develop sustainable biofuels and biochemicals from crops, said co-author Huimin Zhao, CABBI's Conversion Theme Leader and Professor of Chemical and Biomolecular Engineering (ChBE) at Illinois. To reduce reliance on fossil fuels, Conversion researchers are deploying microbes to convert plant biomass into chemicals used in everyday products as an alternative to conventional petroleum-based production.

"This will serve as a blueprint for all the other metabolic engineering products in CABBI," said Zhao, one of several CABBI principal investigators on the project.

The study is published in Nature Communications, and the work builds on years of research on succinic acid production by Zhao and his colleagues using Issatchenkia orientalis, an unconventional yeast ideal for making organic acids.

I. orientalis has the unique ability to thrive in low-pH, or acidic, conditions. Most organisms require a neutral pH environment to survive, including Saccharomyces cerevisiae, a more conventional yeast, or Escherichia coli

In a breakthrough for environmentally friendly chemical production, researchers at the Center for Advanced Bioenergy and Bioproducts Innovation (CABBI) have developed an economical way to make succinic acid, an important industrial chemical, from sugarcane.

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bacteria. Both have been used by companies and labs to produce succinic acid but proved to be too costly, so efforts to scale up production have failed, Zhao said.

Those microorganisms require the addition of a base to neutralize the toxic acidic conditions so they can continue making succinic acid. But that generates side products, such as gypsum or calcium sulfate, which have to be separated out at the end of the pipeline to purify the product, driving up downstream processing costs.

"One of the bottlenecks in the production of organic acids is the separation cost," Zhao said. "We have to add a lot of base to keep the pH near neutral, between 6 to 7."

With I. orientalis, however, "the organism lives happily at a pH of 3 to 4," so the additives are not required, Zhao said. "In the end, that significantly reduces costs."

The CABBI researchers also did extensive metabolic engineering to rewire I. orientalis to produce robust levels of succinic acid—higher than either S. cerevisiae or E. coli, he said. Using metabolic flux analysis from Rabinowitz's lab, they identified the steps in the yeast's metabolism that limited the production of succinic acid. One key roadblock: Native I. orientalis can't utilize the sucrose from sugarcane. So an enzyme was added that could break down sucrose from the sugarcane juice into glucose and fructose to make succinic acid. Other genes were introduced to overproduce succinic acid.

Working with Singh's group at IBRL, the team then scaled up succinic acid production using industrially relevant equipment to conduct an end-to-end integration of the process. The pilot-scale work showed the new strains could produce up to 110 g/L of succinic acid and, after batch fermentation and downstream processing, an overall yield of 64%—impressive results having commercial significance, Singh said.

The combination of higher production levels through genetic engineering and lower costs from the elimination of downstream separation makes the process "very attractive," Zhao said. "That's why the pipeline is so economical, at least at this pilot scale."

The final step was working with Guest to simulate a full end-to-end, low-pH succinic acid production pipeline, using the open-source software platform BioSTEAM developed by his group. The techno-economic analysis (TEA) and life cycle assessment showed the process was financially

viable and could reduce greenhouse gas emissions by 34% to 90% relative to fossil fuel-based production processes.

"These advancements in metabolic engineering could have large-scale benefits, simultaneously driving down costs and environmental impacts in support of a circular bioeconomy," Guest said.

The process emits less carbon dioxide (CO2) than conventional petroleum-based chemical processing. Plants like sugarcane also soak up carbon, and CO2 can be used as a substrate for the process, further reducing its carbon footprint.

"It's definitely more environmentally friendly. That's the premise for all the research in CABBI: using renewable resources to make chemicals and fuels," Zhao said.

Researchers plan further scale-up studies soon to support commercialization of the succinic acid production process.

The work will also be a template for production of other CABBI products using I. orientalis, including 3-hydroxypropionic acid (3-HP). The market for 3-HP, used in components of disposable diapers and sealants, exceeds $1 billion, and research to date shows huge promise, Zhao said.

"We expect I. orientalis can serve as a general industrial platform for the production of a wide variety of organic acids," said Vinh Tran, primary author on the paper and a Ph.D. student in ChBE.

The project involved several lab groups and contributions from all three themes of CABBI's research—using sugarcane juice from the Feedstock Production research team, metabolic research and bioprocessing facilities from the Conversion team, and economic and environmental analysis from the Sustainability team.

Co-authors included CABBI researchers Sarang Bhagwat of CEE and Yihui Shen of the Department of Chemistry at Princeton; Somesh Mishra of ABE; Saman Shafaei, Shih-I Tan, Zia Fatma, and Benjamin Crosly of ChBE; and Jayne Allen of CEE.

Phys Org, 03 October 2023

https://phys.org

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PFAS Exposure May Delay Girls' Puberty

2023-10-03

Research from the University of Cincinnati shows that exposure to PFAS may delay the onset of puberty in girls. The research was published in the journal Environmental Health Perspectives.

This study is the first longitudinal research that included the component of the role hormones play in the delay, according to Susan Pinney, PhD, of the Department of Environmental and Public Health Sciences in the UC College of Medicine and corresponding author of the study.

She says the delay of puberty in girls can lead to negative long-term health outcomes, including a higher incidence of breast cancer, renal disease and thyroid disease.

"Puberty is a window of susceptibility," Pinney says. "Environmental exposures during puberty, not just to PFAS, but anything, have more of a potential for a long-term health effect. What these have done is extended the window of susceptibility, and it makes them more vulnerable for a longer period of time."

New research has shown that PFAS exposure can delay the onset of puberty in girls, which may lead to negative long-term health outcomes.

The published research describes the findings from studying a total of 823 girls who were 6 to 8 years old when they were enrolled in the study — 379 were in the Greater Cincinnati area, the other 444 were in the San Francisco Bay Area. Researchers wanted to start the girls in the study before they hit the beginning of breast development. Then they followed them with exams every six to 12 months to see when they experienced the first signs of breast development and pubic hair.

The results found that 85% of the girls in the two cohorts had measurable levels of PFAS. Pinney says this PFAS research is unique because the hormone component was included and they discovered evidence of decreased hormones. The hormones that were decreased with PFAS exposure were consistent with findings of the delay of the onset of puberty.

"The study found that in girls with PFAS exposure puberty is delayed five or six months on average but there will be some girls where it's delayed a lot more and others that it wasn't delayed at all," Pinney says. "We are especially concerned about the girls at the top end of the spectrum where it's delayed more."

The study also found that over 99% of the girls in the two cohorts had measurable levels of PFOA, one of the most important of the PFAS.

Pinney points to several factors playing a role in PFAS exposure in Greater Cincinnati. The Ohio River is the main source of drinking water in the area and a DuPont plant near Parkersburg, West Virginia, released PFAS into the river for decades which flowed downstream to major water intakes on both sides of the river near eastern Hamilton County. PFAS were also present in firefighting foam and there is a firefighting training ground near those same water intakes.

Pinney, who has studied this topic for years in collaboration with the now-retired Frank Biro, MD, of Cincinnati Children's Hospital and the Department of Pediatrics at the UC College of Medicine, says this and other studies raise the question of, considering the known dangers of PFAS, how did we get to this point? She points to the fact that the United States doesn't follow the "precautionary principle" which is the principle that the introduction of a new product or process whose ultimate effects are disputed or unknown should be resisted.

"The evidence of PFAS being dangerous goes all the way back to the 1980s when chemists were doing studies, noticed that PFAS had the same chemical structure as other dangerous chemicals and they reported on it," Pinney says. "It's taken a very long time for us to recognize it as a human toxin. Meanwhile, all of these toxins got into our environment, and it's going to take a long time before they leave."

Pinney says one of the reasons is that PFAS do not degrade. Studies are being done to explore methods of breaking up the chemicals.

"It seems to take a long time to convince regulators about the health effects of PFAS," she says. "We as scientists need to be more forceful with regulators and say, 'Hey guys, you read the same science we read.'

"The whole thing has been a learning experience for me. Scientists are frustrated with the slowness of movement to change regulatory guidelines. Not only do we need to publish our research findings, but also do our best to inform the general population and the health care community. Efforts toward environmental cleanup have begun but it is very costly."

Reference: Pinney SM, Fassler CS, Windham GC, et al. Exposure to perfluoroalkyl substances and associations with pubertal onset and serum reproductive hormones in a longitudinal study of young girls in

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greater Cincinnati and the San Francisco bay area. Environ Health Persp. 131(9):097009. doi: 10.1289/EHP11811

Technology Networks, 03 October 2023

https://Technologynetworks.com

Doubly oxidised carbene tests the limits of the octet rule

2023-10-03

Carbenes were first discovered at the beginning of the 20th century but their extreme reactivity made them difficult to handle and they were widely dismissed as a laboratory curiosity. These reactive species contain an unusual six-electron carbon atom, bonded to two substituents and with two non-bonding electrons on the carbon centre. Careful choice of the bonded groups can stabilise this electron-deficient carbon and over the last 30 years carbenes have become a powerful tool in synthesis.

An unprecedented four-electron carbon intermediate has been isolated and characterised by researchers in the US. The team used a two-step approach to remove the non-bonding electrons from a stable carbene intermediate to create a crystalline doubly oxidised carbene.

Now, Guy Bertrand and Ying Kai Loh at the University of California San Diego, US have pushed the octet rule of main group elements – that atoms bonded to one another tend to have eight electrons in their valence shell – even further, removing the two non-bonding electrons to prepare a highly-reactive four-electron carbon species. The team began with a bis(imino)carbene whose two electron-donating substituents stabilise the vacant orbital on the central six-valent carbon. However, they quickly encountered problems using single-electron oxidation conditions.

The initial oxidation produces an unstable five-electron carbene radical cation which immediately abstracts a hydrogen radical from the reaction solvent to form an unwanted side product. 'We therefore employed a two-step approach,' explains Loh. 'First, oxidation of the carbene to a carbonyl compound, then, oxide-ion abstraction which removes the oxygen atom along with two electrons to afford the doubly oxidised carbene. This approach bypasses the generation of that highly reactive carbene radical cation.'

The resulting crystalline dication contains just four valence electrons, but the team's careful choice of bulky electron-rich substituents protects the electron-deficient carbon centre from quenching by the crystal counterions while simultaneously stabilising the double positive charge. 'The authors cleverly used imine functional groups to assist in this stabilisation,' explains Todd Hudnall, a main group chemist at Texas State University in the US. 'The two flanking nitrogen atoms are electron rich

and feature lone pairs of electrons that are capable of stabilising the formal C2+ centre through resonance effects. In such a way, the 2+ charge can be distributed throughout the N–C=N–C–N=C–N linkage.'

Even with this stabilisation, the doubly oxidised carbene is potently electrophilic, reacting via the central carbon as both a Lewis acid and an anion abstractor. Intriguingly, the team also identified reduction conditions to convert the dication back to the parent carbene, making the interconversion of these species a unique, reversible two-electron redox system.

Bertrand is confident that this new reactive species will ultimately find many uses throughout the chemical and material sciences and hopes that others will begin to explore the potential of these carbenes. 'This work is fundamental in nature but it paves the way for the isolation of a variety of doubly oxidised carbenes,' he says. 'In the short term, we need to demonstrate that this compound is not unique and many dications could be stable with simpler substituents. In the future other applications may arise and I have no doubt that we or others will find them.'

This discovery has already met with excitement and Hudnall is particularly eager to see how this work will influence future catalytic strategies. 'Given the highly delocalised nature of the 2+ charge in the molecule, it would be interesting to see if this dication can be used to activate small molecule substrates relevant to the renewable energy arena such as carbon monoxide, carbon dioxide or hydrogen,' he says.

Chemistry World, 03 October 2023

https://chemistryworld.com

Team develops superhydrophobic surface that can stay dry for months underwater

2023-10-04

This thin layer of air is called a plastron and for decades, material scientists have been trying to harness its protective effects. Doing so could lead to underwater superhydrophobic surfaces able to prevent corrosion, bacterial growth, the adhesion of marine organisms, chemical fouling, and other deleterious effects of liquid on surfaces. But plastrons have proved highly unstable under water, keeping surfaces dry for only a matter of hours in the lab.

A species of spider lives its entire life underwater, despite having lungs that can only breathe atmospheric oxygen. How does it do it? This spider, known as the Argyroneta aquatica, has millions of rough, water-repellent hairs that trap air around its body, creating an oxygen reservoir and acting as a barrier between the spider's lungs and the water.

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Now, a team of researchers led by the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), the Wyss Institute for Biologically Inspired Engineering at Harvard, the Friedrich-Alexander-Universität Erlangen-Nürnberg in Germany, and Aalto University in Finland have developed a superhydrophobic surface with a stable plastron that can last for months under water.

The team's general strategy to create long-lasting underwater superhydrophobic surfaces, which repel blood and drastically reduce or prevent the adhesion of bacterial and marine organisms such as barnacles and mussels, opens a range of applications in biomedicine and industry.

The research is published in Nature Materials.

"Research in bioinspired materials is an extremely exciting area that continues to bring into the realm of man-made materials elegant solutions evolved in nature, which allow us to introduce new materials with properties never seen before," said Joanna Aizenberg, Amy Smith Berylson Professor of Materials Science and Professor of Chemistry & Chemical Biology at SEAS and co-author of the paper. "This research exemplifies how uncovering these principles can lead to developing surfaces that maintain superhydrophobicity under water."

Researchers have known for 20 years that a stable, underwater plastron was theoretically possible, but until now, haven't been able to show it experimentally.

One of the biggest issues with plastrons is that they need rough surfaces to form, like the hair of Argyroneta aquatica. But this roughness makes the surface mechanically unstable and susceptible to any small perturbation in temperature, pressure, or tiny defect.

Current techniques to assess artificially made superhydrophobic surfaces only take into account two parameters, which don't give enough information about the stability of the air plastron underwater. Aizenberg, Jaakko V. I. Timonen and Robin H. A. Ras from Aalto University, and Alexander B. Tesler and Wolfgang H. Goldmann from FAU and their teams identified a larger group of parameters, including information on surface roughness, the hydrophobicity of the surface molecules, plastron coverage, contact angles, and more, which, when combined with thermodynamic theory, allowed them to figure out if the air plastron would be stable.

With this new method and a simple manufacturing technique, the team designed a so-called aerophilic surface from a commonly used and inexpensive titanium alloy with a long-lasting plastron that kept the surface dry thousands of hours longer than previous experiments and even longer than the plastrons of living species.

"We used a characterization method that had been suggested by theorists 20 years ago to prove that our surface is stable, which means that not only have we made a novel type of extremely repellent, extremely durable superhydrophobic surface, but we can also have a pathway of doing it again with a different material," said Tesler, a former postdoctoral fellow at SEAS and the Wyss Institute, and lead author of the paper.

To prove the stability of the plastron, the researchers put the surface through the ringer—bending it, twisting it, blasting it with hot and cold water, and abrading it with sand and steel to block the surface remaining aerophilic. It survived 208 days submerged in water and hundreds of dunks in a petri dish of blood. It severely reduced the growth of E.coli and barnacles on its surface and stopped the adhesion of mussels altogether.

"The stability, simplicity, and scalability of this system make it valuable for real-world applications," said Stefan Kolle, a graduate student at SEAS and co-author of the paper. "With the characterization approach shown here, we demonstrate a simple toolkit that allows you to optimize your superhydrophobic surface to reach stability, which dramatically changes your application space."

That application space includes biomedical applications, where it could be used to reduce infection after surgery or as biodegradable implants such as stents, according to Goldmann, senior author of the paper, and former Harvard fellow. It also includes underwater applications, where it could prevent corrosion in pipelines and sensors. In the future, it could even be used in combination with the super-slick coating known as SLIPS, the Slippery Liquid-Infused Porous Surfaces, developed by Aizenberg and her team more than a decade ago, to protect surfaces even further from contamination.

Phys Org, 04 October 2023

https://phys.org

Researchers in Missouri have found high concentrations of microplastic in Cliff Cave, a cave system in Saint Louis County that has been closed off to visitors for the past 30 years. The extent of the microplastic contamination is detailed in two new research papers, published in Science of the Total Environment and Water Research.

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Microplastics Found in Cave Closed to Visitors for 30 Years

2023-09-28

This discovery highlights the pervasiveness of microplastics in the environment, the researchers say, while also shedding light on how these plastic particles spread.

Exploring subsurface microplastic contamination

Microplastics are extremely small particles of plastic debris, normally defined as being less than 5 millimeters in length, that can be found across aquatic and terrestrial environments. Plastic microbeads, such as those used in the cosmetics industry, are a well known example. However, microplastics can also be formed through the breakdown of other plastic products in nature, such as plastic bags deteriorating in ocean currents, or synthetic fibers being released during clothes laundering.

Microplastics are an emerging contaminant in modern society, with much still to learn about their environmental impact. Their presence in the marine environment has been a strong focus for early microplastic research, but researchers are keen to examine their effects in other settings.

"A lot of research has been focused on surface water settings," said Elizabeth Hasenmueller, Ph.D., associate professor of Earth and Atmospheric Sciences at Saint Louis University and associate director of the WATER Institute at SLU. "Microplastics research initially started in the ocean because of the highly visible problem of large plastic pollution in this environment."

"However, one of the most understudied areas in this field relates to what's happening to the subsurface in terms of microplastic contamination," she continued.

"These particles could be getting into groundwater, a common drinking water resource, or caves, where fragile ecosystems exist. During the last few years, my research team has been focused on trying to understand microplastic prevalence and transport in these subsurface environments."

In their latest research, Hasenmueller and her team characterized the extent of microplastic contamination in Cliff Cave, a cliff system near St. Louis that has been closed to the public since 1993.

The researchers were also interested in examining how microplastics are moving through the cave system, especially during periods of flooding.

"We know for sure that floodwaters are bringing microplastics into the cave because as we were traversing the cave passages and collecting samples, we found a plastic chip bag that was intertwined with leaves, acorns and other flood debris from the surface," she recalled.

Flooding and air deposition are introducing microplastics to caves

The researchers took water and sediment samples from eight sites in the cave during a flood, using Fourier transform infrared spectroscopy (FTIR) and visual inspections to confirm the presence of microplastics.

The team found that microplastics were present throughout the cave, with the highest concentrations found closest to the mouth of the cave. This distribution pattern is likely to be a result of microplastic-contaminated floodwaters entering the cave, with the microplastic particles being left behind as the floodwater recedes, the researchers say. It is also possible that microplastic particles suspended in the air could be blown into the mouth of the cave where they become trapped.

The team also compared the volume of microplastics found in the cave water samples versus the sediment samples. They found that 99% of the microplastic debris recovered was stored in sediment; only a very small fraction of the microplastics recorded were still actively circulating in the cave water.

"We think what is probably happening is that, after the cave floods, particles in the water are deposited into the sediment," Hasenmueller explained. "As the waters recede, that material remains in the cave sediment, potentially for decades or longer. And, when the water level goes down, microplastic concentrations in the water are much lower."

While the effects of these microplastics on the local environment around Cliff Cave have yet to be determined, the researchers note that microplastics in general can disrupt fragile subsurface habitats and water resources. Bats, amphibians and other animals are already known to be moving freely through Cliff Cave, and would be at risk for exposure to these plastics.

Microplastics reveal human "fingerprint" on the environment

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FTIR analysis confirmed that textile microfibers were the most commonly observed microplastic in the cave, which highlights the impact human activity can have on nearby natural environments.

Though the cave has been closed to visitors for 30 years, the researchers point out that Cliff Cave is located very close to a residential area, and that this could be contributing microplastics to the system.

Hasenmueller highlights ways individuals can lower their output of microplastics.

"It's hard for us as individuals to deal with plastic pollution because of the pervasiveness of these materials, but it helps to be mindful of your personal plastic use," Hasenmueller said. "Individuals can avoid buying plastic materials like synthetic textiles used in clothing, but doing so presents challenges to everyday consumers."

"On a larger scale, we, as a society, could move away from synthetic clothing, because a lot of the debris that we found in this cave was synthetic fibers from textiles. And, of course, reducing our overall plastic production and consumption would help as well," she added.

In light of her team's new findings, Hasenmueller wants to see more research being done to investigate the scale of microplastic contamination and its impacts in other subsurface habitats.

"Understanding what level of threat microplastics pose to the unique and rare animals that only inhabit cave systems is really important," Hasenmueller said. "Only a handful of studies have assessed microplastics in these types of underground ecosystems. So, our work provides resource managers with the information they need to be thinking about to protect these fragile habitats from emerging contaminants like microplastics."

References: Baraza T, Hasenmueller EA. Floods enhance the abundance and diversity of anthropogenic microparticles (including microplastics and treated cellulose) transported through karst systems. Water Res. 2023;242:120204. doi: 10.1016/j.watres.2023.120204

Technology Networks, 28 September 2023

https://technologynetworks.com

It's easy to assume that antimatter is the opposite of matter – it's in the name, right?

Einstein was right: antimatter does what you'd expect

2023-09-28

Mundanely, the 'opposite' merely refers to a particle's electric charge. The 'anti' of a negatively charged electron is a positively charged positron, for instance. This is where differences between antimatter start and finish. They otherwise share the same properties, such as mass, and if you smash matter and antimatter particles together, they'll annihilate each other in a process that converts all their mass to energy.

Antimatter remains elusive, and speculation as to where it's gone, given that matter and antimatter are created together, has led to interesting ideas, including that antimatter might levitate, pushing in the opposite direction to gravity.

An artist's conceptual rendering of antihydrogen atoms falling out the bottom of the magnetic trap of the ALPHA-g apparatus. Credit: Keyi "Onyx" Li/U.S. National Science Foundation

But an experiment at CERN has dashed that idea, and in the process proved Einstein right, yet again.

A collaborating team of researchers tested antimatter against Einstein's general theory of relativity, publishing their study in Nature, and confirming it is attracted towards the Earth at the same rate as normal matter – about 9.8 m/s.

That means any notion of "repulsive antigravity" has been ruled out.

"It [antimatter] surely accelerates downwards, and it's within about one standard deviation of accelerating at the normal rate," says Professor Joel Fajans, a physicist at UC Berkeley.

"The bottom line is that there's no free lunch, and we're not going to be able to levitate using antimatter."

He along with theoretical physicist Professor Jonathan Wurtele proposed this experiment more than 10 years ago. In lay terms, gravitational attraction to the Earth is the idea that objects with mass are pulled towards each other by gravity – if a made-of-matter person jumps towards the sky, the mass of the Earth pulls them back. An antimatter person would do the same.

Fajans, Wurtele and their colleagues have demonstrated this effect using the Antihydrogen Laser Physics Apparatus – or ALPHA – at CERN in Europe.

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But it's not so simple as dropping a tiny antimatter particle and seeing if it hits the ground.

Careful manipulation

"Gravitational force is incredibly weak compared to electrical forces," says Fajans.

That means a 'drop' experiment would likely see surrounding electrical forces contaminating the research. For context, Fajans says a 1 V/m electrical field – weaker than the field you would experience standing beneath a light bulb – would have 40 trillion times more influence on an antiproton than the weak tug of Earth's gravity.

"We have to manipulate the antimatter very carefully or we will lose it," said Fajans.

So, careful to avoid destroying their experimental antimatter via a collision with its normal counterpart, the ALPHA team enclosed 100 antihydrogen atoms in a 25cm tall magnetic bottle. Inside, the antihydrogen atoms are being thrown around the magnetic fields generated at either end of the bottle at speeds of 100m/s. When the bottle is tipped vertically, the antihydrogen moving in the downward direction began accelerating. Those moving upward slowed.

Because of the sudden boost in energy, the down-moving antihydrogen would, according to the study, be capable of escaping the magnetic fields, bumping into the bottle's surface and triggering a matter-antimatter collision that ends in their destruction.

This annihilation would result in the release of pions – tiny subatomic particles consisting of quark and antiquark – amid a burst of light. Measuring this release calculated which way the antihydrogen had moved.

Finally, the magnetic fields were reduced to see where all the matter eventually exited the bottle.

"If you walk down the halls of this department [at Berkeley] and ask the physicists, they would all say that this result is not the least bit surprising. That's the reality," says Wurtele.

"But most of them will also say that the experiment had to be done because you never can be sure."\

Toxic contaminants from metal mining have infiltrated hundreds of thousands of kilometers of river channels around the world, exposing about 23 million people to potentially unsafe levels of lead, zinc, copper, and arsenic (Science 2023, DOI: 10.1126/science.adg6704).

Still, demonstrating both matter and antimatter obey the rules of gravitational attraction is a tiny step forward in understanding this elusive material.

"Physics is an experimental science," says Wurtele.

"You don't want to be the kind of stupid that you don't do an experiment that explores possibly new physics because you thought you knew the answer, and then it ends up being something different."

Cosmos, 28 September 2023

https://cosmosmagazine.com

Toxic metal mining waste could impact 23 million people

2023-09-29

"We've seen a lot of evidence about the way mining can affect river systems," says University of Exeter mining researcher Karen Hudson-Edwards, one of the leaders of the study. They decided to model the problem on a global scale because, she says, "The message about chronic contamination of rivers is not getting out."

When the tailings dams that hold mining waste fail, they can unleash huge amounts of contaminated water into the environment, and that gets a lot of attention, says Hudson-Edwards. She says her team's modelling study highlights the risk caused by slower processes such as the spread of metal-contaminated dust and sediment, seepage from storage facilities, and other processes. The researchers found that 50 times more people are exposed to chronic contamination than are impacted by tailings dam failures.

To fill in this picture, the researchers gathered data about active and inactive metal mines and tailings dams around the world. They combined this with information about rivers and human and livestock populations downstream from these mines. Then they modelled the extent of the world's rivers and lands that are likely contaminated with metal mining waste, drawing on decades of knowledge about how these materials move through the environment. They estimate that 23.48 million people are at risk of being exposed to potentially unsafe levels of copper, lead, zinc, and arsenic. People can be exposed to these metals in dusty air, drinking water, and food grown on contaminated land.

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Richard Marcantonio, an environmental scientist and policy specialist at the University of Notre Dame, says the results are "very, very concerning." And he adds that the model leaves a lot out. The study did not account for mercury, a common waste product of gold mining, or many of the metals released when mining for battery materials, such as cadmium, chromium, and cobalt. The study also can't account for small-scale mining, which is often dirtier, and not recorded in databases. Hudson-Edwards says they were limited by available data, and that the team is expanding their model to be more comprehensive.

Climate change is likely exacerbating the spread of toxic metals. The world is getting windier, says Hudson-Edwards, which means it's more important than ever to control dust at active mines, and to cover tailings storage facilities. Dry conditions caused by more frequent drought speed the formation of metal salts, which dissolve faster when it rains. And increased risk of flooding means more water to move these metals around, contaminating new places, but also potentially diluting toxic metals to safer levels, says Hudson-Edwards.

"Mining is vital now as we're trying to move away from oil," says Hudson-Edwards. There's a big push to develop new mines to meet the growing demand for battery metals. Hudson-Edwards says she hopes highlighting the ongoing risk from historic mining will make governments and mining companies more mindful going forward. "It's in everyone's interest to make mining sustainable."

C&En, 29 September 2023

https://cen.acs.org

Instanton theory extended to describe quantum tunnelling through a conical intersection

2023-10-03

Many-body quantum mechanics forms the mathematical basis for understanding molecular behaviour. But while it is one thing to write down the equations that describe how a system's many electrons and nuclei interact, solving them exactly is quite another. Theoreticians must therefore use tricks to simplify their calculations, the most famous being the Born–Oppenheimer approximation. Taking advantage of the fact that electrons are much lighter than nuclei, the electron wavefunctions can be computed first, which then form a potential energy surface, or landscape, on which the nuclear wavefunctions are solved.

Theoreticians have developed a new method for calculating molecular transition rates on non-trivial energy landscapes. Their slimline approach not only reduces intractable many-body mechanics to manageable computations, but also lets them quantify the individual phenomena that assist or hinder transitions.1

However, Born–Oppenheimer ceases to be valid when the energy landscape of one state stumbles into another. The point where the ground state and an excited state of a system form cone shapes that touch each other tip-to-tip is known as a conical intersection. Conical intersections are important in many photoexcited reactions – for example, DNA repairs itself after UV irradiation by dropping through such a cone.

Another scenario is the thermally activated transition from one local minimum of a ground state to another. The excess positive charge of a bis(methylene)-adamantyl cation periodically shifts itself from one side of the molecule to another, but to do so it must pass through a conical intersection. This is a simple model system for studying the principles at play, but already it poses a formidable computational challenge.

'The standard approach would be to use the Schrödinger equation for the nuclear wave function, and for a three- or four-atom system, you'd have no problem in doing that,' says Jeremy Richardson, of ETH Zurich, Switzerland. But for a molecule with 20 or so atoms? 'Absolutely no chance of doing this on modern computers, nor even in the foreseeable future.'

So, Richardson and colleagues at ETH Zurich and Fudan University in China devised a scheme to capture the essential quantum effects while avoiding intensive calculation of less important aspects. Instead of the Schrödinger equation, they turned to the path-integral formulation of quantum mechanics, which accounts for every possible route the system might take to get from A to B. But this too would be unviable, so the researchers simplified things further by homing in on the most likely routes – a technique called instanton theory.

Quantum route-planning

'This is a bit like when you ask Google to tell you what the best route is to travel from Oxford to Cambridge or whatever, and it will give you the most efficient route out of the infinite number of routes,' says Richardson. 'You guess one, and then you make small modifications to it, and you keep making small modifications to it, until it gives you the optimal path. It's the computer's version of trial and error.'

As well as being efficient, this quantum route-planning allows the researchers to pinpoint individual factors that make the journey easier or harder. For example, the system can avoid an arduous climb up the cone by instead tunnelling through it. Quantum tunnelling is a well-known phenomenon, but Richardson was surprised at just how readily it occurred.

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'People are used to this concept for hydrogen atoms, because they are lighter and therefore much better at tunnelling through the barrier,' he says. 'For carbon atoms tunnelling, it's effectively assumed that this will never happen at room temperature, but we find that it does.' He argues that the narrow, pointy shape of a conical intersection makes tunnelling more amenable than has hitherto been appreciated.

Another key effect – this time one that hampers the transition – is that of the geometric phase. Artur Izmaylov, a theoretical chemist at the University of Toronto, Canada, who has studied this effect in the same system but by a different method,2 explains that routes winding around the cone on its righthand side cancel out those that wind around its left, because of a quantum phase difference arising between the two.

'The important contribution [of Richardson's team's work] is that they account for not only tunnelling, which instantons would do, but also the destructive interference,' Izmaylov says. 'That's very appealing from the point of view that if we would like to think about quantum phenomena classically, this is a relatively simple picture to have.'

Interestingly – and disappointingly, as Richardson admits – for the simple case of bis(methylene)-adamantyl, the speed-up from tunnelling is more or less undone by the geometric slow-down, but he says this is a coincidence that will not hold generally.

'Conical sections are ubiquitous, and we are going to be looking to find examples where tunnelling and geometric phase effects are important for biologically relevant systems,' Richardson adds. 'I am sure that we will find some and it will tell us that the human body only really works because of all these weird effects. I'm very excited to find specific examples of that, and then to get experimental backing for proving it to be true.'

Chemistry World, 03 October 2023

https://chemistryworld.com

New sustainable way to synthesize vital fertilizer

2023-10-04

Dr. Junxian Liu, first author on the study, worked with with co-researchers Professor Yuantong Gu and Associate Professor Liangzhi Kou from the School of Mechanical, Medical and Process Engineering. Their study, "C–N Coupling Enabled by N–N Bond Breaking for Electrochemical Urea Production," was published in Advanced Functional Materials.

QUT scientists have discovered how to produce the vital agricultural fertilizer urea at room temperature without the large energy input of the traditional production process of synthetic urea.

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Dr. Liu said urea is one of the most vital nitrogen fertilizers and supported about 27% of the world's crops.

"Urea is also a basic raw material for manufacturing industries including pharmaceuticals, cosmetic and plastic," Dr. Liu said.

"While urea does occur naturally in the environment it is not sufficient to meet the global demand due to population growth and the expansion of agriculture and these various industries.

"The industrial production of synthetic urea began in the early 20th century and the traditional process involves the reaction of ammonia and carbon dioxide at very high temperatures and high pressure."

Dr. Liu said the team proposed a new solution for synthesizing urea using a chemical reaction between nitrogen and carbon monoxide with a graphene-based catalyst under room temperature and atmospheric pressure conditions.

"This approach significantly reduces energy inputs compared to traditional methods, making it a promising advancement in urea production," she said.

"While this work is in the theoretical stage, we have identified a promising catalyst for sustainable, energy efficient urea synthesis.

"We are now collaborating with other research groups to move towards practical application of this new technology."

Phys Org, 04 October 2023

https://phys.org

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More evidence connecting BPA exposure to ADHD and autism

2023-10-01

Researchers at Rowan-Virtua School of Osteopathic Medicine and Rutgers New Jersey Medical School have built on previous studies that have looked at ADHD and BPA exposure and found how those with neurodevelopmental disorders have a much harder time eliminating BPA from the body.

"[This is] the first hard biochemical evidence that the linkage is between BPA and the development of autism or ADHD," said lead author T. Peter Stein, a Rowan-Virtua professor of surgery. "We were surprised to find that ADHD shows the same defect in BPA detoxification."

In 2016, US researchers found that kids with ADHD had a significantly higher concentration of urinary BPA. Two years later, a large Chinese study supported this, finding that neurodivergent schoolkids had much higher concentrations of both urinary BPA and 8-hydroxy-2'-deoxyguanosine (8-OHdG, a biomarker of oxidative DNA damage).

Until now, there has been little data on the metabolic processes that underpin BPA exposure and neurodevelopmental diseases in humans.

BPA, an industrial chemical compound that hardens plastic, has been used in food packaging since the 1960s. It can be found in a wide range of common products, including polycarbonate drink bottles and food packaging and containers. Earlier this year, the US Food and Drug Administration backed its previous stance on the use of the chemical in consumer items, saying that "BPA is safe at the current levels occurring in foods."

BPA is also an endocrine disruptor that can interfere with the body's natural hormones, affecting cellular responses and important endocrine pathways. Recent studies have shown how extended exposure to BPA can interfere with dopamine transmission, which is a key area of dysregulation in ADHD brains.

Stein and team were looking at the process of glucuronidation in children: 66 with ASD, 44 with ADHD and 37 with no neurodevelopmental issues. Glucuronidation is a key process in the liver that adds a sugar molecule to toxins to make it more water soluble and therefore able to be expelled from the body more quickly. While this process varies between people,

For the first time, scientists have described a biochemical mechanism linking attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) with the common but problematic compound Bisphenol A (BPA), which can leach into food and water from food and drink packaging.

an inability to quickly process BPA leaves the body's tissues vulnerable to exposure to the toxin for longer.

What they found was that the children with ADHD were around 17% less able to add the sugar molecule for efficient glucuronidation, compared to the control group. The process was around 10% poorer for those with ASD.

Clearance of BPA is a "major pathway, otherwise it would not have been so readily detectable in a study of moderate size," said Stein.

Both ASD and ADHD are complex, multifactorial neurodevelopmental disorders that can't be attributed to one source. However, little is known about just how the interplay between environmental factors and genes contribute to the conditions.

The team also points out that not every child with ADHD or ASD has the inability to properly process BPA, and there's little research into older children or adults with these neurodevelopmental conditions.

BPA has already been linked to cognitive impairment, reproductive issues, cancer, and type 2 diabetes. And recent studies have suggested that consumers should not consider its 'alternative', bisphenol S, to be a healthier option.

New Atlas, 01 October 2023

https://newatlas.com

mRNA vaccine innovators win the Nobel Prize in medicine

2023-10-02

The prize is awarded by the Nobel Assembly of Sweden's Karolinska Institute medical university and comes with its signature gold medicine and about $1 million (11 million Swedish crowns).

"Through their groundbreaking findings, which have fundamentally changed our understanding of how mRNA interacts with our immune system, the laureates contributed to the unprecedented rate of vaccine development during one of the greatest threats to human health in modern times," the panel wrote in a press release.

A potential game changer for vaccines

Previously, growing viruses, or at least pieces of viruses, were necessary to make a vaccine. The viruses were often cultivated in giant vats of cells

The 2023 Nobel Prize in medicine was awarded to Katalin Karikó and Drew Weissman, two of the scientists whose work helped pave the way for mRNA vaccines against COVID-19. Karikó is a biochemist from Sagan's University in Hungary and an adjunct professor at the University of Pennsylvania. Karikó was also senior vice president and head of RNA protein replacement at BioNTech until 2022 and has been an advisor for the company. Weissman is a vaccine researcher at the University of Pennsylvania's Perelman School of Medicine and Director of the Penn Institute for RNA Innovations.

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or in or in chicken eggs, like the majority of flu shots. The viruses are then purified before being made into a vaccine.

Using messenger RNA (mRNA) in vaccines is very different. It starts with a snippet of genetic code that brings instructions for making proteins. If the right virus protein is selected for the vaccine, then the body produces its own defenses against the virus.

Genetic information encoded in DNA is transferred to mRNA, which is used as a blueprint for protein production in our cells. During the 1980s, efficient methods for producing mRNA without cell culture began. This process, called in vitro transcription, accelerated the development of molecular biology applications to several fields, but using mRNA technologies for vaccines had several roadblocks. In vitro transcribed mRNA was considered unstable and challenging to deliver since it required scientists to develop sophisticated carrier lipid systems to enclose the mRNA and produced some early inflammatory reactions.

Karikó was devoted to the idea of using mRNA for vaccines and other therapeutics during the 1990s when she became colleagues with Weissman. Weissman was interested in dendritic cells, which are important for immune surveillance and triggering vaccine-induced immune responses.

The breakthrough

The two began to focus on how different RNA types interact with the immune system and noticed that the dendritic cells recognize in vitro transcribed mRNA as a foreign substance. This leads to their activation and release of inflammatory signaling molecules.mRNA from mammalian cells did not give rise to the same reaction, the panel wrote. Different types of mRNA, therefore, must be distinguishable.

RNA contains four bases that are abbreviated A, U, G, and C. These letters correspond to the letters of genetic code in DNA A, T, G, and C. Karikó and Weissman knew that bases in RNA from mammalian cells are often chemically modified, and in vitro transcribed mRNA is not. They then wondered if the absence of altered bases in the in vitro transcribed RNA could explain unwanted inflammatory reactions.

To learn more, they created different variants of mRNA which had unique chemical alterations at their bases. They delivered these to dendritic cells and the results were huge.

The inflammatory response was almost wiped out when these base modifications were included in the mRNA. This was a seismic shift in scientific understanding of how cells recognize and respond to different forms of mRNA. . Their results were published in 2005.

COVID-19 and The Future

Interest in mRNA technology began to accelerate with their discovery. In 2010 several companies were working on developing the method for viruses such as Zika virus and MERS-CoV.

After the COVID-19 pandemic began, two base-modified mRNA vaccines encoding the SARS-CoV-2 surface protein were developed at a breakneck pace. Two highly effective vaccines were approved in December 2020.

One of the major advantages of mRNA technology was that vaccines could be made in extremely large quantities since their main components are made in laboratories, Exeter University infectious disease expert Bharat Pankhania told the Associated Press. mRNA tech could be used to refine vaccines for diseases including Ebola, malaria, and dengue, as well as help immunize people against auto-immune diseases like lupus and even some types of cancer.

The laureates will receive their awards at ceremonies on December 10. The 2022 medicine prize was awarded to Svante Pääbo for sequencing the genome of the Neanderthal. Other past winners include Karl Landsteiner in 1930 for the discovery of human blood groups and co-winner Alexander Fleming for the discovery of penicillin in 1945.

Popular Science, 02 October 2023

https://popsci.com

RNA recovered from extinct animal in world first

2023-09-26

"RNA has never been extracted and sequenced from an extinct species before," said Love Dalen, a Stockholm University professor of evolutionary genomics who co-led the project.

"The ability to recover RNA from extinct species constitutes a small step (toward) maybe being able to resurrect extinct species in the future," he said.

Scientists have for the first time recovered RNA from an extinct species, the Tasmanian tiger, raising hope for the resurrection of animals once thought lost forever, Stockholm University researchers told AFP.

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Dalen and his team were able to sequence RNA molecules from a 130-year-old Tasmanian tiger specimen preserved at room temperature in Sweden's Museum of Natural History.

With this they were able to reconstruct skin and skeletal muscle RNA.

RNA is a molecule that is used to convey information from the genome to the rest of the cell about what it should do.

"If you're going to resurrect an extinct animal, then you need to know where the genes are and what they do, and in what tissues they are regulated," Dalen said, explaining the need for knowledge about both DNA and RNA.

The last known living Tasmanian tiger or thylacine, a carnivorous marsupial, died in captivity in 1936 at the Beaumaris Zoo in Tasmania.

After European colonization of Australia, the animal was declared a pest and in 1888 a bounty was offered for each full-grown animal killed.

Scientists have focused their de-extinction efforts on the Tasmanian tiger as its natural habitat in Tasmania is largely preserved.

'Exciting idea'

Daniela Kalthoff, in charge of the mammal collection at the Museum of Natural History, said the idea of possibly resurrecting the Tasmanian tiger was an "exciting idea".

"This is a fantastic animal and I would love to see it live again," she said, demonstrating the black-and-brown striped skin the researchers used in their study.

Their findings also have implications for studying pandemic RNA viruses.

"Many of the pandemics that have happened in the past have been caused by RNA viruses, most recently the coronavirus but also ... the Spanish flu," Dalen explained.

"We could actually go and look for these viruses in wild animal remains stored in dry museum collections. That might actually help us understand the nature of pandemics and where pandemics come from," he said.

The study opens the door to using museum collections in this new way.

"There are millions and millions of dried skins and dried tissue from insects, mammals and birds and so on in museum collections around the

world, and one could actually now go and recover RNA from all these specimens," Dalen said.

Phys Org, 26 September 2023

https://phys.org

Quantum dots and a bright future

2017-11-19

Quantum dots are semiconducting crystals just a few nanometres wide. They are typically made from combinations of transition metals and/or metalloids, just like regular semiconductors. Cadmium selenide and cadmium telluride are probably the most prominent compounds used in quantum dots.

As they are so small, a quantum dot's excitons (a type of quasiparticle, where an excited electron combines with the positive hole it leaves behind) experience quantum confinement in all three spatial dimensions. Changing the size of a quantum dot changes its properties, in particular its fluorescence, meaning that they can be tuned to different colours. The smaller the nanoparticle, the narrower its photoluminescence wavelength; smaller dots emit blue light while larger ones emit red light.

These properties mean quantum dots are useful for biosensors and intracellular or in vivo imaging, or in chemiluminescence reactions as a catalyst or a light-emitter. Scientists are also experimenting with them in solar cells. Outside the lab, quantum dots are appearing in the next generation of TVs.

Who invented quantum dots?

Alexey Ekimov, a solid-state physicist working at the Vavilov State Optical Institute in Russia, first observed what we now know as quantum dots in 1981 while experimenting with semiconductor-doped glasses. Together with his colleague Alexander Efros, a theoretician at the same institute, they linked the size of the semiconductor crystals to their optical properties. A few years later, Louis Brus, a US chemist studying colloidal semiconductor nanocrystals at AT&T Bell Laboratories, noticed how conductivity changed when he altered the size of the crystals he tested. However, the term as quantum dots only entered our vocabulary in 1988, when physicist Mark Reed, who is credited with making the first quantum dot device, coined it when he worked at Texas Instruments.

Why put quantum dots in TVs?

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Quantum dots can be tuned to emit light with a particular wavelength so quantum dot displays promise to cover a much wider colour gamut than regular light-emitting diode (LED) ones.

Classic liquid crystal display (LCD) TVs use LEDs to produce a white backlight and coloured filters adjust and mix that light as appropriate. However, the white LEDs in your TV aren't pure white – they're blue LEDs coated with a yellow phosphor. This means red on your TV appears dimmer than green and blue, which has a knock-on effect on all the other colours your TV tries to make.

In a quantum dot TV, pure blue LEDs work with red and green quantum dots to create pure white light. This white light then goes through regular colour filters in the LCD screen and the resulting pictures have brighter and more accurate colours. Manufacturers like the concept because it's just a tweak to how regular LCD TVs are made at the moment.

Why not use quantum dots to make all of the colours?

Scientists are still perfecting quantum dots that emit blue light. The problem is, for blue emission, you need quantum dots less than 3nm wide. They're harder to make than the slightly larger ones, especially if you can't use cadmium.

Why can't you use cadmium?

Cadmium-based quantum dots are archetypal. Cadmium, however, is toxic and an increasing number of countries, including the EU and Japan, have banned companies from using it in consumer products.

Until 2014, quantum dot-enabled displays were exempt from EU regulation on cadmium in consumer products under the Restriction of Hazardous Substances (RoHS) and Registration, Evaluation, Authorisation and Restriction of Chemical substances (Reach) guidelines. However, the EU parliament has since restricted the use of cadmium-based quantum dots and asked the European Commission to reassess them.

Cadmium-free quantum dots that work in television screens are available – for example, indium phosphide can be used. However, the jury is still out over whether they are an environmentally sustainable alternative.

How do you make quantum dots?

There are a number of ways to make quantum dots including colloidal synthesis, electron-beam lithography and molecular beam epitaxy. Scientists have also made carbon quantum dots out of urine.

Urine?!

Yes. In 2015, scientists in the US devised a one-step synthetic route to recycle urine into carbon quantum dots and used them as fluorescent probes for detecting metal ions. Generating carbon dots from a liquid source rather than solid materials is more efficient as several processing steps can be bypassed.

Chemistry World, 19 November 2017

https://chemistryworld.com

Nobel Prize in medicine won by two scientists for 'groundbreaking findings' on mRNA Covid-19 vaccines

2023-10-02

The Nobel Prize committee announced the prestigious honor, seen as the pinnacle of scientific achievement, in Sweden on Monday.

It praised the scientists' "groundbreaking findings," which the committee said "fundamentally changed our understanding of how mRNA interacts with our immune system."

Karikó and Weissman published their results in a 2005 paper that received little attention at the time, it said, but later laid the foundation for critically important developments that served humanity during the coronavirus pandemic.

"The laureates contributed to the unprecedented rate of vaccine development during one of the greatest threats to human health in modern times," the committee added in a statement.

Rickard Sandberg, a member of the Nobel Prize in medicine committee, said, "mRNA vaccines together with other Covid-19 vaccines have been administered over 13 billion times. Together they have saved millions of lives, prevented severe Covid-19, reduced the overall disease burden and enabled societies to open up again."

Karikó, a Hungarian-American biochemist, and Weissman, an American physician, are both professors at the University of Pennsylvania. Their work became the foundation for Pfizer and its Germany-based partner BioNTech, as well as Moderna, to use a new approach to produce vaccines that use messenger RNA or mRNA.

This year's Nobel Prize in physiology or medicine has been awarded to Katalin Karikó and Drew Weissman for their work on mRNA vaccines, a crucial tool in curtailing the spread of Covid-19.

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The revolutionary technology has opened a new chapter of medicine. It can potentially be harnessed to develop vaccines against other diseases like malaria, RSV and HIV. It also offers a new approach to infectious disease like cancer, with the prospect of personalized vaccines.

Messenger RNA

Researchers often compare DNA to a massive recipe book with all the instructions for life. Messenger RNA is a temporary single strand of the genetic code that cells can "read" and use to make a protein – a bit like a handwritten copy of a recipe in the cookbook analogy.

In the case of mRNA vaccines, the temporary genetic code is used to tell cells to make what looks like a piece of virus, so the body produces antibodies and special immune system cells in response. Unlike other vaccines, a live or attenuated virus is not injected or required at any point.

All that is needed is the genetic sequence. Vaccine makers don't even need the virus itself – just the sequence.

"The impressive flexibility and speed with which mRNA vaccines can be developed pave the way for using the new platform also for vaccines against other infectious diseases," the Nobel committee said, adding that the technology "may also be used to deliver therapeutic proteins and treat some cancer types."

J. Larry Jameson, executive vice president of UPenn's School of Medicine, praised the scientists' work which he said "changed the world."

"During the biggest public health crisis of our lifetimes, vaccine developers relied upon the discoveries by Dr. Weissman and Dr. Karikó, which saved innumerable lives and paved a path out of the pandemic," Jameson said in a statement. "More than 15 years after their visionary laboratory partnership, Kati and Drew have made an everlasting imprint on medicine."

The Nobel Prize announcements began in Sweden Monday and will continue throughout this week and into next, with awards in physics, chemistry, literature and economics set to be announced in the coming days. The Nobel Peace Prize will be announced in Norway on Friday.

The road to the Nobel

Karikó, 68, began her career in her native Hungary in the 1970s, when mRNA research was new. She, her husband and young daughter left for the United States after she received an invitation from Temple University in Philadelphia. They sold their car, Karikó told The Guardian, and stuffed the

money – an equivalent of about $1,200 – in their daughter's teddy bear for safekeeping.

"We had just moved into our new apartment, our daughter was 2 years old, everything was so good, we were happy," Karikó told the Hungarian news site G7 of her family's departure. "But we had to go."

She continued her research at Temple, before joining the UPenn's School of Medicine in 19xx. But by then, the initial excitement surrounding mRNA research had started to fizz out. Hope turned to skepticism: Karikó's idea that it could be used to fight disease was deemed too radical – and too financially risky to fund.

She applied to grant after grant, but a string of rejections meant that in 1995, she was demoted from her position at UPenn. She was also diagnosed with cancer at the same time.

"It was difficult because people did not believe that messenger RNA can be a therapy," Karikó told CNN, in an interview during the pandemic in December 2020.

But she stuck at it. "Together with my colleague, Drew Weissman, at the University of Pennsylvania, we developed this method where we changed one component in the RNA which made it less immunogenic. It is possible to use it for different kinds of therapies, Karikó said.

Karikó and Weissman met by chance in the late 1990s while photocopying research papers. In 2005, they published their key discovery: mRNA could be altered and delivered effectively into the body to activate the body's protective immune system.

Weissman told CNN that their technology is much more efficient than traditional methods of producing vaccines.

"When the Chinese released the sequence of the SARS-CoV-2 virus, we started the process of making RNA the next day. A couple weeks later, we were injecting animals with the vaccine," he said.

At the time Karikó said she was not at all surprised by the successful results of the trials conducted by Pfizer and Moderna. "I expected that it would work, because we already had enough experiments," she said.

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She celebrated the successful trial results with a bag of Goobers, chocolate-covered peanuts, her favorite candy. "I'm not an exuberant person," Karikó told CNN at the time.

CNN, 02 October 2023

https://edition.cnn.com

Novel Method for DNA Detection Increases Sensitivity by 100 Times

2023-10-03

"DNA detection is in the center of bioengineering," says Jinglei Ping, lead author of the paper that appeared in Proceedings of the National Academy of Sciences. Ping is an assistant professor of mechanical and industrial engineering, an adjunct assistant professor in biomedical engineering and affiliated with the Center for Personalized Health Monitoring of the Institute for Applied Life Sciences. "Everyone wants to detect the DNA at a low concentration with a high sensitivity. And we just developed this method to improve the sensitivity by about 100 times with no cost."

With traditional detection methods, he says, "The challenge is basically finding the needle in a haystack." There are lots of molecules present in a sample that aren't the target DNA that can interfere with the result.

This new method has huge implications for speeding up disease detection. First, because it is so sensitive, diagnoses can happen at earlier stages of a disease progression, which can greatly impact health outcomes.

Also, this method takes minutes, not days, weeks or months, because it's all electric. "This makes it suitable for point of care," he says. "Usually, we provide samples to a lab and they can provide the results quickly or slowly, depending on how fast they go, and it can take 24 hours or longer." For instance, he cites how with a diagnosis, a biopsy sample is frozen and then sent to a lab for processing, which can take up to two months. The near-instant results with this new method mean treatment does not have to wait for lab processing times.

Another benefit: it's portable. Ping describes the device to be similar in size to a blood sugar test tool, which opens the doors to improvements in health on a global scale. "It can be used at places where resources are limited. I went to a country and the doctor usually goes to a village once

UMass Amherst researchers have pushed forward the boundaries of biomedical engineering one hundredfold with a new method for DNA detection with unprecedented sensitivity.

or twice a year, and now, maybe they can have a base that has this kind of tool and they'll have the chance to test for it quickly and easily."

Ping is excited about the breadth of possible applications for this discovery, saying, "The nano-mechanoelectrical approach can be also integrated with other bioengineering technologies, like CRISPR, to elucidate nucleic acid signaling pathways, comprehend disease mechanisms, identify novel drug targets and create personalized treatment strategies, including microRNA-targeted therapies."

Reference: Zhang X, Fan X, Bao H, Ping J. Nanomechanoelectrical approach to highly sensitive and specific label-free DNA detection. Proc Natl Acad Sci USA. 2023;120(33):e2306130120. doi: 10.1073/pnas.2306130120

Technology Networks, 3 October 2023
https://technologynetworks.com

Researchers find high concentrations of microplastics in cave water and sediment

2023-09-27

Elizabeth Hasenmueller, Ph.D., associate professor of Earth and Atmospheric Sciences and associate director of the WATER Institute at SLU, and her team published findings in the journals, Science of the Total Environment and Water Research, finding significant microplastic levels in Cliff Cave in Saint Louis County, Missouri.

The research, which originated from Hasenmueller's research group and Karst Hydrology class, allowed students on the team to participate in field research and publish their findings.

Microplastics are characterized as plastic particles smaller than 5.0 millimeters and can be found across marine, terrestrial, and freshwater environments. Hasenmueller has previously studied microplastics in river systems, such as the Meramec River basin, but now wanted to look at the subsurface, an area that has not seen much research at all.

"A lot of research has been focused on surface water settings," Hasenmueller said. "Microplastics research initially started in the ocean because of the highly visible problem of large plastic pollution in this environment. Recently, more research efforts have gone towards examining rivers, lakes, and other surface freshwater systems.

In two recent papers, Saint Louis University researchers report finding high concentrations of microplastics present in a Missouri cave system that had been closed to human visitors for 30 years.

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"However, one of the most understudied areas in this field relates to what's happening to the subsurface in terms of microplastic contamination. These particles could be getting into groundwater, a common drinking water resource, or caves, where fragile ecosystems exist. During the last few years, my research team has been focused on trying to understand microplastic prevalence and transport in these subsurface environments."

Hasenmueller and her team selected Cliff Cave for their studies as the cave has been closed to the public since 1993, allowing them to eliminate human presence in the cave as a possible cause of any observed microplastic contamination. Their research showed microplastics were found throughout the cave, but the highest concentrations were located near the entrance and in sediment.

"Part of the reason we picked Cliff Cave is because St. Louis County Parks regulates access to the cave," Hasenmueller said. "We knew if we found microplastics in the cave, it's not going to be because somebody has just hiked back into the cave and shed fibers from their clothing or left food wrappers."

Through their research, Hasenmueller and her team discovered that flooding increases the amount of microplastics moving through the cave system. Microplastics move with water, and when flooding occurs, the excess water brings more microplastics with it to the cave.

Flooding also contributed to a higher diversity of microplastics in the cave water. When those flood waters receded, microplastics were likely deposited near the cave's mouth in higher abundances than in locations deeper in the cave.

"We weren't sure what to expect with the dataset, but we found that the cave's main entrance is where there's a lot of microplastic debris, either from flood deposition or possibly from microplastic particles suspended in the air being deposited near the opening of the cave," Hasenmueller said. "We know for sure that floodwaters are bringing microplastics into the cave because as we were traversing the cave passages and collecting samples, we found a plastic chip bag that was intertwined with leaves, acorns, and other flood debris from the surface."

Not only did flood waters contribute to higher levels of microplastics, but Hasenmueller and her team also found that microplastics were almost 100 times more concentrated in sediment than in the water found in Cliff Cave. Microplastics were deposited into the cave's sediment by the cave's stream water and remained there even after the flood water receded.

"We were trying to figure out what fraction of the microplastics are actively moving through the cave stream right now versus what's being stored long-term in the cave's sediment," Hasenmueller said. "One of the really interesting things we found is most of the microplastics were in the sediment. So, 99 percent of the microplastic debris we found in the cave was stored in the sediment; only a very small fraction of the plastic was in the water."

"As the water levels go up during a flood, you see higher abundance and diversity of microplastic particles in the water," Hasenmueller added. "We think what is probably happening is that after the cave floods, particles in the water are deposited into the sediment. As the waters recede, that material remains in the cave sediment, potentially for decades or longer. And when the water level goes down, microplastic concentrations in the water are much lower."

Despite being blocked off from humans, the cave still feels their impact. Cliff Cave is located near residential areas that could be contributing microplastics to the system, a finding that aligns with previous research by SLU's WATER Institute showing that population density is the biggest factor determining where microplastics are found in nature. Hasenmueller said with these findings, there are some things people can do to limit the amount of microplastics they may be contributing to the environment.

"It's hard for us as individuals to deal with plastic pollution because of the pervasiveness of these materials, but it helps to be mindful of your personal plastic use," Hasenmueller said. "Individuals can avoid buying plastic materials like synthetic textiles used in clothing, but doing so presents challenges to everyday consumers. On a larger scale, we, as a society, could move away from synthetic clothing, because a lot of the debris that we found in this cave was synthetic fibers from textiles. And of course, reducing our overall plastic production and consumption would help as well."

Microplastics not only potentially do damage to the cave environment, but they also affect wildlife that call Cliff Cave home. Bats, amphibians, and other animals move freely throughout the cave, and microplastics could disrupt their delicate habitat. Microplastics are not just a human problem, but also an environmental problem, and Hasenmueller calls for more research to ensure the contamination does not become worse.

"Understanding what level of threat microplastics pose to the unique and rare animals that only inhabit cave systems is really important," Hasenmueller said. "Only a handful of studies have assessed microplastics

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in these types of underground ecosystems. So, our work provides resource managers with the information they need to be thinking about to protect these fragile habitats from emerging contaminants like microplastics."

Phys Org, 27 September 2023

https://phys.org

New understanding of perfluorooctanoic acid could pave the way towards safer products and better human health

2023-10-03

Led by Dr. James Chan, Junior Principal Investigator at A*STAR's Singapore Institute of Food and Biotechnology Innovation (SIFBI) and the A*STAR Skin Research Labs (A*SRL), the research team used a virtual model that replicates the biological traits of the human body's chemical processing mechanisms to investigate how PFOA is processed.

A team of A*STAR scientists has made a significant breakthrough in understanding how perfluorooctanoic acid (PFOA) is processed by the human body.

PFOA is an environmental contaminant prevalent in food, food packaging, and consumer products such as non-stick cookware, rugs and cosmetics. It is widely used in various industrial and consumer applications due to its oil-, water-, and heat-resistant properties, and humans are primarily exposed to it through oral ingestion.

It is highly persistent in humans, with a lengthy half-life (amount of time it takes for half of a quantity of a substance to decay or degrade) of up to four years. This can potentially lead to health concerns including liver and kidney cancer, thyroid issues, developmental effects on the immune and reproductive systems, and fetal development. In Singapore, PFOA appears in 99% of tested blood samples from local cohorts, influencing fertility in women.

Despite associations with harmful effects, research on the critical levels of PFOA exposure, and how the human body eliminates it, is limited. This research sheds light on the biology of PFOA, and the mechanisms for its high resistance to biological degradation in humans, which could potentially help the industry design safer replacement chemicals for industrial and consumer products. Regulatory bodies could also employ the findings to measure the impact of PFOA and explore safety limits in products.

The findings highlight that PFOA binds strongly to blood proteins which act as a magnet, limiting its ability to be filtered by the kidney and thus

reducing the speed of its elimination. Additionally, as PFOA resembles the fatty acids that our body needs, the kidney reabsorbs PFOA from the urine, mistaking it for an essential nutrient. Finally, PFOA uses the same pathway as essential fatty acids to enter our tissues, allowing it to be widely distributed within all body organs, increasing the potential for harm. By understanding how PFOA persists in the body, these insights could contribute to the development of safer next-generation chemicals for use in various products.

The model is currently being used to investigate the sources of PFOA exposure within the Singapore population. There are plans to expand the use of the model to investigate other Per- and Polyfluoroalkyl Substances (PFAS), of which PFOA is only one of over 14,000 such chemicals, to help regulatory bodies measure the amount of PFAS in consumer products. The research team has also developed assays that the industry could adopt to test whether their replacement chemicals contain the same properties as PFOA (e.g., a lengthy half-life).

"The data surrounding PFOA is mixed, with some studies suggesting PFOA resides for several months, and others, for years. Our study is the first to provide a rational explanation to these reports by using data of human origin, and not animal models, to reveal the true persistence of PFOA in humans."

"More importantly, it sets forth a general approach that others can use to study PFAS which we know very little about. There are many more of such chemicals that we are exposed to with yet unknown consequences. We hope to work with the broader scientific community to understand their potential for harm and contribute towards better population health," said Dr. James Chan, senior author of the study.

The paper, "Mechanistic Middle-Out Physiologically Based Toxicokinetic Modeling of Transporter-Dependent Disposition of Perfluorooctanoic Acid in Humans," is published in Environmental Science & Technology.

Phys Org, 3 October 2023

https://phys.org

As hydrogen industries take off around the world, researchers are still looking for ways to make zero-emissions hydrogen cheaper than fossil fuels.

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Methane pyrolysis: another weird way to make hydrogen

2023-10-02

At present, electrolysis (splitting water into hydrogen and oxygen with electricity) is in the early stages of commercialisation, and is zero emissions assuming you're using renewable electricity. But it's still more expensive than fossil fuels, or indeed emissions-intensive hydrogen.

One promising method – methane pyrolysis – could be cheaper than electrolysis technology. But while it could be a negative emissions product, it could also be emissions-intensive.

Where it ends up will be down to regulation and certification, says Professor Gus Nathan, director of The University of Adelaide's Centre for Energy Technology, and a member of the new Global Hydrogen Production Technologies, or HyPT, Centre.

Methane pyrolysis is the process of splitting methane gas (CH4) into hydrogen gas (H2) and pure, "hard" carbon (C).

This can be done in a number of ways: using plasma (basically a super-reactive gas), microwaves, or a molten metal. A company in the US is upscaling their plasma method to the commercial level, but most other techniques are still at the experimental stage.

"The energy needed for [methane pyrolysis] is only about a quarter of the energy of water splitting," says Nathan.

Plus, as well as hydrogen, the hard carbon can be used in other products, like car tyres, black inks, and graphite.

"You potentially make two valuable products instead of one," says Nathan.

"Currently, there's already quite a big carbon market – probably not as big as could be, if we start to make quite a bit of it."

"If we're going to have large volumes of hydrogen, you rapidly saturate current markets. So then you need to go to things like construction materials – carbon can be blended into cement, which therefore displaces some of that CO2."

The most common source of methane at the moment is a fossil fuel: "natural" gas. But, says Nathan, the methane could come from biogas: made by the breakdown of organic matter, like plants or animal waste.

The source of the methane plays a big part in deciding whether the process releases emissions or not.

"If you start with a purely a biogas, then obviously at that extreme, any carbon that you make – unless you burn it – is going to become captured," says Nathan.

A mixture of biogas and natural gas could still have net negative emissions. But the methane's source isn't the only problem.

"You have to worry about whether any methane leaks," says Nathan.

Methane has 27-30 times the warming effect of carbon dioxide by weight, making methane leaks a major source of greenhouse gas emissions.

"There are already companies emerging who can do certification and management of the of the methane supply chain," says Nathan.

Added to this is the complication of whether the hard carbon is turned into products that get back into the atmosphere at end of life, and how fast that happens. If it's turned into a single-use plastic and then incinerated, for instance, that's no net benefit.

But the carbon could also be buried in the ground – "reverse coal" – or made into biochar for use in fertilisers, or sequestered in other long-term products like concrete.

"Conceptually, [methane pyrolysis] can be net zero. It can be negative, but it could also be positive," says Nathan.

"At the end of the day, you need to have proper certification and tracking."

Cosmos, 02 October 2023

https://cosmosmagazine.com

study Finds Unexpected Demographic to Have Highest Concentration Of Dangerous Chemical In Blood

2023-10-01

Often referred to as "forever chemicals," they cannot be broken down in humans or the environment and can lead to serious health complications, such as types of cancer, birth defects, and kidney disease.

They are so prevalent that they can now be found in human blood samples, and a study has found that one particular demographic seems to have higher levels in their bodies than others.

Harmful chemicals known as PFAS can be found in food, water, and items we use on a daily basis.

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What's happening?

Per- and polyfluorinated alkyl substances, shortened to PFAS, were developed by DuPont through the 1940s, leading to the creation of Teflon, which was used on non-stick cooking utensils, waterproof clothing, and stain-repellent items.

They have since been used in manufacturing for decades, but their impact on health became apparent when it was clear they contaminated the water supply in Parkersburg, West Virginia, near a DuPont plant, affecting the lives of workers and residents.

Despite DuPont having to pay millions following a class-action lawsuit from people in Parkersburg who were exposed to the chemicals — and even more in further legal settlements alongside similar companies — PFAS are still present in a number of items we use today. Forever chemicals are, unsurprisingly, becoming more ubiquitous worldwide.

And a peer-reviewed study, summarized by the Guardian, has now found that Asian Americans have 88% higher median levels of PFAS in their blood compared to non-Hispanic white people.

Why are the levels of PFAS in Asian Americans higher?

The research didn't draw a conclusion on why levels in Asian Americans were among the highest between demographics. But study lead Shelley Liu told the Guardian of one potential reason.

Liu observed that fish is a major source of PFAS exposure, so populations that have higher levels of seafood in their diets might be more at risk.

Notably, the study found "no statistical disparity in PFAS levels of non-Hispanic Black and white people, and Mexican Americans had lower levels than white," reports the Guardian.

How can we limit our exposure to forever chemicals?

It's almost impossible to avoid forever chemicals entirely — because of their presence in a number of things essential to life and their inability to break down — but there are certain things we can do to avoid overexposure.

Clean Water Action suggests avoiding non-stick cookware, even if the item claims to be PFA/PFOA-free. Stainless steel or cast-iron pots and pans are a much safer alternative.

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Meanwhile, other advice includes using your own metal or glass containers for takeout food and leftovers, steering clear of microwavable popcorn bags, avoiding stain-resistant coatings on furniture, and not buying outdoor clothing made with fabrics like Scotchgard and Gore-Tex.

The Cool Down, 01 October 2023

https://thecooldown.com

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