

Bulletin Board

Contents

JUN. 28, 2024

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Aussie premier defends city's water quality after discovery of 'unsafe' chemicals.....	4
Vietnam Promulgates the National Plan on Management and Elimination of Ozone-Depleting Substances.....	5

AMERICA

Vermont Amends PFAS Law to Include More Products.....	5
Changes to the Cosmetic Ingredient Hotlist.....	5
PFAS Contamination Detected in 41 Maryland Public Water Systems.....	7

EUROPE

OVERCONSUMPTION OF TRANSITION MINERALS WILL COST US THE EARTH.....	8
Upcoming GB active substance expiry dates.....	9

INTERNATIONAL

Environmental laws are NOT pushing chemical producers out of the EU..	10
Largest number of regulatory agencies for medical products approved as WHO Listed Authorities.....	11

REACH UPDATE

Further Tasks in EU Legislative Phase.....	13
New version of ePIC now available.....	13

JANET'S CORNER

Control.....	14
--------------	----

HAZARD ALERT

Toluene.....	15
--------------	----

GOSSIP

Researchers find flexible solution for separating gases.....	24
--	----

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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

Bulletin Board

Contents

JUN. 28, 2024

Xylitol latest sugar alcohol to be linked to heart attacks and strokes.....	26
Alcohol Rehab and Abstinence Reduces Risk of Alcohol-Linked Cancers, Study Finds	29
Aromatic compounds: A ring made up solely of metal atoms	31
Sweetener erythritol linked to heart problems.....	32
CBD use during pregnancy produces strange behavior in offspring.....	34
Novel Human Antibodies Neutralize Black Widow Venom	37
Synthetic pathway for promising nitride compounds discovered.....	39
Microrobot-packed pill shows promise for treating inflammatory bowel disease in mice.....	40

CURIOSITIES

Researchers Create "Glassy Gels", A New Class of Materials	42
'Weightless' battery stores energy directly in carbon fiber structures.....	45
3D-printed chip sensor detects foodborne pathogens for safer products	47
Eczema Drug May Provide Relief for Other Itchy Skin Diseases	48
Green hydrogen breakthrough swaps in water for iridium	50
Secrets of salt drop stains unveiled: New research decodes chemical composition from simple photos.....	52
Scientists discovered a hiccup cure technique that actually has '100 percent cure rate'.....	54
Isotope tracking suggests that plants cycle carbon faster than previously thought	55
Interest in Potentially Harmful "Magic Mushroom" May Endanger Public Health.....	57
Jurassic Park in Real Life: MIT Creates Synthetic Amber for DNA Storage..	59

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ..	63
CHEMICAL EFFECTS	63
ENVIRONMENTAL RESEARCH	63
PHARMACEUTICAL/TOXICOLOGY	63
OCCUPATIONAL.....	63

Bulletin Board

Regulatory Update

JUN. 28, 2024

ASIA PACIFIC

Aussie premier defends city's water quality after discovery of 'unsafe' chemicals

2024-06-11

Australia has been urged to lift its standards after the US found there was 'no safe level of exposure' to cancer-causing 'forever chemicals'.

Experts want Australian water standards to be lifted in line with a recently tightened US regulation as NSW plans a review into the quality of the state's drinking supply.

NSW Premier Chris Minns on Tuesday defended Sydney's water quality as "very good" after the US cut the maximum level of cancer-causing so-called "forever chemicals" allowed in its drinking water.

In April, the US Environmental Protection Agency found there was "no safe level of exposure" of the chemicals perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in drinking water and they were likely to cause cancer.

A federally funded University of Queensland study published in 2011 found high levels of the contaminants in about half of drinking water samples taken from 34 locations across the nation.

Why experts are worried about forever chemicals in water?

Experts have called for US-style regulations to be rolled out in Australia, where the chemicals are permitted at levels up to 140 times higher than those allowed in the US.

UN chemicals expert and National Toxics Network senior advisor Mariann Lloyd-Smith said the toxic substances were linked to kidney and liver disease, thyroid dysregulation, reproductive problems, developmental problems and cancer.

Read More

YahooNews, 11-06-24

<https://au.news.yahoo.com/aussie-premier-defends-citys-water-quality-after-discovery-of-unsafe-chemicals-040148932.html>

Bulletin Board

Regulatory Update

JUN. 28, 2024

Vietnam Promulgates the National Plan on Management and Elimination of Ozone-Depleting Substances

2024-06-20

Vietnam is a party to the “Vienna Convention on the Protection of the Ozone Layer” and the “Montreal Protocol on Substances that Deplete the Ozone Layer”. On June 11, 2024, Vietnam issues Decision No. 496/QĐ-TTg, promulgating the national plan on management and elimination of controlled substances that deplete the ozone layer and greenhouse gases. The Decision came into effect on the promulgation date.

[Read More](#)

Chemlinked, 20-06-24

<https://sustainability.chemlinked.com/news/vietnam-promulgates-the-national-plan-on-management-and-elimination-of-ozone-depleting-substances>

AMERICA

Vermont Amends PFAS Law to Include More Products

2024-06-13

Vermont enacted Act 131 to phase out a variety of consumer products, including cosmetics or menstrual products, textiles, ski wax, rugs or carpets, firefighting foam and food packaging, etc.

On May 30, 2024, the Governor of Vermont signed into Senate Bill 25 (S.25) which amends Senate Bill 20: An act relating to restrictions on perfluoroalkyl and polyfluoroalkyl substances (PFAS) and other chemicals of concern in consumer products (S.20). It shall take effect on July 1, 2024.

[Read More](#)

Chemlinked, 13-06-24

<https://chemical.chemlinked.com/news/chemical-news/vermont-amends-pfas-legislation-to-include-more-products>

Bulletin Board

Regulatory Update

JUN. 28, 2024

Changes to the Cosmetic Ingredient Hotlist

2024-05-30

May 2024 Changes to the Cosmetic Ingredient Hotlist

Items Added

Basic green 4

This ingredient was added to the list of prohibited substances due to potential developmental effects, as assessed by the Government of Canada’s Chemicals Management Plan (CMP) under the Canadian Environmental Protection Act, 1999 (CEPA 1999).

Benzophenone

This ingredient was added to the list of restricted substances due to adverse maternal effects such as decreased body weight, as assessed by the Government of Canada’s Chemicals Management Plan (CMP) under the Canadian Environmental Protection Act, 1999 (CEPA 1999).

p-Chloro-m-cresol

This ingredient was added to the list of restricted substances due to health concerns regarding the adrenal organs, as assessed by the Government of Canada’s Chemicals Management Plan (CMP) under the Canadian Environmental Protection Act, 1999 (CEPA 1999).

Solvent violet 13

This ingredient was added to the list of restricted substances due to health concerns, as assessed by the Government of Canada’s Chemicals Management Plan (CMP) under the Canadian Environmental Protection Act, 1999 (CEPA 1999).

Items Amended

Dialkanolamines, secondary

This entry was amended to include secondary alkyl- and alkanolamines and their salts for clarity. These substances have similar potential to act as precursors of carcinogenic nitrosamines.

Bulletin Board

Regulatory Update

JUN. 28, 2024

Alpha-hydroxy acids

This entry was amended to clarify that Polyhydroxy acids (PHAs) and bionic acids with alpha-hydroxyl groups, as well as their salts, are included. They meet the chemical definition of AHAs and there is insufficient information to support that PHAs are less likely to cause irritation or sun sensitivity than other AHAs. Additionally, the maximum permitted concentration for the consumer use category was increased from 10% to 18%. The expansion of the consumer use category was a result of a retrospective analysis of Evidence of Safety data submitted to Health Canada for professional-use cosmetic products. Other amendments include updated warnings and cautionary statements and additional product-specific directions for safe use.

Hydroquinone

This entry was amended to expand the permitted nail product categories to include products for consumer use, increase the maximum concentration permitted for these products, and introduce a combined limit when both p-hydroxyanisole and hydroquinone are used in a nail product.

p-Hydroxyanisole

This entry was amended to introduce a combined limit when both p-hydroxyanisole and hydroquinone are used in a nail product.

Talc

This entry was amended to help reduce chronic inhalation exposure to talc in cosmetics that may result in non-cancer lung effects (such as inflammation or fibrosis), as well as genital exposure to the population with intact ovary/ovaries which may result in ovarian cancer, as assessed by the Government of Canada's Chemicals Management Plan (CMP) under the Canadian Environmental Protection Act, 1999 (CEPA 1999). Cautionary statements related to acute inhalation risks were also adjusted to include all loose powder products.

Read More

Government of Canada, 30-05-24

<https://www.canada.ca/en/health-canada/services/consumer-product-safety/cosmetics/cosmetic-ingredient-hotlist-prohibited-restricted-ingredients/changes.html#may2024>

Bulletin Board

Regulatory Update

JUN. 28, 2024

PFAS Contamination Detected in 41 Maryland Public Water Systems

2024-06-11

Maryland residents are among the 89.3 million Americans affected by contamination of their drinking water with toxic "forever chemicals," collectively known as PFAS, according to new data from the U.S. Environmental Protection Agency (EPA). This development follows the EPA's recent implementation of landmark drinking water standards that establish stringent limits on two of the most harmful PFAS compounds: PFOA and PFOS.

Testing and Findings in Maryland

The latest testing cycle in 2023 and 2024 revealed PFAS presence in at least one-third of the 4,750 public water systems sampled nationwide. Specifically, 41 Maryland public water systems have reported the presence of these chemicals. An Environmental Working Group (EWG) analysis indicates that many of these systems have PFAS levels exceeding the proposed federal limits, while some remain below the threshold.

Military Bases and PFAS Contamination

The EWG's analysis highlights that many contaminated water systems are linked to military installations. Notable sites with substantial PFAS contamination include Fort Detrick in Frederick, the former Naval Surface Warfare Center in Silver Spring, Fort Meade near Odenton, Aberdeen Proving Ground, the former Annapolis Bay Head Road Annex, and the Gunpowder Military Reservation in Baltimore County.

According to Defense Department data compiled by the EWG, more than 700 U.S. military sites have either confirmed or suspected discharges of toxic PFAS chemicals, primarily from using PFAS-based firefighting foam. The EWG map highlights these sites across all 50 states, where military regulations mandated using PFAS-based aqueous film-forming foam (AFFF) for over five decades.

Read More

Environment Energy Leader, 11-06-24

<https://www.environmentenergyleader.com/2024/06/pfas-contamination-detected-in-41-maryland-public-water-systems/>

Bulletin Board

Regulatory Update

JUN. 28, 2024

EUROPE

OVERCONSUMPTION OF TRANSITION MINERALS WILL COST US THE EARTH

2024-05-24

The world is scrambling for the critical minerals needed for the clean energy transition. Last week at the OECD Minerals Forum in Paris, representatives from government, business, and civil society discussed how to source them responsibly. But to avoid a repeat of past injustices and ensure a just energy transition, imposing strict sustainability requirements is not enough. Rich countries must curb their relentless production and consumption of critical minerals, argue Beverly Besmanos and Alejandro González.

The rich world is on a global scramble for the minerals that are crucial to ensuring our planet remains liveable. Wealthy countries already use six times more natural resources per capita than low-income ones.

This demand is set to explode as demand for electric vehicles gains momentum. The accompanying surge in mining will have such devastating social and environmental impacts across the globe that no responsible mining standard could match it.

Of course, the worlds' largest economies need to take climate action and decarbonise as fast as possible. But the current geopolitical competition between the EU, US and China risks perpetuating an already unequal system where countries in the Global North reap the economic benefits, while the environmental and social costs are borne by producing countries in the Global South.

[Read More](#)

EEB, 29-05-24

<https://meta.eeb.org/2024/05/29/overconsumption-of-transition-minerals-will-cost-us-the-earth/>

Upcoming GB active substance expiry dates

2024-06-12

Biocidal products must be phased off the GB market

The active substance/product type combinations listed below are due to expire under the GB BPR on the following dates:

Bulletin Board

Regulatory Update

JUN. 28, 2024

- Cis-tricos-9-ene, (Z)-tricos-9-ene (muscalure) (CAS 27519-02-4 EC 248-505-7) in product type 19

30 September 2024

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

30 June 2025

- 2-bromo-ethanoic acid (bromoacetic acid) (CAS 79-08-3 EC 201-175-8) in product type 4

30 June 2025

- Benzoic acid (CAS 65-85-0 EC 200-618-2) in product types 3 and 4

30 June 2025

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

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

[Read More](#)

HSE UK, 12-06-24

<https://www.hse.gov.uk/guidance/index.htm>

INTERNATIONAL

Environmental laws are NOT pushing chemical producers out of the EU

2024-06-05

It's Mythbuster Wednesday at ChemSec, and we thought we'd poke a hole in the false idea that progressive environmental legislation is forcing chemical producers out of the European Union. Here's why that is not true.

Bulletin Board

Regulatory Update

JUN. 28, 2024

It's like a broken record. Chemical industry complaining about environmental legislation, saying that if the screws are tightened even more, European companies will be forced to move their operations elsewhere. This narrative has been around forever it seems and keeps popping up time and again in policy discussions.

A recent example comes from the widely discussed Antwerp Declaration for a European Industrial Deal, which suggests that environmental policy targets in the EU are forcing investments to "move to other regions".

Another example comes from the Belgian Prime Minister Alexander De Croo's speech to the Chancellor of Germany, in which he claims that Europe is "a continent of sticks" (in other words, legal requirements) and that industrial production moving out of the region "is a real risk".

[Read More](#)

Chemsec, 05-06-24

<https://chemsec.org/environmental-laws-are-not-pushing-chemical-producers-out-of-the-eu/>

Largest number of regulatory agencies for medical products approved as WHO Listed Authorities

2024-05-20

WHO has approved designation of 33 national and regional regulatory authorities as WHO Listed Authorities (WLAs) that can be relied on for fulfilling the highest level of regulatory standards and practices for quality, safety and efficacy of medicines and vaccines. This listing makes a total of 36 regulatory authorities from 34 Member States now designated as WLAs since the launch of the initiative in March 2022.

The newly approved WLAs include: the U.S. Food and Drug Administration (US FDA) and the European Medicines Regulatory Network (EMRN), which is composed of the European Commission, the European Medicines Agency (EMA) and the medicines regulatory authorities of the following 30 countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany (Federal Institute for Drugs and Medical Devices & Paul-Ehrlich-Institut), Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Bulletin Board

Regulatory Update

JUN. 28, 2024

Furthermore, the Health Sciences Authority (HSA) of Singapore, which was previously designated as a WLA in October 2023, was approved for an expanded scope of functions.

"Today marks a significant progress in our collective efforts to improve access to safe, quality and effective medicines and vaccines. With leading regulatory authorities joining our list, we are stronger and more united to improve access to quality, safe and effective medicines and vaccines for millions more people," said Dr Tedros Adhanom Ghebreyesus, WHO Director-General. "I would like to congratulate all agencies designated as WLAs for their investment and commitment to the quality and safety of medicines and vaccines. My thanks also to our experts for their diligent work to implement a transparent and evidence-based assessment throughout the evaluation process".

The decision is based on the recommendation by the WHO technical advisory group on WHO Listed Authorities (TAG-WLA) following WHO performance evaluations confirming consistency of advanced performance by these authorities in line with international standards and best regulatory practices for ensuring the quality, safety and efficacy of medicines and vaccines.

"This crucial expansion of the WLA framework is a transformative milestone in the global public health regulatory landscape," said Dr Yukiko Nakatani, Assistant Director-General, Access to Medicines and Health Products and Assistant Director-General, Antimicrobial Resistance and Interim. "As WLAs, these agencies can be relied on to reassure quality and safety of medicines and vaccines to streamline processes, optimize resources, and expedite access to medicines and vaccines".

WHO approval for U.S. FDA and EMRN includes all regulatory functions for the product streams of medicines – including multisource (generics) and new medicines (new chemical entities), biotherapeutics and similar biotherapeutic products – and vaccines.

[Read More](#)

WHO, 20-05-24

<https://www.who.int/news/item/20-05-2024-largest-number-of-regulatory-agencies-for-medical-products-approved-as-who-listed-authorities>

Bulletin Board

REACH Update

JUN. 28, 2024

Further Tasks in EU Legislative Phase

2024-06-13

The European Chemicals Agency (ECHA) plays a leading role among regulatory authorities in implementing the chemicals legislation in Europe. In January 2024, ECHA published its Strategy Statement 2024-2028, which reflects the broadening of ECHA's legal mandate in support of the EU's ambitious goals on chemical safety. Speaking at the ChemCon Asia conference held in Bangkok on June 7, 2024, Mr. Kevin Pollard, an official from ECHA, shared further tasks in the EU legislative phase.

Read More

Chemlinked, 13-06-24

<https://chemical.chemlinked.com/news/chemical-news/further-tasks-in-eu-legislative-phase>

New version of ePIC now available

2024-06-13

Our IT tool for submitting export and import notifications under the Prior Informed Consent (PIC) Regulation, ePIC, has been updated on 11 June 2024. The main changes are:

- A combined nomenclature (CN) code is required for each Annex I chemical present in the mixture or article composition. Before submitting new notifications, companies must update their existing datasets with CN codes for each PIC chemical included in the mixture or article composition. Earlier, only the CN code for the mixture itself was required.
- Resubmissions of export notifications close to the export date specified in the initial submission are blocked. The expected date of first export needs to be at least 20 days after the resubmission.

Read More

ECHA, 13-06-24

<https://echa.europa.eu/support/dossier-submission-tools/epic>

Bulletin Board

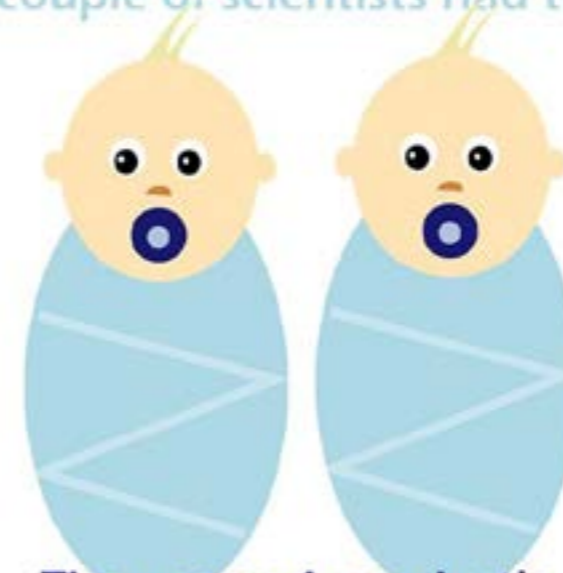
Janet's Corner

JUN. 28, 2024

Control

2024-06-26

A couple of scientists had twins



They named one Justin
and the other Control

<http://www.calpaclab.com/science-jokes/>

Bulletin Board

Hazard Alert

JUN. 28, 2024

Toluene

2024-06-28

Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal. [1,2]

USES [2,3]

The majority of toluene is used as a component of petrol. It is also used in paints, lacquers, inks, adhesives, rubber, and cleaning agents. It is used to manufacture benzene, urethane raw materials, and other organic chemicals. It is used in the production of pharmaceuticals, dyes, and cosmetic nail products. It is used against roundworms and hookworms.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- **Industry sources:** The primary sources of toluene are the industries that manufacture it or use it in production. Some of the industries that manufacture it or use it in production are oil refiners, chemical industry, rubber manufacturers, pharmaceutical industry, metal degreasing, printing, manufacturers of paints, varnishes and lacquers. These emissions mainly are to the air, but are also to the soil and water.
- **Diffuse sources:** Other possible emitters of toluene are vapours and spilling of petrol, commercial and household painting and paint, varnish and lacquer removal, tobacco smoke, and consumer products containing toluene. These emissions are to the air unless there is a spill.
- **Natural sources:** Natural sources of toluene include volcanoes, forest and bush fires and crude oil.
- **Transport sources:** Some toluene is found in vehicle exhaust.
- **Consumer products:** Adhesives, Auto polish and cleaners, floor polish, hard surface cleaners, paints, inks, paint cleaners, paint and varnish removers and thinners, coatings, particleboard, leather dressings, lubricating oils, fingernail enamels and removers, shoe polish and cleaners, solvent thinned products (exterior stains, primers, interior stains, clear finish), colouring pens and markers, wood office furniture, vinyl flooring.

Toluene, formerly known as toluol, is a clear, water-insoluble volatile liquid with an aromatic odour (smells like paint thinners) and the molecular formula C₆H₅CH₃.

Bulletin Board

Hazard Alert

JUN. 28, 2024

Routes of Exposure

- **Air:** Air pollution from motor vehicle exhaust is unquestionably a major source of exposure. Occupational subpopulations involved in toluene production or use are likely to be exposed to considerably higher levels than the general population. In addition, air levels in the vicinity of industrial sources and petrol stations are likely to represent an additional burden to both workers and local residents.
- **Smoking:** Toluene is a major component of tobacco smoke and concentrations can vary greatly. The concentration per cigarette in sidestream smoke is typically higher than in mainstream smoke. The amount of toluene in mainstream smoke from an unfiltered cigarette was estimated to range from 100 to 200 mg with a sidestream/mainstream smoke ratio of 1.3, using samplers to adsorb toluene in the breathing zone of smokers and nonsmokers over a 24-hour period, found that active smokers were exposed to about four times the level for passive smokers. Cigarette smoking enhanced elimination of toluene and hippuric acid from the body. Smokers had significantly higher blood levels than nonsmokers with the level affected more by the length of time since the last cigarette was smoked than by the extent of smoking.
- **Drinking-water:** Exposure via drinking-water is minor, except in cases of unusually heavy contamination. Levels indicated by surveys in the USA are generally less than 10 µg/l.
- **Food:** Exposure via food is also considered to be insignificant. A daily contribution from fish was estimated to be between 0.1–0.2 mg/kg bw.
- Inhalation is the predominant route of exposure.

HEALTH EFFECTS [4]

Acute Health Effects

- The Central Nervous System (CNS) is the primary target organ for toluene toxicity in both humans and animals for acute and chronic exposures. CNS dysfunction (which is often reversible) and narcosis have been frequently observed in humans acutely exposed to low or moderate levels of toluene by inhalation; symptoms include fatigue, sleepiness, headaches, and nausea. CNS depression and death have occurred at higher levels of exposure.
- Cardiac arrhythmia has also been reported in humans acutely exposed to toluene.

Bulletin Board

Hazard Alert

JUN. 28, 2024

- Following the ingestion of toluene a person died from a severe depression of the CNS. Constriction and necrosis of myocardial fibres, swollen liver, congestion and haemorrhage of the lungs, and tubular kidney necrosis were also reported. Acute exposure of animals to toluene has been reported to affect the CNS as well as to decrease resistance to respiratory infection.
- Acute animal tests in rats and mice have demonstrated toluene to have low acute toxicity by inhalation or oral exposure.

Carcinogenicity

- Available studies in workers have reported limited or no evidence of the carcinogenic potential of toluene. Similarly, the few available epidemiological studies have failed to demonstrate increased risk of cancer due to inhalation exposure to toluene. However, these studies were limited due to the size of the study population and lack of historical monitoring data.
- Chronic inhalation exposure of rats did not produce an increased incidence of treatment-related neoplastic lesions.
- Under the Guidelines for Carcinogen Risk Assessments (US. EPA, 2005), the EPA considers that there is inadequate information to assess the carcinogenic potential of toluene.

Other Effects

- CNS depression has been reported to occur in chronic abusers exposed to high levels of toluene. Symptoms include drowsiness, ataxia, tremors, cerebral atrophy, nystagmus (involuntary eye movements), and impaired speech, hearing, and vision. Neurobehavioral effects have been observed in occupationally exposed workers.
- Effects on the CNS have also been observed in studies of animals chronically exposed by inhalation.
- Chronic inhalation exposure of humans to toluene causes irritation of the upper respiratory tract and eyes, sore throat, dizziness, headache, and difficulty with sleep.
- Inflammation and degeneration of the nasal and respiratory epithelium and pulmonary lesions have been observed in rats and mice chronically exposed to high levels of toluene by inhalation.
- Mild effects on the kidneys and liver have been reported in solvent abusers chronically exposed to toluene vapour. However, these studies are confounded by probable exposure to multiple solvents.

Bulletin Board

Hazard Alert

JUN. 28, 2024

- Slight adverse effects on the liver, kidneys, and lung and high-frequency hearing loss have been reported in some chronic inhalation studies of rodents.
- The Reference Concentration (RfC) for toluene is 5 milligrams per cubic metre (5 mg/m³) based on neurological effects in humans.
- The Reference Dose (RfD) for toluene is 0.08 milligrams per kilogram body weight per day (0.08 mg/kg/d) based on increased kidney weight in rats.

SAFETY

First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Bulletin Board

Hazard Alert

JUN. 28, 2024

Engineering Controls & Practices [4]

- 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 work-station location.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling toluene:

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

Personal Protective Equipment 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.

Bulletin Board

Hazard Alert

JUN. 28, 2024

REGULATION

United States

OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-2 (See also ANSI Z37.12-1967)	200 ppm TWA 300 ppm Ceiling 500 ppm Peak (10 minutes)	HE7	Central nervous system depression, causing fatigue, headache, confusion, paresthesia, dizziness, and muscular incoordination
		HE15	Irritation of the eyes, mucous membranes, and upper respiratory tract
OSHA PEL - Construction Industry See 29 CFR 1926.55 Appendix A	200 ppm (750 mg/m ³) TWA	HE7	Central nervous system depression, causing fatigue, headache, confusion, paresthesia, dizziness, and muscular incoordination
		HE15	Irritation of the eyes, mucous membranes, and upper respiratory tract

Bulletin Board

Hazard Alert

JUN. 28, 2024

OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	200 ppm (750 mg/m ³) TWA	HE7	Central nervous system depression, causing fatigue, headache, confusion, paresthesia, dizziness, and muscular incoordination
		HE15	Irritation of the eyes, mucous membranes, and upper respiratory tract
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	100 ppm (375 mg/m ³) TWA 150 ppm (560 mg/m ³) STEL	HE7	Fatigue, weakness, confusion, headache, dizziness, drowsiness
		HE8	Unconsciousness
		HE15	Irritation of the eyes, respiratory tract, and skin
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2007)	20 ppm (75 mg/m ³) TWA A4; BEI	HE5	Female reproductive system damage and pregnancy loss
		HE7	Central nervous system impairment and visual impairment

Bulletin Board

Hazard Alert

JUN. 28, 2024

CAL/OSHA PELs	10 ppm (37 mg/m ³) TWA 500 ppm Ceiling 150 ppm (560 mg/m ³) STEL Skin	HE5	Female reproductive toxicity, spontaneous abortion
		HE7	Impaired colour vision, impaired hearing, decreased performance in neurobehavioral analysis, changes in motor and sensory nerve conduction velocity, headache, and dizziness

The United States Environmental Protection Agency (EPA) has set a limit of 1 milligram per litre of drinking water (1mg/L).

- Discharges, releases, or spills of more than 1,000 pounds of toluene must be reported to the National Response Centre.

REFERENCES

- <http://en.wikipedia.org/wiki/Toluene>
- http://www.euro.who.int/_data/assets/pdf_file/0020/123068/AQG2ndEd_5_14Toluene.PDF
- <http://www.atsdr.cdc.gov/tfacts56.pdf>
- <http://www.npi.gov.au/resource/toluene-methylbenzene>
- <http://www.epa.gov/ttn/atw/hlthef/toluene.html>
- <http://www.sciencelab.com/msds.php?msdsId=9927301>
- https://www.osha.gov/dts/chemicalsampling/data/CH_272200.html

Bulletin Board

Gossip

JUN. 28, 2024

Some Landfill “Burps” Contain Airborne PFAS, Study Finds

2024-06-27

Many municipal landfills “burp” gas from decomposing organic matter rather than letting it build up. And burps from buried waste containing per- and polyfluoroalkyl substances (PFAS) can release these “forever chemicals” into the air, say researchers in ACS’ Environmental Science & Technology Letters. Their study reports unexpectedly high levels of airborne PFAS at three landfills and demonstrates that vented gases and liquid by-products called leachates could transport similar amounts of these contaminants to the environment.

Some consumer products and commercial waste, such as children’s clothing, cosmetics and wastewater treatment sludge solids, contain PFAS — and they ultimately end up in landfills. Timothy Townsend and colleagues previously established that PFAS-containing waste can contaminate the water that seeps through landfills. This leachate is usually captured and treated before entering the environment. Landfills also produce gas that can be captured and controlled, but unlike leachate, it’s often released untreated. The burped gas is mostly made up of methane and carbon dioxide; however, two recent studies also discovered a subset of airborne PFAS called fluorotelomer alcohols, which have the potential to be toxic when inhaled and can be transported long distances. Since the prevalence of PFAS-contaminated landfill vapors isn’t yet widely known, Townsend, Ashley Lin and their team wanted to identify and measure them in vented gas at three sites in Florida.

The researchers pumped landfill gas from pipes through cartridges filled with resin that captured the airborne PFAS. They freed the compounds from the cartridges with organic solvents and analyzed the extracts for 27 neutrally charged PFAS, including fluorotelomer alcohols. Surprisingly, some of the fluorotelomer alcohol levels were up to two orders of magnitude higher than previous studies at other landfills. Three of these alcohols (abbreviated 6:2, 8:2 and 10:2) comprised most of the vaporized contaminants measured at each site. The researchers also collected leachate samples at the Florida sites and analyzed them for ionic PFAS commonly found in water samples. From this data, they estimated that the annual amount of fluorine (as a proxy for PFAS content) leaving the landfills through gas emissions could be similar to, or even greater than, the amount leaving through leachates.

Because landfills are repositories for PFAS, this work indicates that vented gas from these sites should be considered in future mitigation and

Bulletin Board

Gossip

JUN. 28, 2024

management strategies to reduce potential inhalation exposure and release to the environment. Some landfills burn the vapors or trap them for energy production, and the team suggests that further research is needed to determine the degree of removal these treatments provide for airborne contaminants.

Technology Networks, 27 June 2024

<https://technologynetworks.com>**Researchers find flexible solution for separating gases**

2024-06-27

For a broad range of industries, separating gases is an important part of both process and product—from separating nitrogen and oxygen from air for medical purposes to separating carbon dioxide from other gases in the process of carbon capture or removing impurities from natural gas.

Separating gases, however, can be both energy-intensive and expensive.

“For example, when separating oxygen and nitrogen, you need to cool the air to very low temperatures until they liquefy. Then, by slowly increasing the temperature, the gases will evaporate at different points, allowing one to become a gas again and separate out,” explains Wei Zhang, a University of Colorado Boulder professor of chemistry and chair of the Department of Chemistry. “It’s very energy intensive and costly.”

Much gas separation relies on porous materials through which gases pass and are separated. This, too, has long presented a problem, because these porous materials generally are specific to the types of gases being separated. Try sending any other types of gas through them and they don’t work.

However, in research published today in the journal *Science*, Zhang and his co-researchers detail a new type of porous material that can accommodate and separate many different gases and is made from common, readily available materials. Further, it combines rigidity and flexibility in a way that allows size-based gas separation to happen at a greatly decreased energy cost.

“We are trying to make technology better,” Zhang says, “and improve it in a way that’s scalable and sustainable.”

Adding flexibility

Bulletin Board

Gossip

JUN. 28, 2024

For a long time, the porous materials used in gas separation have been rigid and affinity-based—specific to the types of gases being separated. The rigidity allows the pores to be well-defined and helps direct the gases in separating, but also limits the number of gases that can pass through because of varying molecule sizes.

For several years, Zhang and his research group worked to develop a porous material that introduces an element of flexibility to a linking node in otherwise rigid porous material. That flexibility allows the molecular linkers to oscillate, or move back and forth at a regular speed, changing the accessible pore size in the material and allowing it to be adapted to multiple gases.

“We found that at room temperature, the pore is relatively the largest and the flexible linker barely moves, so most gases can get in,” Zhang says.

“When we increase the temperature from room temperature to about 50 degrees (Celsius), oscillation of the linker becomes larger, causing effective pore size to shrink, so larger gases can’t get in. If we keep increasing the temperature, more gases are turned away due to increased oscillation and further reduced pore size. Finally, at 100 degrees, only the smallest gas, hydrogen, can pass through.”

The material that Zhang and his colleagues developed is made of small organic molecules and is most analogous to zeolite, a family of porous, crystalline materials mostly comprised of silicon, aluminum and oxygen.

“It’s a porous material that has a lot of highly ordered pores,” he says. “You can picture it like a honeycomb. The bulk of it is solid organic material with these regular-sized pores that line up and form channels.”

The researchers used a fairly new type of dynamic covalent chemistry that focuses on the boron-oxygen bond. Using a boron atom with four oxygen atoms around it, they took advantage of the reversibility of the bond between the boron and oxygen, which can break and reform again and again, thus enabling self-correcting, error-proof behavior and leading to the formation of structurally ordered frameworks.

“We wanted to build something with tunability, with responsiveness, with adaptability, and we thought the boron-oxygen bond could be a good component to integrate into the framework we were developing, because of its reversibility and flexibility,” Zhang says.

Sustainable solutions

Developing this new porous material did take time.

Bulletin Board

Gossip

JUN. 28, 2024

Zhang says, “Making the material is easy and simple. The difficulty was at the very beginning, when we first obtained the material and needed to understand or elucidate its structure—how the bonds form, how angles form within this material, is it two-dimensional or three-dimensional. We had some challenges because the data looked promising, we just didn’t know how to explain it. It showed certain peaks (X-ray diffraction), but we could not immediately figure out what kind of structure those peaks corresponded to.”

So, he and his research colleagues took a step back, which can be an important but little-discussed part of the scientific process. They focused on the small-molecule model system containing the same reactive sites as those in their material to understand how molecular building blocks are packed in a solid state, and that helped explain the data.

Zhang adds that he and his co-researchers considered scalability in developing this material, since its potential industrial uses would require large amounts, “and we believe this method is highly scalable. The building blocks are commercially available and not expensive, so it could be adopted by industry when the time is right.”

They have applied for a patent on the material and are continuing the research with other building block materials to learn the substrate scope of this approach. Zhang also says he sees the potential to partner with engineering researchers to integrate the material into membrane-based applications.

“Membrane separations generally require much less energy, so in the long term they could be more sustainable solutions,” Zhang says. “Our goal is to improve technology to meet industry needs in sustainable ways.”

Phys Org, 27 June 2024

<https://phys.org>

Xylitol latest sugar alcohol to be linked to heart attacks and strokes

2024-06-26

The low-calorie sweetener xylitol, a five-carbon sugar alcohol, has been linked with a risk of major adverse cardiovascular events such as heart attack and stroke. The researchers, who are based at the Cleveland Clinic in Ohio, US, say that further studies examining the cardiovascular safety of xylitol are ‘warranted’.

Bulletin Board

Gossip

JUN. 28, 2024

Xylitol is produced at low levels in the body as a side product of glucose metabolism. However, in recent years it has been increasingly used as a replacement for sucrose in patients with diabetes and can be found in sweets, chewing gum and oral care products.

Last year, scientists at the Cleveland Clinic linked another sugar alcohol, erythritol, to heart problems. This, and other links between sweeteners and heart problems, led them to wonder whether the structurally similar sugar alcohol xylitol could cause similar cardiovascular issues.

The researchers initially measured the levels of xylitol in blood plasma samples collected between 2001 and 2007 from two independent cohorts comprising over 3000 participants who had fasted overnight. They found that a third of those who had the highest levels of circulating xylitol were more likely to experience a cardiovascular event, such as a heart attack or stroke. The researchers noted that these samples largely pre-dated recent increases in xylitol in processed foods, meaning the levels likely reflected endogenous xylitol production.

To investigate how xylitol may cause these effects they then carried out a series of functional studies in which they examined the effect of xylitol on human whole blood, platelet-rich plasma and isolated platelets in vitro, as well as an in vivo murine arterial injury model.

'When we measured xylitol in an independent cohort of several 1000 people, we could see that circulating levels predicted future risk for heart attack, stroke and death,' explains Stanley Hazen, who headed up the team at the Lerner Research Institute at the Cleveland Clinic. 'So then we went through ... a series of studies, both in vitro and animal models, and saw that xylitol fosters platelets to become much more hyperresponsive and prone to clots.'

Elevated platelet activity

To further assess the effects of xylitol consumption on platelet function the researchers then gave drinks sweetened with 30g of xylitol – comparable with a pint of xylitol-sweetened ice cream – to 10 healthy volunteers. They then compared platelet activity in baseline samples to samples taken 30 minutes after the drink was consumed and found that every measure of platelet clotting significantly increased after ingestion.

In the body, platelets cluster together at the site of an injury to prevent and stop bleeding, but they can also clot inside blood vessels,

Bulletin Board

Gossip

JUN. 28, 2024

compromising the blood supply to the heart and brain and raising the risk of a heart attack or stroke.

'All of the volunteers were healthy and started with [platelet function] levels that were in the bottom 25% of our population, and we saw that every single measure of platelet functional responsiveness enhanced dramatically in the post-prandial sample,' says Hazen. 'It was seen in every individual subject with every measure at every concentration that we looked at – so it's quite significant even though it's a small pilot study.'

Hazen told Chemistry World that the long-term goal of his team was to discover new pathways linked to heart disease. 'The sugar alcohols, starting with erythritol, are linked to cardiovascular disease,' he says. 'Just like cholesterol [which] is an endogenous metabolite that we both synthesise and ingest in our diet and is linked to the development of cardiovascular disease, so too erythritol and xylitol are endogenous metabolites and in the last decade or two, have become something that we ingest in much, much higher levels.'

Missing information

Duane Mellor, a registered dietician and associate dean at Aston University in the UK, says the study is noteworthy but adds that there is some important information missing. 'It's an interesting one because it looks at what happens if you put it in a drink, and the response of that, and it looks at levels in plasma, but it doesn't actually tell you if people are consuming xylitol in their diet.'

'Xylitol has a pathway where it can be synthesised in the human body ... we had a similar paper to this with erythritol a few months ago, which again can be synthesised in the human body ... so it could be that we just get more xylitol made in bodies at higher risk – there's nothing to test that.'

Mellor says ideally the study should have factored in the participants' dietary intake. 'Then you look at whether it is the xylitol in the diet that's a problem.'

Tracy Parker, senior dietitian at the British Heart Foundation, says the study adds to a 'constantly growing base' of evidence about how zero-calorie sweeteners could affect our health. 'While not yet definitive, the results highlight the importance of investment into further research, to ensure these additions to our food are not contributing to an increased risk of devastating cardiovascular events.'

Bulletin Board

Gossip

JUN. 28, 2024

'It's important to note this research is not a green light to have more sugar instead. We all need to reduce our intake of the processed foods and beverages that contain high levels of sugars, sweeteners and salt,' Parker adds. 'This is the best way of ensuring a healthy diet and a lowered risk of heart and circulatory disease.'

Chemistry World, 26 June 2024

<https://chemistryworld.com>

Alcohol Rehab and Abstinence Reduces Risk of Alcohol-Linked Cancers, Study Finds

2024-06-27

A new study conducted by the Centre for Addiction and Mental Health (CAMH), Bordeaux University Hospital, France, and the World Health Organization (WHO) has found that individuals with alcohol dependence who undergo rehabilitation or maintain abstinence experience significantly lower risks of developing alcohol-associated cancers. The article, entitled Alcohol rehabilitation and cancer risk: a nationwide hospital cohort study in France was published today in Lancet Public Health. It is the largest of its kind to provide evidence linking reduced or ceased alcohol consumption with a decreased risk of all alcohol-attributable cancers, including liver and throat cancers.

The nationwide retrospective cohort study analyzed data from more than 24 million French people, all adults residing in mainland France who were discharged from hospital between 2018 and 2021. The researchers found that approximately 6.3 percent of men and 1.6 percent of women had alcohol dependence, which was strongly associated with alcohol-related cancers, including hepatocellular carcinoma, as well as oral, pharyngeal, laryngeal, esophageal, and colorectal cancers, in both sexes. However, they also found that that rehabilitation treatment or a history of abstinence was associated with significantly lower risks compared to alcohol dependence without rehabilitation or abstinence. This underscores the effectiveness of treatment strategies in combating cancer risks linked to alcohol dependence.

"The research team was surprised at the size of the treatment intervention effect in this study," said Dr. Jürgen Rehm, Senior Scientist at the Institute for Mental Health Policy Research at CAMH and study senior author. "We know that alcohol dependence treatment is effective but the fact that alcohol dependence is a recurring chronic disease often makes us forget

Bulletin Board

Gossip

JUN. 28, 2024

that even with relapses, periods of abstinence markedly lower the risk of cancer and other chronic diseases."

"From a public health standpoint, our research highlights a troubling neglect of alcohol dependence compared to other health issues in both research and policy priorities," added article lead author Dr. Michaël Schwarzingier, Department of Prevention, Bordeaux University Hospital. "Consequently, alcohol dependence continues to be a silent, dreadful epidemic in countries like France, especially given that the average annual level of adult alcohol consumption per capita in that country is over twice the global average."

"We know that the most effective strategy to reduce the overall burden of harms caused by alcohol, including cancer, lies in population-level policies—measures such as increasing alcohol taxes, reducing alcohol availability, and banning or restricting marketing," said Dr. Carina Ferreira-Borges, Regional Adviser for Alcohol, Illicit drugs, and Prison health at the WHO Regional Office for Europe. "However, this study underscores that health systems' response is also crucial to lower the risk of alcohol-attributable cancers. By increasing accessibility to interventions for alcohol rehabilitation and abstinence in healthcare settings countries could do more to protect their populations from preventable cancers. Therefore, we call for more investment in rehabilitation and treatment services for alcohol use disorders in France and other countries of the WHO European Region."

Dr. Leslie Buckley, CAMH's Chief of Addictions, emphasized the importance of these findings: "In Canada, hospital admissions for alcohol-attributable conditions out-number those for myocardial infarction, and many people face barriers to evidence-based treatment due to stigma and challenges in accessing in-person care. Innovations such as virtual treatment can overcome these challenges by offering flexible and cost-effective solutions. At CAMH, we're conducting research on fully-virtual day programs which show promise, replicating traditional rehabilitation intensity without the need for physical infrastructure, thereby reducing wait times and making treatment more accessible.

Given the imminent increase to alcohol availability in Ontario, it's essential to consider how we could make treatment more accessible. Increased alcohol availability is likely to lead to higher consumption, and accessible

Bulletin Board

Gossip

JUN. 28, 2024

virtual treatment programs could address this by providing crucial care to those in need.”

Technology Networks, 27 June 2024

<https://technologynetworks.com>

Aromatic compounds: A ring made up solely of metal atoms

2024-06-27

The term aromaticity is a basic, long-standing concept in chemistry that is well established for ring-shaped carbon compounds. Aromatic rings consisting solely of metal atoms were, however, heretofore unknown.

The research team led by Prof. Dr. Lutz Greb, a scientist at Heidelberg University's Institute of Inorganic Chemistry, recently succeeded in isolating such a metal ring and describe it in full in an article published in the journal Nature Chemistry.

Aromatic compounds, or aromatics, are a substance class in organic chemistry, named after the aromatic smell by which the initially discovered compounds of this class were identified. In addition to ring-shaped carbon compounds, aromatic metal complexes are also known, whereby the metal atom is bound to an aromatic organic molecule.

The metal ring described by the Heidelberg University chemists is different. It is made up solely of metal atoms of elemental bismuth. The isolation and characterization of this metal ring was made possible by a new approach of supramolecular stabilization.

Greb's research group arranged a negatively charged molecular shell around the positively charged metal ring that inhibits possible decomposition reactions.

“We assume that our approach can be used as a general method in other areas of stabilization of positively charged rings and cages. First of all, aromatic compounds consisting solely of metal atoms aid our fundamental understanding. However, several unexpected effects of our work point to a new basic concept in the field of aromaticity.

Bulletin Board

Gossip

JUN. 28, 2024

“It could be significant for charge transport in metals,” says Greb, who heads up the research group in molecular main group chemistry at the Institute of Inorganic Chemistry.

Phys Org, 27 June 2024

<https://phys.org>

Sweetener erythritol linked to heart problems

2023-03-06

The sweetener erythritol has been linked to a dramatically increased risk of cardiovascular problems.

Erythritol is a four-carbon sugar alcohol naturally present in small amounts in fruits and vegetables, but at levels 1000 times higher in some processed foods such as pastries and ice creams. It is around two-thirds as sweet as sucrose and is increasingly popular as a natural sugar substitute.

However, a US study has found that people with higher levels of erythritol in their blood had a notably higher risk of cardiovascular problems. ‘The top 25% had twice the risk of heart attack, stroke and death compared to the bottom 25%,’ says Stanley Hazen, a cardiologist at Cleveland Clinic, Ohio, who led the research. ‘That places it on par with the strongest other cardiovascular risk factors, such as diabetes.’

Hazen did not set out to investigate sweeteners. Instead, blood samples were taken from 1157 patients undergoing cardiac risk assessments and followed for three years, to seek a chemical signature that could predict risk of heart attack or stroke. ‘If you treat existing risk factors like cholesterol, blood pressure and diabetes, you lower cardiac risk, but the majority of events continue to happen,’ says Hazen. He sought residual risk factors.

Erythritol stood out as the best predictor of heart problems – even above high cholesterol levels. The researchers then measured erythritol levels in a US patient group and a European patient group who all had or were at risk of heart disease. Individuals with high erythritol levels in these groups had double the risk of heart attack or stroke.

This means that seven serious cardiovascular events would be expected over three years for every 100 people in the quarter of the US group with the lowest erythritol levels, explains Kevin McConway, emeritus professor of statistics at the Open University, who wasn't involved in the study. By contrast, 12 serious cardiovascular events would be expected in the

Bulletin Board

Gossip

JUN. 28, 2024

quarter with the highest erythritol levels, with a margin of error between nine and 18. The margin of error is even wider for the European cohort. McConway stresses that it's important to note that the study can't tell us whether the increase is actually caused by erythritol or some other factor, though.

Next, cell experiments revealed that erythritol boosted aggregation of platelets – cells that adhere to and heal damaged blood vessels. 'Erythritol is lowering the threshold for making a platelet adhere to a surface, which is the first step in forming a clot,' says Hazen. Further studies then showed that the sweetener sped up the formation of clots in mice with injured blood vessels.

To test the effects of eating erythritol in humans, eight healthy volunteers consumed a drink sweetened with 30g of the sugar. This is the kind of quantity someone could consume in a can of an artificially sweetened drink or a pint of keto diet ice cream. Following consumption of the drink, erythritol plasma levels spiked and remained 1000 times higher for hours, staying above the threshold linked to heightened clotting risks for more than two days.

Hazen says that after eating a large portion of keto-diet friendly ice cream, people in at risk groups would be at a heightened risk of experiencing a clot. He is concerned that the very people most vulnerable to heart attacks or strokes – such as those trying to lose weight or with diabetes – will most likely consume foods with artificial sweeteners.

'I'm counselling my patients, if you are at risk for cardiovascular disease, you should avoid highly processed foods,' says Hazen. 'Read the label and make sure there is no erythritol.'

Cardiac epidemiologist Noel Mueller at Johns Hopkins Bloomberg School of Public Health says this study does an exceptional job in bringing observational, in vitro, animal and dietary intervention studies together. But he warns that 'the findings are based on observational studies, which could be confounded by other factors, such as if erythritol consumption is associated with a poor diet,' which is itself a risk factor for cardiovascular disease and could be contributing to the higher risk in those with high blood erythritol.

'This definitely warrants further investigation of erythritol,' Mueller says. 'The next step would be to do a randomised control trial to see if this is truly causal.' He praises the additional experiments as 'strengthening the plausibility of these findings as potentially causal'.

Bulletin Board

Gossip

JUN. 28, 2024

McConway notes that the risk of major cardiovascular events was roughly doubled for the 25% with the highest levels of circulating erythritol, compared with the 25% with the lowest levels, but 'there was essentially no difference between the quarter with the lowest erythritol levels and the middle two quarters.' 'This perhaps indicates that any increases in risk are associated only with the high levels of circulating erythritol and therefore maybe with high levels of consumption,' McConway notes.

Hazen notes that erythritol is made endogenously, too. 'We appear to have discovered a new pathway that leads to disease, that is found in everybody,' he concludes, 'and you can make that pathway much worse by ingesting amounts that are only found in processed food.'

Dietitian Duane Mellor at Aston University emphasises that the pentose phosphate pathway in our body also generates erythritol, and it ramps up when someone has excess energy onboard. 'It's also upregulated by oxidative stress, which can be a result of obesity, type 2 diabetes, smoking, [lack of] physical activity,' says Mellor. 'Things we know are risk factors for cardiovascular disease.'

'We cannot be sure that people who are at higher risk of heart attacks don't make more [erythritol],' adds Mellor. He views the sweetener as of potential concern only for those trying to replace sugar with sugar alcohols.

The European Food Safety Authority is currently re-evaluating 15 sweeteners, including erythritol. A spokesperson said that the working group experts will now look at the methods and results from the US study.

Correction: Kevin McConway's name was corrected on 8 March 2023

Chemistry World, 6 June 2024

<https://chemistryworld.com>

CBD use during pregnancy produces strange behavior in offspring

2024-06-25

While CBD or cannabidiol is now widely available, widely used and generally considered safe, new research has found that its use during pregnancy may produce some strange behavior in offspring and changes to the way their brains process sensory information.

Bulletin Board

Gossip

JUN. 28, 2024

Because it doesn't produce perception-altering effects like THC does, cannabidiol (CBD), one of the active ingredients in cannabis, is deemed to be safe. Indeed, it's been shown to be an effective treatment for a wide variety of health issues, from reducing epileptic seizures to treating inflammation.

Indicative of public belief about the safety of CBD, recently published research using data from the International Cannabis Policy Study found that one in five pregnant women (20.4%) in the US and Canada were using CBD-only products compared to 11.3% of non-pregnant women. Reasons for use included anxiety and depression, pain, headache, and morning sickness.

However, new research presented at the Federation of European Neuroscience Societies (FENS) Forum 2024, currently being held in Vienna, suggests that using CBD during pregnancy may not be as safe as it's considered to be.

"Scientific evidence has proven that CBD crosses the placenta, can reach the brain of rodents and human embryos and is also present in breast milk; therefore, it's a public health priority to understand the impact of CBD on the developing nervous system as we don't yet know the consequences of CBD exposure to the brain during development," said Alba Caceres Rodriguez, a PhD student at INSERM Aix-Marseille University, a French public research organization that focuses on human health. "An important part of the research we are conducting in mice is longitudinal follow-up of the behavioral consequences of gestational exposure to CBD, and we are also investigating what is happening to the neurons in the brain that may be the basis of such changes in behavioral traits."

The researchers administered a low dose of CBD (3 mg/kg) to pregnant mice by an injection under the skin from days five to 18 of the gestational period, more than two-thirds of pregnancy. Injecting the CBD, rather than administering it orally, ensured that each mouse received the same concentration. Another group of pregnant mice did not receive CBD and acted as controls.

Pups born to both groups of mice were tested once they reached adulthood. The researchers placed the mice in a new environment, and their social interactions were monitored with Live Mouse Tracker, software that uses a depth-sensing camera and machine learning to analyze the behavior of groups of mice in real-time. The results suggested that CBD altered specific mice behaviors and was sex-dependent.

Bulletin Board

Gossip

JUN. 28, 2024

"We found a number of behavioral changes among the mice exposed to CBD," Caceres Rodriguez said. "CBD-exposed females tended to move around their new environment more compared to females that didn't receive CBD during gestation. Furthermore, compared to control mice, both male and female mice treated with CBD established more physical contacts with each other."

Examining the mice's brains, the researchers found changes in two parts of the insular cortex (IC), the brain's 'integration hub': the anterior IC (aIC), responsible for processing emotional and social signals, and the posterior IC (pIC), which processes pain perceptions and the body's physical and emotional state.

"Our results reveal that prenatal exposure to CBD profoundly changes the functionality of neurons in the insular cortex," Iezzi said. "We saw differences according to sex and also according to IC sub-regions. In particular, pyramidal neurons in the pIC lose their cellular identity following prenatal exposure to CBD and no longer behave like typical pIC neurons. This could have negative consequences on specific functions of the pIC. These neurons specialize in integrating sensory information from the environment and the internal state of the body in order to generate an appropriate behavioral response. Therefore, a loss of pIC differentiation following prenatal exposure to CBD can have a considerable impact on the ability to understand and react properly to the environment."

The study's findings advance our understanding of the effect of CBD use on the developing fetus and challenge the belief that it's safe for pregnant women, the researchers say.

"These findings have significant implications for understanding the effects of CBD on fetal life, changing the general idea that CBD is a universally safe compound, and revealing the need for additional studies on the effect of prenatal CBD exposure," said Iezzi. "Furthermore, several studies have shown that IC dysfunction increases the risk of developing psychiatric disorders, including anxiety, addiction, depression and schizophrenia."

One of the study's limitations is that the mice were given a controlled dose of CBD, whereas human females may be more likely to use CBD intermittently throughout their pregnancy as needed to help with symptoms such as morning sickness. They might also take considerably larger doses than those given to the mice.

Nonetheless, the researchers say a strength was the study's naturalistic approach.

Bulletin Board

Gossip

JUN. 28, 2024

"A strength of our study is that we are able to reproduce a more naturalistic environment, which permits us to study group dynamics that would be impossible to unmask with other conventional task-based tests," said Caceres Rodriguez. "This study serves as a good starting point to dive deeper to understand the actual consequences of these changes in overall social interactions in the long term."

This research has only been presented at the FENS Forum 2024 and hasn't been published or peer-reviewed yet.

New Atlas, 25 June 2024

<https://newatlas.com/a>

Novel Human Antibodies Neutralize Black Widow Venom

2024-06-12

There are various types of widow spiders, including black, red, and brown varieties in North and South America, the Australian redback spider, and several button spider species that inhabit South Africa. In Europe, *Latrodectus tredecimguttatus* – the European black widow – inhabits the Mediterranean region, but recently and due to the changing climate, the widows have been expanding their habitat.

Widow spiders' bites can cause latrodectism, a disease where the spider's venom, a neurotoxin known as alpha-latrotoxin, attacks the nervous system and causes symptoms like severe pain, hypertension, headache, and nausea. Black widow bites can be treated with antibodies derived from horses, but to make treatment safer for patients, researchers in Germany have set out to develop fully human antibodies.

"For the first time, we present human antibodies which show neutralization of black widow spider venom in a cell-based assay," said Prof Michael Hust, a biologist at the Technical University of Braunschweig and senior author of the study published in *Frontiers in Immunology*. "This is the first step to replace the horse sera that are still used to treat the severe symptoms after a black widow spider bite."

Fishing for proteins

Many patients bitten by black widows aren't treated altogether because the antivenom is made from proteins derived from horses which are foreign to the human body and can cause undesirable side effects. These include serum sickness, a reaction to proteins in antisera derived from

Bulletin Board

Gossip

JUN. 28, 2024

non-human animal sources, and serious allergic reaction. The available antivenom is also an undefined mix of antibodies that varies from batch to batch. Despite these shortcomings, this antivenom is the most efficient treatment option available right now.

"We set out to replace horse sera with recombinant human antibodies to get a better product for the patients and to avoid the use of horses for serum production," Hust said. To do so, the scientists used an in vitro method called antibody phage display. "This approach uses extremely diverse gene collections of more than 10 billion different antibodies. From this large diversity of antibodies, phage display can fish out antibodies which can bind the desired target, in this case the toxin," explained Hust.

Antibodies engineered in such a way can be reproduced in the same quality again and again because the DNA sequence of the human antibody is known. They also could also improve animal welfare because horses do not need to be immunized and bled to produce black widow anti-toxins.

Antibody optimization

What the team around Hust came up with are antibody candidates that can be used for the development of therapeutic antibodies. 45 of 75 generated antibodies showed in-vitro neutralization of alpha-latrotoxin. One antibody, called MRU44-4-A1, showed outstandingly high neutralization.

What surprised the researchers, however, was that just two of the antibodies turned out to be effective against the venom of other widow varieties. "To develop a potential treatment for all latrotoxins, and not only the toxin of the European black widow, we would need further improved cross reactive antibodies," Hust pointed out. The researchers also said that further preclinical steps are needed to evaluate the efficacy of the antibodies before clinical trials can be started.

"In another project, we have shown that we can develop human antibodies to treat diphtheria which are effective in in vivo studies. We intend to take the same steps for the black widow antivenom antibodies. This is especially important because with the invasion of the spiders into new habitats, the incidence of latrodectism and the need for therapeutic alternatives might increase over the next years," Hust concluded.

Technology Networks, 12 June 2024

<https://technologynetworks.com>

Bulletin Board

Gossip

JUN. 28, 2024

Synthetic pathway for promising nitride compounds discovered

2024-06-27

Ruddlesden-Popper compounds are a class of materials with a special layered structure that makes them interesting for numerous applications—as superconductors or catalysts, for example, or for use in photovoltaics. There have been many halides and oxides of this structural type before now, but no nitrides. Although scientists expected Ruddlesden-Popper nitrides to have outstanding material properties, they were unable to actually manufacture them.

Now researchers led by Dr. Simon Kloß from the Department of Chemistry at LMU have developed a special synthetic pathway which has enabled them to manufacture nitride materials that crystallize in the Ruddlesden-Popper structural type. The study is published in the journal *Nature Chemistry*.

Stability of nitrogen posed a challenge

The stability of the triple bond in the nitrogen molecule (N₂) and the low electron affinity of the element made it very challenging for the chemists to manufacture the nitrogen-rich Ruddlesden-Popper nitrides. They achieved a breakthrough by carrying out the syntheses under extreme conditions.

Employing large-volume presses, they compressed their samples at pressures of 8 gigapascals, which is equivalent to 80,000 bars. Then they used an active nitrogen source such as sodium azide to prepare the rare-earth transition-metal nitride compounds.

“We think we can systematically investigate Ruddlesden-Popper nitrides compounds with our new synthesis strategy,” says Kloß. The scientists demonstrated this by investigating three new compounds of this materials class—a cerium-tantalum nitride (Ce₂TaN₄) and praseodymium- and neodymium-rhenium nitrides (Ln₂ReN₄ (Ln = Pr, Nd)).

“These three initial materials already exhibit a rich variety of structural, electronic, and magnetic properties,” says Kloß.

The praseodymium and the neodymium compounds displayed exciting magnetic characteristics. For example, the neodymium compound is a remarkable hard ferromagnet with irreversible magnetic behavior. In addition, the tantalum compound is a semiconductor with properties that

Bulletin Board

Gossip

JUN. 28, 2024

make it exciting for applications in the energy conversion domain or as a ferroelectric material.

“The same synthetic method will probably lead to other Ruddlesden-Popper nitride compounds and their derivatives,” explains Kloß. “Consequently, a large new class of nitrides is waiting to be researched.”

Phys Org, 27 June 2024

<https://phys.org>

Microrobot-packed pill shows promise for treating inflammatory bowel disease in mice

2024-06-26

Engineers at the University of California San Diego have developed a pill that releases microscopic robots, or microrobots, into the colon to treat inflammatory bowel disease (IBD). The experimental treatment, given orally, has shown success in mice. It significantly reduced IBD symptoms and promoted the healing of damaged colon tissue without causing toxic side effects.

The study was published June 26 in *Science Robotics*.

IBD, an autoimmune disorder characterized by chronic inflammation of the gut, affects millions of people worldwide, causing severe abdominal pain, rectal bleeding, diarrhea and weight loss. It occurs when immune cells known as macrophages become overly activated, producing excessive levels of inflammation-causing proteins called pro-inflammatory cytokines. These cytokines, in turn, bind to receptors on macrophages, triggering them to produce more cytokines, and thereby perpetuating a cycle of inflammation that leads to the debilitating symptoms of IBD.

Now, researchers have developed a treatment that successfully keeps these cytokine levels in check. A team led by Liangfang Zhang and Joseph Wang, both professors in the Aiso Yufeng Li Family Department of Chemical and Nano Engineering at UC San Diego, engineered microrobots composed of inflammation-fighting nanoparticles chemically attached to green algae cells. The nanoparticles absorb and neutralize pro-inflammatory cytokines in the gut. Meanwhile, the green algae use their natural swimming abilities to efficiently distribute the nanoparticles throughout the colon, accelerating cytokine removal to help heal inflamed tissue.

Bulletin Board

Gossip

JUN. 28, 2024

What makes these nanoparticles so effective is their biomimetic design. They are made of biodegradable polymer nanoparticles coated with macrophage cell membranes, allowing them to act as macrophage decoys. These decoys naturally bind pro-inflammatory cytokines without being triggered to produce more, thus breaking the inflammatory cycle.

“The beauty of this approach is that it’s drug-free -- we just leverage the natural cell membrane to absorb and neutralize pro-inflammatory cytokines,” said Zhang.

The researchers have ensured that their biohybrid microrobots meet rigorous safety standards. The nanoparticles are made of biocompatible materials, and the green algae cells used in this study are recognized as safe for consumption by the U.S. Food and Drug Administration.

The microrobots are packed inside a liquid capsule with a pH-responsive coating. This coating remains intact in the acidic environment of the stomach acid, but dissolves upon reaching the neutral pH of the colon. This ensures that the microrobots are selectively released where they are needed most. “We can direct the microrobots to the diseased location without affecting other organs,” said Wang. “In this way, we can minimize toxicity.” The capsule keeps the functionalized algae in the liquid phase until their release.

The capsule was administered orally to mice afflicted with IBD. The treatment reduced fecal bleeding, improved stool consistency, reversed IBD-induced weight loss and reduced inflammation in the colon, all without apparent side effects.

The research team is now focusing on translating their microrobot treatment into clinical studies.

This work is supported by the Defense Threat Reduction Agency Joint Science and Technology Office for Chemical and Biological Defense (HDTRA1-21-1-0010).

Science Daily, 26 June 2024

<https://sciencedaily.com>

Bulletin Board

Curiosities

JUN. 28, 2024

Researchers Create “Glassy Gels”, A New Class of Materials

2024-06-20

Researchers at North Carolina State University have created a new class of materials that blends the hardness of glass with the stretchability of gels. The new materials – which they have termed “glassy gels” – can stretch up to five times their original length without breaking, while still being extremely tough and fracture-resistant.

The easy-to-make materials could have applications in 3D printing, batteries and soft robotics, the researchers say. Their research is published in *Nature*.

What is a glassy gel?

Polymer gels and glassy polymers are both types of polymer material, with radically different properties.

A plastic chair would be an example of a glassy polymer – it is stiff and strong because the polymer chains it is made up of are all interacting with each other, keeping them held together in a very rigid shape.

These interactions can be lessened by adding liquid to the polymer, which will turn it into a gel. A good example of a polymer gel is a contact lens, which contains a large proportion of water to make it pliable and comfortable on the eye. Anyone who has ever fallen asleep with their contact lenses in can tell you that this is not the case for a dry contact lens.

These polymer gels and glasses are extremely useful materials, with almost completely opposite properties. Glassy polymers are stiff and strong, but they are also brittle; gels are stretchier, but they are not very strong.

But what if there was a way to combine the most favorable properties of both materials? Enter the glassy gels.

“We’ve created a class of materials that we’ve termed glassy gels, which are as hard as glassy polymers, but – if you apply enough force – can stretch up to five times their original length, rather than breaking,” said study author Michael Dickey, a professor of chemical and biomolecular engineering at North Carolina State University (NC State). “What’s more, once the material has been stretched, you can get it to return to its original shape by applying heat. In addition, the surface of the glassy gels is highly adhesive, which is unusual for hard materials.”

Bulletin Board

Curiosities

JUN. 28, 2024

Making a glassy gel

Just like a regular polymer gel, glassy gels are made by adding liquid to a precursor glassy polymer. This high liquid content is also responsible for one of the material's most interesting properties – its ability to conduct electricity despite being a tough plastic.

"A key thing that distinguishes glassy gels is that they are more than 50% liquid, which makes them more efficient conductors of electricity than common plastics that have comparable physical characteristics," said Meixiang Wang, a co-lead author of the paper and a postdoctoral researcher at NC State. "Considering the number of unique properties they possess, we're optimistic that these materials will be useful."

So how do you make a glassy gel and not just a regular gel? The trick is in what type of liquid is added. To make their glassy gels, the NC State researchers added an ionic liquid to a mix of glassy polymer precursors. This mixture is then poured into a mold, cured with ultraviolet light and demolded to reveal the finished glassy gel material.

"The ionic liquid is a solvent, like water, but is made entirely of ions," explained Dickey. "Normally when you add a solvent to a polymer, the solvent pushes apart the polymer chains, making the polymer soft and stretchable. That's why a wet contact lens is pliable, and a dry contact lens isn't."

"In glassy gels, the solvent pushes the molecular chains in the polymer apart, which allows it to be stretchable like a gel," he continued. "However, the ions in the solvent are strongly attracted to the polymer, which prevents the polymer chains from moving. The inability of chains to move is what makes it glassy. The end result is that the material is hard due to the attractive forces, but is still capable of stretching due to the extra spacing."

While not every class of polymer that the researchers tested was able to form a glassy gel, they found that a significant number of different polymer types were compatible with this straightforward synthesis process.

"Polymers that are charged or polar hold promise for glassy gels, because they're attracted to the ionic liquid," Dickey said.

Future applications

Bulletin Board

Curiosities

JUN. 28, 2024

The researchers report that their glassy gels exhibit "enormous" fracture strength, toughness, yield strength and a high Young's modulus (a measure of stiffness) comparable to that of strong thermoplastics such as polyethylene. But the novelty of this new material class is that, unlike thermoplastics, they can be stretched up to five times their original length without breaking.

The gels also have shape memory, which can be programmed by deforming the material as it is heated and cooled to "fix" it in a certain shape, which is reset easily through further heating. Heat can also be used to self-heal the glassy polymer or join two fragments of the polymer together.

Additionally, despite consisting of between 50-60% liquid, the new glassy gels did not appear to naturally evaporate and dry out as seen with traditional polymer gels.

"Maybe the most intriguing characteristic of the glassy gels is how adhesive they are," Dickey added. "Because while we understand what makes them hard and stretchable, we can only speculate about what makes them so sticky."

While this suite of material properties certainly makes for some interesting potential applications in robotics or 3D printing, the researchers believe that their ease to make could be the thing to set these materials apart as an option for further development.

"Creating glassy gels is a simple process that can be done by curing it in any type of mold or by 3D printing it," said Dickey. "Most plastics with similar mechanical properties require manufacturers to create polymer as a feedstock and then transport that polymer to another facility where the polymer is melted and formed into the end product."

"We're excited to see how glassy gels can be used and are open to working with collaborators on identifying applications for these materials," he added.

Technology Networks, 20 June 2024

<https://technologynetworks.com>

Bulletin Board

Curiosities

JUN. 28, 2024

'Weightless' battery stores energy directly in carbon fiber structures

2024-06-18

Building on the trailblazing carbon-fiber-as-a-battery work started at Sweden's Chalmers University of Technology, deep-tech startup Sinonus is working to commercialize a groundbreaking new breed of multifunctional carbon fiber. In its vision, the wonder-composite will save weight not merely because of its famously low base weight but because it will double as a set of energy-managing electrodes, becoming a structural battery that cuts reliance on the traditional standalone battery pack. The company believes this style of energy storage could help revolutionize everything from electric aircraft to windmills.

Imagine an electric car that isn't weighed down by a huge, kilowatt-hour-stuffed battery. It wouldn't need as much power to drive it forward and could rely on a smaller motor, saving yet more weight. Or imagine an eVTOL that could take off without lifting a lithium-ion anchor that requires it to be back on the ground within an hour for charging. Or a windmill with blades that work as their own batteries, storing energy during low demand periods for distribution at peak hours.

Sinonus hopes to write a future in which all those visions come true. It's hard at work on a new breed of smart carbon fiber capable of serving as the electrodes of an integrated battery.

The Swedes have long been working on structural composites capable of storing electricity. We first heard tell of the work over a decade ago when Volvo publicized its participation in a research project it had undertaken in cooperation with a number of academic partners, including Chalmers.

Chalmers picked up the ball and ran with it, and a few years later, it had identified a specific subset of carbon fibers that could deliver just the right blend of electrical conductivity and structural stiffness. It eventually went on to develop a prototype "massless" carbon battery.

In 2022, the university and VC firm Chalmers Ventures spun off the project into its own company, Sinonus. The startup sums up its purpose as "multipurpose," pursuing materials that serve two or more functions in an effort to conserve overall resources.

In an EV, for instance, its carbon fiber battery system would presumably weigh the same as or less than traditional steel and aluminum structural

Bulletin Board

Curiosities

JUN. 28, 2024

components but with the advantage of storing its own power and eliminating the need for a large, heavy battery pack.

This month, Sinonus appointed Markus Zetterström as its new CEO, responsible for commercializing carbon fibers that double as electrodes. While the company doesn't estimate when that commercialization effort might result in the first market-ready products, the tech has come a long way since those rough Volvo prototype days.

Sinonus says that it has already proven its concept in the lab by replacing AAA batteries with its carbon-electrode battery in low-power applications. To go where it wants to go, it will have to scale power up in a major way, first with devices like IoT hardware and computers, and eventually upward to power-hungry equipment like electric cars and aircraft.

"Storing electrical energy in carbon fiber may perhaps not become as efficient as traditional batteries, but since our carbon fiber solution also has a structural load-bearing capability, very large gains can be made at a system level," Zetterström explains.

Of course, that "not as efficient as traditional batteries" isn't something to skip over. Sinonus has not yet published an energy-density figure for its battery concept, but 2021's Chalmers lab prototype had a paltry density of 24 Wh/kg, a fraction of what you get from the modern lithium-ion packs found in everything from smartphones to electric cars and airplanes.

Sinonus remains optimistic, pointing to a previous Chalmers study that found structural carbon fiber batteries had the potential to increase EV range by up to 70%. The lower energy density could also prove a positive, the company suggests, eliminating volatile chemicals and high energy concentrations to ultimately decrease the chances of catastrophic failure.

Cost is another question mark that dangles like a foreboding storm cloud over Sinonus' Gothenburg headquarters. EV batteries are expensive in themselves, but would replacing them with specially sandwiched electrical-grade carbon fiber really be any cheaper?

It sounds like Markus Zetterström has some difficult but fascinating work ahead. We look forward to watching as he and the Sinonus team attempt to find answers to the questions surrounding the structural battery concept and its ultimate market viability.

New Atlas, 18 June 2024

<https://newatlas.com>

Bulletin Board

Curiosities

JUN. 28, 2024

3D-printed chip sensor detects foodborne pathogens for safer products

2024-06-25

Every so often, a food product is recalled because of some sort of contamination. For consumers of such products, a recall can trigger doubt in the safety and reliability of what they eat and drink. In many cases, a recall will come too late to keep some people from getting ill.

In spite of the food industry's efforts to fight pathogens, products are still contaminated and people still get sick. Much of the problem stems from the tools available to screen for harmful pathogens, which are often not effective enough at protecting the public.

In AIP Advances, researchers from Guangdong University of Technology and Pudong New District People's Hospital developed a new method for detecting foodborne pathogens that is faster, cheaper, and more effective than existing methods. The researchers hope their technique can improve screening processes and keep contaminated food out of the hands of consumers.

Even with the best detection method, finding contaminating pathogens is not an easy task.

"Detecting these pathogens is challenging, due to their diverse nature and the various environments in which they can thrive," said author Silu Feng. "Additionally, low concentrations of pathogens in large food samples, the presence of similar non-pathogenic organisms, and the complex nature of different food types make accurate and rapid detection difficult."

Existing detection methods do exist, such as cell culture and DNA sequencing, but are challenging to employ at large scales. Not every batch of food can be thoroughly tested, so some contaminants inevitably slip through.

"Overall, these methods face limitations such as lengthy result times, the need for specialized equipment and trained personnel, and challenges in detecting multiple pathogens simultaneously, highlighting the need for improved detection techniques," said Feng.

The study's authors decided to take a different approach, designing a microfluidic chip that uses light to detect multiple types of pathogens simultaneously. Their chip is created using 3D printing, making it easy to fabricate in large amounts and modify to target specific pathogens.

Bulletin Board

Curiosities

JUN. 28, 2024

The chip is split into four sections, each of which is tailored to detect a specific pathogen. If that pathogen is present in the sample, it will bind to a detection surface and change its optical properties. This arrangement let the researchers detect several common bacteria, such as E. coli, salmonella, listeria, and S. aureus, quickly and at very low concentrations.

"This method can quickly and effectively detect multiple different pathogens, and the detection results are easy to interpret, significantly improving detection efficiency," said Feng.

The team plans to continue developing their device to make it even more applicable for food screening.

Phys Org, 25 June 2024

<https://phys.org>

Eczema Drug May Provide Relief for Other Itchy Skin Diseases

2024-06-11

A drug approved to treat eczema provided significant improvement in the symptoms of patients with severe itching diseases that currently have no targeted treatments, according to a new study published in JAMA Dermatology. The drug, abrocitinib, was found to cause minimal side effects during a small 12-week study led by University of Maryland School of Medicine (UMSOM) researchers. It was beneficial for those with an itching disease called prurigo nodularis as well as for those with chronic pruritus of unknown origin, a condition that causes chronic unexplainable itching symptoms.

"Very few treatments exist for prurigo nodularis and chronic pruritus of unknown origin; patients often suffer for years in horrible discomfort, which can lead to anxiety and depression, severely impacting their quality of life," said Shawn Kwatra, MD, the Joseph W. Burnett Endowed Professor and Chair of Dermatology at UMSOM and Chief of Service Dermatology at the University of Maryland Medical Center (UMMC). "The rationale for this study came from my laboratory's studies findings of altered inflammatory mediators in these conditions that all function through JAK1. Through this trial, we hope to continue to move the needle toward personalized therapies that can provide sustainable relief for coping with these debilitating conditions."

Bulletin Board

Curiosities

JUN. 28, 2024

Affecting at least 130,000 Americans, prurigo nodularis causes dozens of extremely itchy and disfiguring bumps, usually on the chest, arms, and legs. Dr. Kwatra's previous research indicates that prurigo nodularis occurs more than 3 times as frequently in Black patients than white patients, tends to be more common in women, and is associated with depression, diabetes, chronic kidney disease, and HIV. Chronic pruritus of unknown origin is most prevalent among older adults and causes severe itching lasting longer than six weeks. Current therapies used to help manage symptoms include over-the-counter and prescription itch relief ointments and anti-inflammatory drugs such as antihistamines and corticosteroids. None of these medications, however, provide sustained relief.

The study involved a total of 20 patients, half of whom had prurigo nodularis and half of whom had chronic pruritus of unknown origin. They were all given a 200-milligram pill of abrocitinib once a day for 12 weeks; the patients knew they were being given an experimental treatment, and the study did not include a placebo group. Abrocitinib was found to reduce itching and pain symptoms by 78 percent in the prurigo nodularis patients. Patients with chronic pruritus of unknown origin experienced a 54 percent reduction in itching and pain symptoms. Patients in both groups also reported an improvement in their quality of life and in their sleep habits.

None of the patients experienced serious adverse events. The most common side effect, in 10 percent of patients, was small acne-like bumps.

Abrocitinib is a JAK1 inhibitor drug that works to suppress inflammation, specifically pro-inflammatory chemicals called cytokines that are involved in an overactive immune system. The drugs appear to slow down immune activity by suppressing intracellular signaling of these cytokines.

"This is not only an encouraging study but also sets the stage for a Phase 3 clinical trial," said Mark T. Gladwin, MD, who is the John Z. and Akiko K. Bowers Distinguished Professor and Dean of UMSOM, and Vice President for Medical Affairs at University of Maryland, Baltimore. "It holds promise for introducing a novel treatment to patients in underserved communities disproportionately affected by prurigo nodularis, a condition historically overlooked by dermatology."

Technology Networks, 11 June 2024

<https://technologynetworks.com>

Bulletin Board

Curiosities

JUN. 28, 2024

Green hydrogen breakthrough swaps in water for iridium

2024-06-21

Hydrogen shows a lot of promise as a powerful, clean fuel source – as long as the process that creates it is also green. A new report shows how tough it might be to get to truly green hydrogen, while a new study removes a barrier to its creation.

According to a paper published today in the journal Nature Energy, by researcher Kiane de Kleijne from Radboud University and Eindhoven University of Technology in the Netherlands, the production of hydrogen more often than not leads to gains in atmospheric carbon dioxide (CO₂). That's only in part because some of it comes from natural gas production.

There are greener ways to produce hydrogen such as using solar or wind to power the process that splits it off from water molecules, but De Kleijne argues that in such cases, the carbon footprint of creating those facilities needs to be considered. So does the fact that green power is most effective in places with lots of sun and wind like Africa or Brazil, which means that hydrogen produced there then needs to be transported to the rest of the world for use, which again, raises its carbon footprint.

"If you look at the entire life cycle in this way, green hydrogen often, but certainly not always, leads to CO₂ gains," De Kleijne said. "CO₂ gains are usually higher when using wind power rather than solar power. This will improve further in the future as more renewable energy will be used to manufacture the wind turbines, solar panels and steel for the electrolyzer, for example."

Aquatic elephant in the room

Until that time, a new breakthrough in a popular hydrogen-production process called a proton-exchange-membrane (PEM) may help.

PEM is a water electrolysis process that splits off hydrogen from water molecules. Aside from the carbon cost of the electricity that powers the process, PEM is considered a green technology because its only output is oxygen, rather than carbon dioxide. The problem is that iridium is one of the only elements that can stand up to the harsh acidic environment in which water molecules are sheared apart. And iridium is very hard to find, as it's one of the rarest metals on Earth, so PEM facilities are difficult to create at scale.

Bulletin Board

Curiosities

JUN. 28, 2024

Enter a new study from the Institute of Photonic Sciences (ICFO) in Spain, explained in detail in the following video.

Basically, the ICFO researchers created an anode catalyst made from more common elements: cobalt and tungsten. But to protect the anode from the predicted degradation from the electrolysis process, they took a unique turn by impregnating a cobalt-tungsten oxide with water – the very substance in which it is made to operate.

“At the beginning of the project, we were intrigued about the potential role of water itself as the elephant in the room in water electrolysis”, said Ranit Ram, first author of the study. “No one before had actively tailored water and interfacial water in this way”

The result was that during the electrolysis process, as the new anode degraded by losing material, water and hydroxide – two compounds prevalent in the process – rushed in to fill the holes it left behind. The result was a kind of aqueous shield that kept the anode from degrading too quickly.

The whole periodic table

In tests using a PEM reactor, the new material performed admirably.

“We increased five times the current density, arriving to 1 A/cm² – a very challenging landmark in the field,” said leading co-author Dr. Lu Xia. “But, the key is that we also reached more than 600 hours of stability at such high density. So, we have reached the highest current density and also the highest stability for non-iridium catalysts.”

While the researchers admit that the new water-impregnated alloy doesn't remain stable as long as current anodes, they say the finding makes up for it in demonstrating an efficient PEM approach that doesn't rely on scarce metals. In fact, the team says the process could even work with other materials, which is desirable because cobalt is often sourced from mines making use of child labor.

“Cobalt, being more abundant than iridium, is still a very troubling material considering from where it is obtained,” said study participant and ICFO professor, García de Arquer. “That is why we are working on alternatives based on manganese, nickel and many other materials. We will go through the whole periodic table, if necessary. And we are going to explore and try with them this new strategy to design catalysts that we have reported in our study.”

Bulletin Board

Curiosities

JUN. 28, 2024

The PEM study has been published in the journal Science.

New Atlas, 21 June 2024

<https://newatlas.com>

Secrets of salt drop stains unveiled: New research decodes chemical composition from simple photos

2024-05-24

Imagine zooming in on a dried drop of salt solution—each pattern a unique masterpiece, reminiscent of abstract art, yet no larger than the size of a penny.

New research by scientists in the Florida State University Department of Chemistry and Biochemistry uses the patterns formed by a dried salt solution to train a machine learning algorithm that can identify the chemical composition of different salts. The work was published in the Proceedings of the National Academy of Sciences.

“We are taking chemical fingerprints of different salts,” said Oliver Steinbock, Cottrell Professor of Chemistry. “Thinking of sodium chloride, or table salt, for example—among all samples of this type, they always look similar. There are differences from sample to sample, but all examples are distinct enough from other types that we can tell what kind of salt it is.”

When a salt solution dries, all sorts of forces are at play. Chemists have studied how fluid motion, crystal growth, environmental factors and other processes interact to determine the deposit pattern. The FSU researchers approached the problem from the opposite direction: If presented with a pattern of a dried solution droplet, could they determine what type of salt it was?

To do that, the researchers recorded 7,500 photos of 42 different types of salt stains. Using a new software approach, they translated each image into 16 parameters that can be rapidly analyzed by machine learning methods. The parameters capture features such as deposit area, compactness and texture. Each image was translated into numbers that in subtle ways encode the patterns' arrangement of tiny crystals in rings, needles and leaf-like shapes.

To test their program's ability to predict composition, the researchers analyzed additional images that were not part of the initial dataset. These programs successfully identified the correct salt in 90% of attempts.

Bulletin Board

Curiosities

JUN. 28, 2024

"We were surprised at how well this worked," Steinbock said. "Who would think that from a photo, you can tell the difference between sodium chloride and potassium chloride? They look very similar in the pictures. But the method is very good."

The researchers plan to add to the training dataset by analyzing hundreds of thousands of new images, which would make their tool even more accurate and versatile. This vast number calls for lab automation, and such a robotic drop imager is currently being tested in Steinbock's group.

"The difference between a human doing this and a computer is that the computer and our software can do this quantitatively," Steinbock said. "If I were to present you 7,500 images, you would be confused. But the computer gets better and better with more and more images."

The ability to quickly provide insight into the chemical composition of a sample from a photograph has many potential applications. For example, outfitting a rover exploring another planet with a full chemistry lab would be difficult and expensive, but a camera offers a cheap and lightweight alternative. Other scenarios, such as testing materials for lab safety, rapid screening for suspected drugs or low-cost blood analysis in places without access to hospitals, offer other potential applications.

Another benefit of this approach is that it only requires a minute amount of material. With just a few milligrams that make up a salt deposit, users could understand what they are likely handling and inform their decisions about how to proceed.

"If you want to have a rough idea of what that stain or spill is on a lab bench, you might use this as a cursory, first-step analysis," said Bruno Batista, a senior researcher in Steinbock's lab and the paper's lead author.

Co-authors on this paper were Semhare Tekle, an undergraduate researcher in Steinbock's lab; Jie Yan, a professor in the Department of Computer Science at Bowie State University; and Beni Dangi, an associate professor in the Department of Chemistry at Florida A&M University.

Phys Org, 24 June 2024

<https://phys.org>

Bulletin Board

Curiosities

JUN. 28, 2024

Scientists discovered a hiccup cure technique that actually has '100 percent cure rate'

2024-06-25

We've all been there, haven't we? Whether that be because we ate our dinner far too quickly, or downed a pint at the local pub, hiccups are certainly a pain in the backside.

Particularly when you are with a group of people, having the hiccups can be rather embarrassing.

That is because they are very difficult to get rid of. Of course, we've heard of the old wives tales of how you need to make someone who has hiccups jump, but how many times can you actually recall that working?

Well, those who don't seem to have much success with that are in luck, with one study finding a '100 per cent cure rate' for hiccups.

To be honest, the method is fairly simple and involves just four steps.

Step 1: breathe completely out, emptying your lungs

Step 2: take a deep breath in and hold it a few seconds

Step 3: without letting any air out, breathe in a little more air, then hold for a few seconds.

Step 4: well, this sees a repeat of step three.

For such a long time, there has been collective knowledge on the subject of hiccups, that is, until Ali Seifi arrived on the scene.

Known as an inventor and entrepreneur, Seifi is perhaps the most knowledgeable individual on the planet when it comes to hiccups.

"They can have different frequencies, but 10 times per minute is most common," he said in a previous study.

"I don't know how God created that, but most of the time they're equally spaced."

Now we know how to get rid of hiccups, why do we hiccup in the first place?

There are a few ideas out there, but one weird idea is that hiccups have their origins in our evolutionary history. And we're not talking 'Missing

Bulletin Board

Curiosities

JUN. 28, 2024

Link' evolution, or even when we looked like a cross between a monkey and a lemur.

However, we're talking way before that, to the point where creatures started crawling out of the oceans onto dry land.

The 'hic' that we hear is our windpipe closing up to prevent anything from falling down it and into our lungs.

It's been speculated over the years that the reflex evolved to allow animals with both gills and lungs to push water over their gills without any of it getting into their lungs.

Robb Dunn said: "The first air-breathing fish and amphibians extracted oxygen using gills when in the water and primitive lungs when on land and to do so, they had to be able to close the glottis, or entryway to the lungs, when underwater.

"Importantly, the entryway (or glottis) to the lungs could be closed. When underwater, the animals pushed water past their gills while simultaneously pushing the glottis down.

"We descendants of these animals were left with vestiges of their history, including the hiccup. In hiccupping, we use ancient muscles to quickly close the glottis while sucking in (albeit air, not water)."

Unilad, 25 June 2024

<https://unilad.com>

Isotope tracking suggests that plants cycle carbon faster than previously thought

2024-06-25

Tracking the carbon-14 released by twentieth century nuclear weapons tests suggests that the biosphere cycles carbon more quickly than previously thought. This could be because plants store more carbon in short-lived shoots and leaves rather than in woody biomass. The results could mean plants are less able to offset climate change than had previously been estimated.

Numerous nuclear bomb tests in the 1950s and 1960s significantly elevated the amount of the radioactive carbon-14 isotope in Earth's atmosphere. Its movement has subsequently been used to track atmospheric mixing and other environmental phenomena.

Bulletin Board

Curiosities

JUN. 28, 2024

Now, climate physicist Heather Graven at Imperial College London and her colleagues have analysed carbon-14 levels from the period between 1963 and 1967, when there were no significant nuclear tests, to estimate the rate at which carbon is taken up by vegetation.

By focusing on the mid-1960s, the researchers were able to analyse data from a period when there was no new input of carbon-14 into the Earth-system, and, as the half-life of carbon-14 is about 5730 years, the decay would have been negligible. 'The radiocarbon would have just been exchanging between the air, the plants and soils on land, and the ocean,' explains Graven. 'So then we just had to take into account how much was lost from the atmosphere and how much went into the ocean, and we could calculate how much went into the biosphere by taking the residual.'

While state-of-the-art computer models predict that vegetation takes up 43–76 billion tonnes of carbon per year, the researchers' findings suggest a figure of at least 80 billion tonnes per year. The vast majority of this is ultimately returned to the atmosphere by processes such as grazing, harvesting or decomposition by aerobic organisms.

As carbon dioxide levels in the atmosphere have risen, the biosphere has absorbed some of this extra carbon. However, Graven says that 'we're not really quantifying that carbon sink'. She notes that if carbon is removed from the atmosphere more quickly, it is likely to be returned more quickly. 'There is this larger-scale turnover of carbon, and it seems like this is happening faster than models are simulating,' she says.

This could be explained if a larger proportion of the carbon is stored in smaller, shorter-lived shoots, leaves and leaves than in long-lived 'woody biomass' such as tree trunks, branches and large roots. Whatever the explanation, the shorter storage time needs to be considered when modelling the ability of vegetation to offset climate change, says Graven. 'The carbon that's within the living vegetation is not going to be stored there as long as we had previously estimated,' she notes. 'The idea that we can store even more carbon in the biosphere than what's happening naturally is not really feasible.'

'It's huge for our field,' says biogeochemist Lisa Welp at Purdue University in Indiana, US, who was not involved in the research. She says that 'because there are so few ways to measure [the hidden flux of carbon in and out of land plants] all of them are significant'. According to Welp, it is unclear what specific implications this has for projecting future climate models, but she points out that 'the fact that all the models aren't really

Bulletin Board

Curiosities

JUN. 28, 2024

doing the right thing now doesn't give us an awful lot of confidence that they're going to do the right thing in the future.'

Chemistry World, 25 June 2024

<https://chemistryworld.com>

Interest in Potentially Harmful "Magic Mushroom" May Endanger Public Health

2024-06-11

Americans' interest in a potentially harmful "magic mushroom" is soaring, with Google searches skyrocketing 114 percent from 2022 to 2023, according to a new study by researchers at the University of California San Diego Herbert Wertheim School of Public Health and Human Longevity Science. In a paper published in the American Journal of Preventive Medicine, the scientists suggest that the growing market for Amanita muscaria may be sparked in part by emerging clinical research supporting the safety and efficacy of psilocybin as a treatment for depression.

Like psilocybin mushrooms, Amanita muscaria mushrooms have psychotropic effects. These include a feeling of weightlessness, visual and auditory hypersensitivity, space distortion, unawareness of time, and colored hallucinations. The psychotropic effects are produced by compounds that naturally occur in the mushroom called muscimol and ibotenic acid, its biosynthetic precursor.

However, in addition to being psychotropic, these compounds can also be more toxic than fentanyl, cocaine, and PCP, according to the scientists' review of estimates from published mouse studies. Nevertheless, gummies and chocolates containing these compounds are being marketed with health-related claims such as mitigation of anxiety, depression, and other conditions, often by vague references to clinical studies related to psilocybin, which is not as toxic and produces different psychotropic effects.

"There is a lot of interest in the therapeutic potential for psilocybin and for good reason. But at the same time, a growing industry may be trying to capitalize on this interest by marketing other mushrooms. For example, some manufacturers are calling Amanita muscaria products 'magic mushroom gummies' and not disclosing what mushroom they contain, or not making it clear Amanita muscaria is a different mushroom than psilocybin and has essentially no clinical evidence supporting its use as a therapy," said Eric Leas, Ph.D., M.P.H., assistant professor in the UC San

Bulletin Board

Curiosities

JUN. 28, 2024

Diego Herbert Wertheim School of Public Health and Human Longevity Science and senior author on the paper.

Psilocybin and muscimol work in different ways. Psilocybin is an antidepressant that primarily binds to serotonin receptors, activating a neural pathway that mediates happiness and optimism. Amanita muscaria however is a depressant, similar to alcohol and benzodiazepines, which suppress the central nervous system. Leas believes that marketing Amanita muscaria as a psilocybin-type product violates consumers' right to informed consent.

"There may be some pharmaceutical potential to Amanita muscaria, but muscimol does not have the same effects on the body as psilocybin, so it probably would not have the same treatment applications if it ever went through drug development. For this reason, it is misleading not to clearly distinguish between muscimol and psilocybin. If someone is consenting to a psychedelic experience, they have a right to know what substance they are taking and receive accurate information about its potential health benefits and health risks."

False marketing may be enabled by lack of federal regulation of Amanita muscaria. Under the 1970 Controlled Substances Act, psilocybin is a Schedule 1 drug, making its manufacture, distribution, import/export, possession and use illegal. In 2017, the FDA designated psilocybin as a "breakthrough therapy" and in 2023 loosened restrictions to allow drug developers and scientists to conduct clinical trials with psilocybin, including some that are taking place at UC San Diego. Nevertheless, it continues to be a Schedule 1 controlled substance, and, therefore its use is disallowed out of the context of clinical trials.

Not so for Amanita muscaria. Although there are several published case studies of hospitalizations and deaths resulting from Amanita muscaria consumption, to date it is not included on a Controlled Substances list (except for the State of Louisiana, where sales are restricted). However, it is often marketed as a dietary supplement, products covered by regulations enforced by the U.S. Food and Drug Administration and the Federal Trade Commission.

"We have found that many manufacturers use supplement labeling, including 'Supplement Facts' panels," said Leas. "However, there is a process for bringing a supplement to market that involves presenting safety data and filing an application, and we cannot find any evidence that any of these manufacturers have gone through this process, and this makes the current products sold in this manner illegal."

Bulletin Board

Curiosities

JUN. 28, 2024

"In my view, if a manufacturer wanted to develop a dietary supplement from *Amanita muscaria*, the application probably would not be approved because of muscimol and ibotenic acids' inherent risks," he added. "But right now it is the 'Wild West,' and companies are profiting from delayed enforcement while putting consumers at risk."

The authors are making several general recommendations. The most restrictive would be to put *Amanita muscaria* on the Controlled Substances list, where it could first be evaluated for its medical potential and abuse liability before it is widely sold. However, if *Amanita muscaria* is not placed on a drug schedule, they recommend commonsense precautions, such as setting age restrictions, accurate dosing standards, childproof packaging, and marketing aimed at adults rather than children, all now required for legal sales of recreational cannabis. The authors would also like to see mental health professionals help their patients distinguish between psilocybin and *Amanita muscaria*.

The authors' key takeaway is that "companies who are making these products are pushing the limits of our regulations. They are getting away with making a buck until someone tells them they can't. Given the substantial risks associated with using *Amanita muscaria* products, it is a buyer beware marketplace where consumers are at risk and are not accurately informed. The time for a public health first response is now."

Technology Networks, 11 June 2024

<https://technologynetworks.com>

Jurassic Park in Real Life: MIT Creates Synthetic Amber for DNA Storage

2024-06-25

With their "T-REX" method, DNA embedded in the polymer could be used for long-term storage of genomes or digital data such as photos and music.

A new polymer developed by MIT researchers offers a significant advancement in DNA storage, providing room-temperature preservation without the energy costs associated with traditional freezing methods. This technology not only stores large amounts of data effectively but also ensures easy retrieval and undamaged DNA, making it a promising solution for both genetic and digital archival.

Advancements in DNA Preservation Technology

Bulletin Board

Curiosities

JUN. 28, 2024

In the movie "Jurassic Park," scientists extracted DNA that had been preserved in amber for millions of years, and used it to create a population of long-extinct dinosaurs.

Inspired partly by that film, MIT researchers have developed a glassy, amber-like polymer that can be used for long-term storage of DNA, whether entire human genomes or digital files such as photos.

Most current methods for storing DNA require freezing temperatures, so they consume a great deal of energy and are not feasible in many parts of the world. In contrast, the new amber-like polymer can store DNA at room temperature while protecting the molecules from damage caused by heat or water.

The researchers showed that they could use this polymer to store DNA sequences encoding the theme music from Jurassic Park, as well as an entire human genome. They also demonstrated that the DNA can be easily removed from the polymer without damaging it.

"Freezing DNA is the number one way to preserve it, but it's very expensive, and it's not scalable," says James Banal, a former MIT postdoc. "I think our new preservation method is going to be a technology that may drive the future of storing digital information on DNA."

Banal and Jeremiah Johnson, the A. Thomas Geurtin Professor of Chemistry at MIT, are the senior authors of the study, published on June 12 in the *Journal of the American Chemical Society*. Former MIT postdoc Elizabeth Prince and MIT postdoc Ho Fung Cheng are the lead authors of the paper.

Exploring New DNA Encoding Methods

DNA, a very stable molecule, is well-suited for storing massive amounts of information, including digital data. Digital storage systems encode text, photos, and other kind of information as a series of 0s and 1s. This same information can be encoded in DNA using the four nucleotides that make up the genetic code: A, T, G, and C. For example, G and C could be used to represent 0 while A and T represent 1.

DNA offers a way to store this digital information at a very high density: In theory, a coffee mug full of DNA could store all of the world's data. DNA is also very stable and relatively easy to synthesize and sequence.

In 2021, Banal and his postdoc advisor, Mark Bathe, an MIT professor of biological engineering, developed a way to store DNA in particles of silica,

Bulletin Board

Curiosities

JUN. 28, 2024

which could be labeled with tags that revealed the particles' contents. That work led to a spinout called Cache DNA.

One downside to that storage system is that it takes several days to embed DNA into the silica particles. Furthermore, removing the DNA from the particles requires hydrofluoric acid, which can be hazardous to workers handling the DNA.

Innovative Polymer Design for DNA Storage

To come up with alternative storage materials, Banal began working with Johnson and members of his lab. Their idea was to use a type of polymer known as a degradable thermoset, which consists of polymers that form a solid when heated. The material also includes cleavable links that can be easily broken, allowing the polymer to be degraded in a controlled way.

"With these deconstructable thermosets, depending on what cleavable bonds we put into them, we can choose how we want to degrade them," Johnson says.

For this project, the researchers decided to make their thermoset polymer from styrene and a cross-linker, which together form an amber-like thermoset called cross-linked polystyrene. This thermoset is also very hydrophobic, so it can prevent moisture from getting in and damaging the DNA. To make the thermoset degradable, the styrene monomers and cross-linkers are copolymerized with monomers called thionolactones. These links can be broken by treating them with a molecule called cysteamine.

The T-REX Method: A Novel Approach to DNA Storage

Because styrene is so hydrophobic, the researchers had to come up with a way to entice DNA — a hydrophilic, negatively charged molecule — into the styrene.

To do that, they identified a combination of three monomers that they could turn into polymers that dissolve DNA by helping it interact with styrene. Each of the monomers has different features that cooperate to get the DNA out of water and into the styrene. There, the DNA forms spherical complexes, with charged DNA in the center and hydrophobic groups forming an outer layer that interacts with styrene. When heated, this solution becomes a solid glass-like block, embedded with DNA complexes.

The researchers dubbed their method T-REX (Thermoset-REinforced Xeropreservation). The process of embedding DNA into the polymer

Bulletin Board

Curiosities

JUN. 28, 2024

network takes a few hours, but that could become shorter with further optimization, the researchers say.

To release the DNA, the researchers first add cysteamine, which cleaves the bonds holding the polystyrene thermoset together, breaking it into smaller pieces. Then, a detergent called SDS can be added to remove the DNA from polystyrene without damaging it.

Future of DNA Storage Technology

Using these polymers, the researchers showed that they could encapsulate DNA of varying length, from tens of nucleotides up to an entire human genome (more than 50,000 base pairs). They were able to store DNA encoding the Emancipation Proclamation and the MIT logo, in addition to the theme music from "Jurassic Park."

After storing the DNA and then removing it, the researchers sequenced it and found that no errors had been introduced, which is a critical feature of any digital data storage system.

The researchers also showed that the thermoset polymer can protect DNA from temperatures up to 75 degrees Celsius (167 degrees Fahrenheit). They are now working on ways to streamline the process of making the polymers and forming them into capsules for long-term storage.

Implications for Personalized Medicine and Future Research

Cache DNA, a company started by Banal and Bathe, with Johnson as a member of the scientific advisory board, is now working on further developing DNA storage technology. The earliest application they envision is storing genomes for personalized medicine, and they also anticipate that these stored genomes could undergo further analysis as better technology is developed in the future.

"The idea is, why don't we preserve the master record of life forever?" Banal says. "Ten years or 20 years from now, when technology has advanced way more than we could ever imagine today, we could learn more and more things. We're still in the very infancy of understanding the genome and how it relates to disease."

Sci Tech Daily, 25 June 2024

<https://scitechdaily.com>

Bulletin Board

Technical Notes

JUN. 28, 2024

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

CHEMICAL EFFECTS

[Blood levels of persistent organic pollutants among women in France in the 90's: main profiles and individual determinants](#)

[Nephrotoxicity of organophosphate flame retardants in patients with chronic kidney disease: A 2-year longitudinal study](#)

ENVIRONMENTAL RESEARCH

[Association between exposure to specific PM2.5 constituents and environment, lifestyle, and clinical parameters in patients with COPD](#)

[Metal\(loid\)s in urban soil from historical municipal solid waste landfill: Geochemistry, source apportionment, bioaccessibility testing and human health risks](#)

[Association between environmental phthalates exposure and gut microbiota and metabolome in dementia with Lewy bodies](#)

PHARMACEUTICAL/TOXICOLOGY

[Toxicity assessment of Cucurbita pepo cv Dayangua and its effects on gut microbiota in mice](#)

[Associations of co-exposure to polycyclic aromatic hydrocarbons and lead \(Pb\) with IGF1 methylation in peripheral blood of preschool children from an e-waste recycling area](#)

OCCUPATIONAL

[A follow-up study of vibration-induced injuries in workers exposed to transient and high frequency vibrations](#)

[Effects of nanoplastic exposure routes on leaf decomposition in streams](#)

[N-Acetyltransferase Metabolism and DNA Damage Following Exposure to 4,4'-Oxydianiline in Human Bronchial Epithelial Cells](#)