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

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ASIA PACIFIC

Agricultural chemical products and approved labels

2024-04-02

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

Table 1: Agricultural products based on existing active constituents

Application no.	142288
Product name	Flonicaman Insecticide
Active constituent	500 g/kg flonicamid
Applicant name	Grochem Australia Pty Ltd
Applicant ACN	169 400 033
Date of registration	11 March 2024
Product registration no.	94384
Label approval no.	94384/142288
Description of the application and its purpose, including the intended use of the chemical product	Registration of a 500 g/kg water dispersible granule formulation of flonicamid for the control of aphids and mealybug in apples, pears and nursery stock; for the control of aphids and mirids in cotton; for the control of aphids and silverleaf whitefly in cucurbits; for the control of aphids in potatoes; for the control of whitefly in tomatoes; for the control of aphids, whiteflies and green mirids in strawberries

Application no.	142285
Product name	Fluaza-Stick Fungicide
Active constituent	500 g/L fluazinam
Applicant name	Grochem Australia Pty Ltd
Applicant ACN	169 400 033
Date of registration	11 March 2024

Application no.	142285
Product registration no.	94382
Label approval no.	94382/142285
Description of the application and its purpose, including the intended use of the chemical product	Registration of 500 g/L suspension concentrate formulation of fluazinam for the control of white root rot in apples, club root of broccoli, brussels sprouts, cabbage, cauliflower and kohlrabi; Eutypa dieback and the pre-bud burst suppression of phomopsis cane and leaf blight in grapevines, and the control of late blight and sclerotinia in potatoes

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APVMA, 02-04-24

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-7-2-apr-24

Veterinary chemical products and approved labels

2024-04-02

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

Table 4: Veterinary products based on existing active constituents.

Application no.	138780
Product name	X-Mite Oral Solution for Chickens
Active constituent	10 g/L fluralaner
Applicant name	Abbey Laboratories Pty Ltd
Applicant ACN	156 000 430
Date of registration	19 March 2024
Product registration no.	93351
Label approval no.	93351/138780

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Application no.	138780
Description of the application and its purpose, including the intended use of the chemical product	Registration of 10 g/L fluralaner oral solution product for the treatment and control of poultry red mite (Dermanyssus gallinae) infestation in pullets, breeders, and layer hens

Application no.	138772
Product name	Quartet Multi-Combination Drench for Sheep
Active constituents	40 g/L levamisole hydrochloride, 37.5 g/L closantel, 25 g/L albendazole, 1 g/L abamectin
Applicant name	Alleva Animal Health Ltd
Applicant ACN	N/A
Date of registration	20 March 2024
Product registration no.	93343
Label approval no.	93343/138772
Description of the application and its purpose, including the intended use of the chemical product	Registration of a 40 g/L levamisole hydrochloride, 37.5 g/L closantel, 25 g/L albendazole and 1.0 g/L abamectin oral suspension drench product and label approval for the treatment and control in sheep of susceptible gastrointestinal roundworms, lungworm, tapeworms, mature and late immature liver fluke, nasal bot and itch mite

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APVMA, 02-04-24

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-7-2-apr-24

Approved active constituents

2024-04-02

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

Table 7: Approved active constituents.

Application no.	140971
Active constituent	Gibberellic acid
Applicant name	Qilu Pharmaceutical (Inner Mongolia) Co., Ltd.
Applicant ACN	N/A
Date of approval	13 March 2024
Approval no.	93937
Description of the application and its purpose, including the intended use of the active constituent	Approval of the active constituent gibberellic acid for use in agricultural chemical products

Application no.	138775
Active constituent	Closantel
Applicant name	Alleva Animal Health Ltd
Applicant ACN	N/A
Date of approval	13 March 2024
Approval no.	93346
Description of the application and its purpose, including the intended use of the active constituent	Approval of the active constituent closantel for use in veterinary chemical products

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APVMA, 02-04-24

https://www.apvma.gov.au/news-and-publications/publications/gazette/gazette-7-2-apr-24

Application to introduce Emesto Prime, a new fungicide for potatoes

2024-04-04

An EPA decision-making committee has approved the application to import or manufacture Emesto Prime.

Emesto Prime is a fungicide containing penflufen for use on potatoes to control the soil-borne fungus, Rhizoctonia solani.

Read the decision document for Emesto Prime (PDF, 433 KB)

There are rules for using Emesto Prime

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- There is a maximum application rate of once every two years, using a restricted amount.
- There are wind speed and use restrictions, and it cannot be applied aerially.
- There are additional label statements to minimise groundwater contamination.

Approval document for Emesto Prime (PDF, 189 KB)

Background

Bayer New Zealand Limited applied for approval to import or manufacture for release Emesto Prime.

The active ingredient, penflufen, is a new active ingredient to Aotearoa New Zealand but has been approved in various overseas jurisdictions, including Australia, Canada, Europe, Japan and the USA.

Notably, Emesto Prime has no hazard classifications for human health, although wearing personal protective equipment (PPE) is still recommended.

The application was open for public consultation during September and October 2023. Five submissions were received. We consulted with the only submitter who wished to be heard at a hearing and as a result, the offer to hold a hearing or provide written statements in lieu of a hearing was declined. This application was progressed to the decision-making committee for consideration in November 2023.

Read More

EPA New Zealand, 04-04-24

https://www.epa.govt.nz/public-consultations/decided/application-to-introduce-a-new-fungicide-for-potatoes/

AMERICA

EPA Announces "Commonsense Standards" To Limit Air Toxic Pollution At Gasoline Distribution Facilities

2024-03-15

EPA announced on March 14, 2024, its action to reduce toxic air pollution from gasoline distribution facilities, including storage tanks, loading operations, and equipment leaks. EPA states that it expects these rules,

which exclude gas stations, to reduce emissions of air toxics, including benzene, hexane, toluene, and xylene, by 2,220 tons per year, and emissions of VOCs by 45,400 tons per year. According to EPA, this action will require gasoline distribution facilities to adopt cost-effective practices and control technologies to reduce emissions from storage tanks, loading operations, and equipment leaks. EPA is issuing final NSPS for Bulk Gasoline Terminals to reflect the best system of emissions reduction for loading operations and equipment leaks. EPA notes that the final action includes revisions related to emissions during periods of startup, shutdown, and malfunction; monitoring and operating provisions for control devices; and electronic reporting. The final rule will take effect 60 days after publication in the Federal Register.

Read More

B&C, 15-03-24

https://www.lawbc.com/recent-federal-developments-for-march-2024/

PFAS No Longer Used In Grease-Proofing Products

2024-03-15

On February 28, 2024, the U.S. Food and Drug Administration (FDA) announced that grease-proofing substances containing per- and polyfluoroalkyl substances (PFAS) are no longer being sold by manufacturers for food contact use in the U.S. market. This announcement follows a voluntary market phase-out period initiated from a post-market safety assessment conducted by FDA in 2020. FDA conducts post-market safety evaluations to ensure that "risk determinations continue to be accurate and based in the current science." FDA notes that it first raised safety concerns with certain PFAS in the early 2000s and that certain long-chain compounds used in food contact were discontinued on the U.S. market between 2011 and 2016. Additional information is available at the link here.

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B&C, 15-03-24

https://www.lawbc.com/recent-federal-developments-for-march-2024/

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EPA warns farmworkers about risks of Dacthal

2024-04-01

WASHINGTON — Today, April 1, the U.S. Environmental Protection Agency is announcing its next steps to protect people from the herbicide dimethyl tetrachloroterephthalate (DCPA, or Dacthal). EPA is warning people of the significant health risks to pregnant individuals and their developing babies exposed to DCPA and will be pursuing action to address the serious, permanent, and irreversible health risks associated with the pesticide as quickly as possible. EPA has also issued a letter to AMVAC, the sole manufacturer of DCPA, restating the risks the agency found and stating that due to the serious risks posed by DCPA, the agency is pursuing further action to protect workers and others who could be exposed. EPA is taking this rare step of warning farmworkers about these concerns while it works on action to protect workers because of the significant risks the agency has identified.

"DCPA exposure represents a serious risk to pregnant workers and their children, so it's imperative that we warn people about those risks now," said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff. "We're committed to taking action to protect the health of children, workers, and others who are exposed to DCPA."

DCPA is an herbicide registered to control weeds in both agricultural and non-agricultural settings, but is primarily used on crops such as broccoli, Brussels sprouts, cabbage and onions.

DCPA is currently undergoing registration review, a process that requires reevaluating registered pesticides every 15 years to ensure they cause no unreasonable adverse effects on human health or the environment. In May 2023, EPA released its assessment on the risks of occupational and residential exposure to products containing DCPA, after the agency reviewed data that it compelled AMVAC to submit, which had been overdue for almost 10 years. The assessment found concerning evidence of health risks associated with DCPA use and application, even when personal protective equipment and engineering controls are used. The most serious risks extend to the developing babies of pregnant individuals. EPA estimates that some pregnant individuals handling DCPA products could be subjected to exposures from four to 20 times greater than what current DCPA product label use instructions indicate is considered safe. EPA is concerned that pregnant women exposed to DCPA could experience changes to fetal thyroid hormone levels, and

these changes are generally linked to low birth weight, impaired brain development, decreased IQ, and impaired motor skills later in life.

Also of concern are risks to developing babies of pregnant individuals entering or working in areas where DCPA has already been applied (especially post-application workers involved in tasks such as transplanting, weeding and harvesting). Current product labels specify that entry into treated fields must be restricted for 12 hours after application. However, the evidence indicates that for many crops and tasks, levels of DCPA in the previously treated fields remained at unsafe levels for 25 days or more. EPA also identified potential risks for individuals using golf courses and athletic fields after DCPA was applied. Spray drift from pesticide application could also put developing babies at risk for pregnant individuals living near areas where DCPA is used.

Read More

EPA, 01-04-24

https://www.epa.gov/newsreleases/epa-warns-farmworkers-about-risks-dacthal?source=email

Legislation To Protect Waters From Plastic Pollution Introduced In The House

2024-03-15

On March 12, 2024, Representatives Mike Levin (D-CA) and Mary Sattler Peltola (D-AK) introduced the Plastic Pellet Free Waters Act (H.R. 7634) to address plastic pollution in U.S. waterways and along its coasts. According to Levin's March 13, 2024, press release, the bill would require EPA to issue a rule that prohibits the discharge of plastic pellets and other types of plastic into U.S. waters. The press release states that "[c]urrently, EPA does not have an established federal rule to address plastic pellets specifically, and most states do not have meaningful regulations to combat plastic pollution."

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B&C, 15-03-24

https://www.lawbc.com/recent-federal-developments-for-march-2024/

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Our new map offers tools to encourage EPA to do better risk assessments of chemicals

2024-03-15

Exposure to many chemicals causing the same or similar health harms increases the risk of serious health problems.

We've focused on three major categories of health harms from exposure to these chemicals: cancer, developmental harm and asthma.

Using emissions data for 23 of EPA's high priority toxic chemicals, this map visualizes how communities are cumulatively exposed to multiple toxic chemicals that cause the same harms, leading to serious health issues.

Use this tool to see where facilities are polluting these toxic chemicals into our air, water and land and how it's putting our health at risk, then click through to encourage EPA to take action.

Read More

Environmental Defense Fund, 15-03-24

https://chemicalactionmap.edf.org/

EUROPE

Report assesses state of transition to circular economy in Europe

2024-04-03

On March 21, 2024, the European Environment Agency (EEA) published a report titled "Accelerating the circular economy in Europe: State and outlook 2024." The report aims to analyze how recent policies in the European Union support the transition toward a circular economy and offers options and prospects to further promote this transition in the future.

The report identifies several areas where efforts to develop a circular economy need to be made to alleviate environmental pressure and address the triple planetary crises of climate change, biodiversity loss, and pollution – many are relevant to food packaging:

- Europe continues to revolve around mass-producing products which often results in low product lifetimes.

- Recycling rates are stagnating, and the current recycling system appears to be insufficient in reaching 2030 waste reduction targets (FPF reported).
- Consumption levels in the EU continue to increase. The authors emphasize a need for "fundamental changes to consumption behavior," including shifting from single-use products to reusable alternatives.

"The likelihood of reaching the 2030 targets is either low or moderate," the authors state, highlighting the need for additional measures. Some proposed approaches include more binding and target-oriented policies, measures to promote higher quality recycling, or designing safe and sustainable products in the first place (FPF reported).

Read More

Food Packaging Forum, 03-04-24

https://www.foodpackagingforum.org/news/report-assesses-state-of-transition-to-circular-economy-in-europe

European Parliament adopts its position on Green Claims Directive

2024-03-028

On March 12, 2024, the European Parliament voted in favor of the Green Claims Directive. The directive aims to ensure that companies substantiate their claims before promoting products as environmentally friendly, thereby fostering transparency and trust among consumers (FPF reported). The Green Claims Directive comes in addition to a recent directive on environmental 'buzzwords' but is set to be "more specific and elaborate the conditions for using environmental claims in greater detail" (FPF reported). While this previous directive also focuses on repairability and durability claims, the Green Claims Directive additionally addresses carbon offsetting schemes, in the hopes of complementing each other.

More specifically, the new directive mandates companies to provide evidence supporting environmental assertions such as "biodegradable," "less polluting," "water saving," or "bio-based content." EU member states would appoint verifiers responsible for pre-approving the usage of such claims.

Key provisions of the directive include stringent deadlines for claim verification, with Parliament proposing a 30-day assessment period. However, simpler claims and products could undergo quicker or simplified

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verification processes. Notably, micro-enterprises would be exempt from the new regulations, while small and medium-sized enterprises (SMEs) would have an additional year to comply compared to larger corporations. Penalties for non-compliance could include temporary exclusion from public procurement tenders, revenue losses, and fines equivalent to at least 4% of annual turnover.

Read More

Food Packaging Forum, 28-03-24

https://www.foodpackagingforum.org/news/european-parliament-adopts-its-position-on-green-claims-directive

INTERNATIONAL

Forum Showcases Methane Mitigation Successes for Stronger Climate Action

2024-03-27

The Global Methane Initiative (GMI) and UN Economic Commission for Europe (UNECE), in partnership with the Global Methane Hub and the Climate and Clean Air Coalition (CCAC), gathered national and international policymakers, country representatives, project developers, and organizations from more than 50 countries to share replicable successes to catalyze methane emission reductions in line with the Global Methane Pledge.

The Global Methane Pledge aims to reduce global methane emissions by at least 30% from 2020 levels by 2030. It has 157 countries and the EU on board.

The Global Methane Forum sought to "turn commitment into real cuts in methane emissions" to help achieve the Paris Agreement goal of limiting the global average temperature rise to 1.5°C above pre-industrial levels by 2050.

A UNECE press release notes that methane is a powerful greenhouse gas (GHG) with a warming effect more than 80 times greater than that of carbon dioxide (CO_2) over a 20-year timeframe. "Methane is responsible for around 30% of total warming since the Industrial Revolution and is the second largest contributor to global warming after CO_2," meaning that "action to cut emissions now can unlock significant near-term benefits for climate action."

REACH Update

APR. 12, 2024

Closing nanomaterials' information gaps: EUON welcomes new study proposals

2024-04-03

- questions related to the health and safety aspects of nanomaterials, including hazard and risk assessment;
- specific issues surrounding the uses and associated risks, benefits of nanomaterials; or
- information about markets of nanomaterials.

If you have study ideas, submit your proposal to nano-observatory[at]echa.europa.eu by 30 April 2024 and contribute to the work conducted by the EUON.

More information about the call

The EUON usually conducts two studies each year to address knowledge gaps on nanomaterials. Studies are based on desk research and surveys and should not require laboratory research.

Studies can cover nanomaterials in general, a specific nanomaterial, or a defined group of nanomaterials. The EUON team will assess all proposals, and if selected, they will be carried out through EUON's existing procurement channels. The outcome and study reports will be made available on the EUON website.

Please submit your proposal in .docx or .pdf format. Include a title, and a brief description (maximum 1 page) detailing the study topic and why a particular knowledge gap should be addressed. Even if you are unsure about the duration or scope of your proposal, you may still submit it to the EUON team who will be able to evaluate the feasibility of your proposal.

Note: Receiving a proposal does not commit the EUON to carry out a study on the topic. If your topic is selected, the EUON may contact you for further information.

Read More

ECHA, 03-04-24

https://euon.echa.europa.eu/view-article/-/journal_content/title/closing-nanomaterials-information-gaps-euon-welcomes-new-study-proposals

The European Union Observatory for Nanomaterials (EUON) invites proposals for upcoming studies aimed at addressing knowledge gaps to nanomaterials within the EU market, such as:

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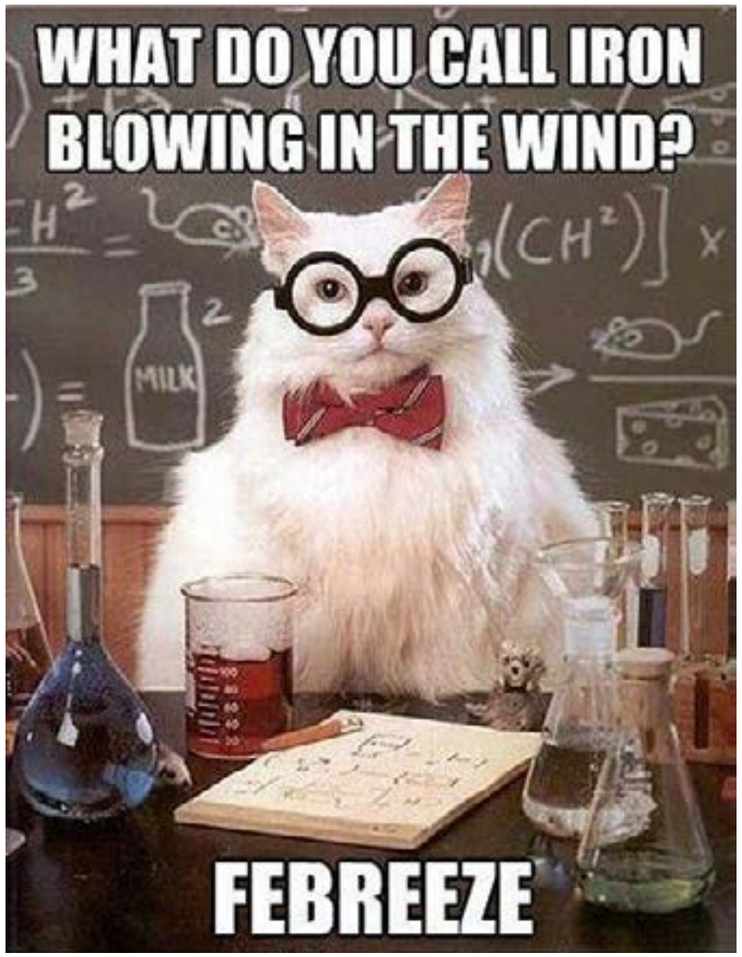
Janet's Corner

APR. 12, 2024

~Febreeze

2024-04-17



https://au.pinterest.com/pin/569283209119309559/

Chlorine Trifluoride

2024-04-12

Chlorine trifluoride is an interhalogen compound with the formula ClF3. This colourless, poisonous, corrosive and very reactive gas condenses to a pale-greenish yellow liquid, the form in which it is most often sold (pressurised at room temperature). [1,2]

USES [2,3]

Chlorine trifluoride is primarily of interest as a component in rocket fuels, in industrial cleaning and etching operations in the semiconductor industry, in nuclear reactor fuel processing, and other industrial operations. In the semiconductor industry, chlorine trifluoride is used to clean chemical vapour deposition chambers. It has the advantage that it can be used to remove semiconductor material from the chamber walls without having to dismantle the chamber. Unlike most of the alternative chemicals used in this role, it does not need to be activated by the use of plasma since the heat of the chamber is enough to make it decompose and react with the semiconductor material.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- The manufacture and transportation of chlorine trifluoride
- Use as a fluorinating agent in organic and inorganic chemical synthesis; used in the separation of uranium isomers
- Use as a cutting agent for well castings in oil well drilling and as a cutting oil for high-temperature metals
- Use as a rocket fuel oxidiser and as an igniter and propellant in rockets and liquid propellant engines; used as an incendiary
- Use in nuclear reactions fuel processing; used as a pyrolysis inhibitor for fluorocarbon polymers

HEALTH EFFECTS [4]

Acute Health Effects

Exposure to chlorine trifluoride can occur through inhalation, ingestion, and eye or skin contact. Effects of exposure to chlorine trifluoride in humans have not been reported.

Chlorine trifluoride is an interhalogen compound with the formula ClF3. This colourless, poisonous, corrosive and very reactive gas condenses to a pale-greenish yellow liquid, the form in which it is most often sold (pressurised at room temperature).

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However, based on animal studies:

- Inhalation can be expected to result in delayed and progressive irritation of the respiratory tract, chemical pneumonitis, and pulmonary oedema.
- Contact with the eyes may cause tearing, irritation, and corneal ulcerations. Permanent loss of vision can occur.
- The liquid is severely corrosive to the skin and eyes.
- Exposure to solutions containing more than 50% of the agent produces immediate burning, erythema, and tissue damage.
- Exposure to solutions ranging from 20% to 50% of the agent results in pain and erythema which may be delayed up to 1 to 8 hours.
- Exposure to solutions containing less than 20% of the agent causes erythema and pain immediately or delayed up to 24 hours after exposure [NLM 1995].
- The fluoride ion acts as a direct cellular poison by interfering with calcium metabolism and enzyme mechanisms, and hypocalcemia may occur following oral or extensive dermal exposure [NLM 1995].
- Chronic exposure to low concentrations of chlorine trifluoride may cause fluorosis.

SAFETY

First Aid Measures [5]

- **Inhalation:** Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
- **Skin/eye contact:** In case of skin contact, wearing rubber gloves rub 2.5% calcium gluconate gel continuously into the affected area for 1.5 hours or until further medical care is available. May cause severe chemical burns to skin and cornea. Suitable first-aid treatment should be immediately available. Seek medical advice before using product. Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contaminated clothing. Drench affected area with water for at least 15 minutes. Obtain medical assistance
- **Ingestion:** Ingestion is not considered a potential route of exposure.

Workplace Controls & Practices [4]

Control measures include:

- Enclosing chemical processes for severely irritating and corrosive chemicals;
- Using local exhaust ventilation for chemicals that may be harmful with a single exposure; and
- Using general ventilation to control exposures to skin and eye irritants.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

Personal Protective Equipment [5]

- **Skin Protection:** Wear work gloves for cylinder handling. Where contact with product is possible, such as when changing out cylinders, wear two pairs of gloves—inner gloves of smooth leather and outer gloves of 17 mil nitrile. The breakthrough time of the selected gloves must be greater than the intended use period. Metatarsal shoes for cylinder handling. Protective clothing consisting of a PVC splash suit and double glove as described above should be worn wherever contact with product is possible, such as during cylinder changeout. Emergency protective clothing should consist of the recommended double gloves and a totally encapsulating chemical protective suit worn over natural fibre clothing. Select per OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.
- **Eye/Face Protection:** Wear safety glasses when handling cylinders; vapour-proof goggles and a face shield during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.133.
- **Respiratory Protection:** A respiratory protection program that meet OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable) requirements must be followed whenever workplace conditions warrant respirator use. Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapour cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus.

NOTE: Protective clothing and equipment that has been in contact with the product or is suspected of contact must be decontaminated or discarded using an approved method. This clothing should not be worn or carried outside the area where the product is used. Clothing, including chemical protective suits, may react and burn on contact with liquid product.

REGULATION

United States

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for chlorine trifluoride:

- General Industry: 0.1 ppm, 0.4 mg/m3 ceiling
- Construction Industry: 0.1 ppm, 0.4 mg/m3 ceiling

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for chlorine trifluoride of 0.1 ppm, 0.38 mg/m3 ceiling

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for chlorine trifluoride of 0.1 ppm ceiling

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The science of static shock jolted into the 21st century

2024-04-10

Now Princeton researchers have sparked new life into static. Using millions of hours of computational time to run detailed simulations, the researchers found a way to describe static charge atom-by-atom with the mathematics of heat and work. Their paper, "Thermodynamic driving forces in contact electrification between polymeric materials," appears in Nature Communications.

The study looked specifically at how charge moves between materials that do not allow the free flow of electrons, called insulating materials, such as vinyl and acrylic. The researchers said there is no established view on what mechanisms drive these jolts, despite the ubiquity of static: the crackle and pop of clothes pulled from a dryer, packing peanuts that cling to a box.

"We know it's not electrons," said Mike Webb, assistant professor of chemical and biological engineering, who led the study. "What is it?"

Webb first asked himself that question as a postdoctoral researcher at the University of Chicago. He puzzled over it with colleagues, baffled that such a common phenomenon could be so poorly understood. But the more they looked, the more insurmountable the questions became. "It just seemed out of reach," he said.

It had been out of reach since Thales of Miletus first rubbed amber with fur and watched the amber (Greek: elektron) collect feathers and dust—26 centuries ago. Thales was one of the first people to explain nature through reason rather than supernatural forces. He played a critical role in the development of philosophy and eventually science. Despite the depth and breadth of knowledge accumulated over subsequent millennia, despite the myriad technologies born of that knowledge, science, in all that time, never cracked static. Maybe it never would.

At Princeton, Webb got to talking to his colleague Sankaran Sundaresan, a leading expert in chemical reaction engineering who specializes in the flow of materials in gaseous chambers. In those environments, loaded with volatile chemicals, a stray spark could be deadly. Sundaresan had worked with static charge for decades, using reliable experimental data to predict but not fully fathom how charge moved in these systems.

"I treat that like a black box," said Sundaresan, the Norman John Sollenberger Professor in Engineering. "We do some experiments and the

Shuffling across the carpet to zap a friend may be the oldest trick in the book, but on a deep level that prank still mystifies scientists, even after thousands of years of study.

experiments tell me: This is what happens. This is the charge." He works down to the limit and carefully notes what he sees. What happens inside the black box remains a mystery.

One thing you find no matter where you look, though, according to Sundaresan, is trace amounts of water. Charged water molecules are everywhere, in nearly everything, clinging to virtually every surface on Earth. Even in extremely arid conditions, under intense heat, stray water ions pool into microscopic oases that harbor electrical charge.

Incidentally, Thales is best known not for his work on electricity but for an even grander project. He proposed that the entirety of nature was made of water, that water was the Ur-substance, the essential stuff. It was the first attempt at a unified theory of everything. Aristotle wrote it all down.

Over the arc of Sundaresan's career, he and his colleagues shrunk that black box so that the mysteries have been pushed ever deeper. But mysteries they remain.

The conversation between he and Webb led to a mutual realization. Sundaresan had decades of insight into data from reactors, and Webb could apply sophisticated atom-scale computational techniques to look at these water ions from the perspective of thermodynamics.

How much energy would it take for a water ion to bolt from surface to surface? Maybe that would explain what was happening inside Sundaresan's black box. The unresolved puzzle from Webb's postdoc days came unlocked.

By modeling the relationship between charged water molecules and the amount of energy those molecules have available to propel them between surfaces, Webb and graduate student Hang Zhang demonstrated a very precise mathematical approximation of how electrical charge moves between two insulating materials.

In other words, they used math to simulate the movement of around 80,000 atoms. Those simulations matched real-life observations with a very high degree of precision. It turns out, in all likelihood, static shock is a function of water, and more specifically, the free energy of stray water ions.

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With that framework, Webb and Zhang revealed the molecular underpinnings of those familiar shocks in infinitesimal detail. They blew Sundaresan's black box wide open. If only Thales could see.

Phys Org, 10 April 2024

https://phys.org

97% of Antarctic Seabirds Have Ingested Microplastic

2024-03-16

Antarctica and the Arctic are two places on Earth most inhospitable to human life, leaving them largely untouched and uninvestigated by mankind. But that doesn't mean that these remote reaches of our planet are immune to anthropogenic pollution, far from it.

Previous studies have found traces of microplastics – tiny particles of plastic measuring less than 5 millimeters in size – in Antarctic snow and the Arctic deep sea. Now, a new systematic review published in Frontiers in Marine Science is shining a light on the consequences of this pollution on the regions' seabirds.

Looking at more than 40 years of data, the review found that over 90% of the Arctic and Antarctic seabirds studied had ingested or tried to ingest at least one piece of microplastic.

Seabird exposure to microplastics

After searching literature databases for combinations of the terms "microplastic", "nanoplastic", "seabird", "Arctic" and "Antarctic", the researchers were able to identify 14 relevant research papers covering a study period from 1983 to 2023.

Collectively, these papers studied the impact of microplastics on four Arctic seabird species and nine Antarctic species, including white-chinned petrels, glaucous gulls and four different species of penguin.

More than 1,100 samples originating from these birds were captured by these studies, with the most-studied sample type being pellets – the name given to the morsels of undigested food that birds will sometimes regurgitate. The stomach contents of deceased birds and bird excrement (guano) were also frequent sample types. In some cases, food that had

been stashed away by little auks and similar species into the small pouches located below their beaks was also examined.

Technology Networks, 16 March 2024

https://technologynetworks.com

Kombucha microbes break down fat stores like fasting – without the effort

2024-04-03

It may not be to everyone's taste, but kombucha tea may be able to deliver the benefits of fasting, without the hardest part – the fasting itself. Researchers found that when the yeasts and bacteria from the fermented, sweetened tea colonized the gut, they altered fat metabolism, without any other dietary changes, resulting in lower fat stores.

At the center of these findings is the flora found in kombucha tea's SCOBY (Symbiotic Cultures of Bacteria and Yeasts), the gelatinous starter, rich in microbes, found floating near the surface of the fermented liquid. The probiotic microbes, including species of Acetobacter, Lactobacillus and Komagataeibacter genera, have previously been linked to a range of positive health benefits including lowering blood pressure.

Now, researchers from the University of North Carolina at Chapel Hill have discovered how, in Caenorhabditis elegans, kombucha's microbes directly influence intestinal gene expression, particularly in those linked to fat metabolism. The introduced flora boosted the proteins needed to break down fat, while conversely they helped dial down the formation of proteins that help build the lipid (or fat) compounds known as triglycerides.

While triglycerides are the most common forms of fat circulating in the human body, and play an important role in energy storage and release, excess calorie intake can result in high levels of these lipids and drive comorbidities of obesity such as heart disease.

The changes in fat metabolism – the way specific proteins were dialed up and down, ultimately reducing fat stores – produced a cellular effect much like that of fasting. Here, however, no reduction or limiting of food intake was required.

"We were surprised to find that animals consuming a diet consisting of the probiotic microbes found in kombucha tea displayed reduced fat accumulation, lower triglyceride levels, and smaller lipid droplets – an

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organelle that stores the cell's lipids – when compared to other diets," the researchers noted. "These findings suggest that the microbes in kombucha tea trigger a 'fasting-like' state in the host even in the presence of sufficient nutrients."

While the study was conducted on the model worm C. elegans – a microscopic nematode that, admittedly, doesn't have quite the same fat-storage concerns that we do – the researchers believe the kombucha metabolic effects will likely be observed in humans.

Nonetheless, it adds weight – so to speak – to the case for kombucha, which most recently was linked to positive blood sugar outcomes for those with type 2 diabetes. Other studies have suggested the ancient fermented drink shows great potential as an inflammation-reducing antioxidant and an antibacterial. On the flip side, many studies have also failed to find significant health benefits of kombucha.

As for the current research, the scientists note that more work is needed in order to see if the 'fasting-like' effects shown in the lab can translate to people trying to lose or maintain their weight.

"We want to make it explicitly clear that we are not making judgements, conclusions or claims regarding kombucha tea's use in any human medical practices or its recreational consumption," the researchers noted in the study. "Our findings do, however, offer exciting insights into possible mechanisms of kombucha tea microbe-mediated host metabolic reprogramming and lays the foundation for future studies in mammalian model systems that could deconvolute the biological underpinnings of kombucha tea's potential health benefits."

The study was published in the journal PLOS Genetics.

New Atlas, 03 April 2024

https://newatlas.com

Research uncovers why urine sprayed by cats emits a pungent odor

2024-04-10

Notably, sprayed urine has a more pungent odor on the human nose than normal urine in their litter boxes. While it is believed that sprayed urine contains additional chemicals possibly derived from anal sac secretions, scientific evidence supporting this remains unclear. Japanese researchers

Cats communicate with others through their scents. One of their scent-marking behaviors is spraying urine on vertical surfaces such as walls and furniture.

examined why the sprayed urine had distinctive smell compared to the normal urine.

The researchers initially compared the chemical profiles of volatile organic compounds emitted from sprayed urine, normal urine, and bladder urine collected using ureteral catheters. Chemical analyses revealed a high degree of similarity in these profiles within the same individuals. The study has been published in the Journal of Chemical Ecology.

Behavioral analyses further demonstrated that cats perceived the sprayed urine and urine remaining in the bladder after spraying as similar odors, whereas the odors of another cat's urine were perceived as different. According to Prof. Masao Miyazaki, a leader of the research project, the data indicate that the sprayed urine originates from bladder urine without supplementation with chemicals from other secretory glands.

Given the high degree of similarity of volatile chemical profiles between sprayed urine and naturally normal urine, researchers examined why sprayed urine emits a pungent odor from another perspective.

They observed that cat urine samples easily adhered to the inner surface of plastic syringes when they transferred the samples into glass vials for urinary volatile analyses.

"This observation prompted us to explore the underlying mechanisms," said Reiko Uenoyama, the paper's first author.

Twenty years ago, Prof. Miyazaki discovered that healthy cats excrete a substantial amount of a urinary protein named cauxin (curiosity in Japanese), which contributes to the production of sulfur-containing odorants responsible for the distinct catty smell.

"Generally, the wettability of a liquid on solid surface increases as the surface tension decreases. Based on this knowledge, we hypothesized that the high protein concentration in cat urine might reduce the surface tension of cat urine, enhancing the emission of urinary volatile compounds from the large vertical surface area that was spread over the urine," said Uenoyama.

As anticipated, the surface tension was reduced with increasing concentrations of the urinary protein cauxin. At the same protein concentration, the wettability was higher in the cauxin solution than in the control solution containing albumin, a major protein contained in mammalian blood.

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When comparing the surface tension of cat urine with and without proteins, they confirmed that urine with proteins exhibited significantly lower surface tension than deproteinized urine. Interestingly, the urine with proteins also demonstrated greater adhesion to vertically positioned glass plates than the deproteinized urine.

In their observations, odorants responsible for the distinctive catty smell were detectable in an artificial miniature garden designed to mimic natural environments in which a block sprayed with tomcat urine was placed. In contrast, no such odorant was below the detection limit in another garden where the same urine was poured directly into sandy soil and then covered.

"The difference in environmental odors between the two gardens, despite using the same urine sample, can be explained by most of the urinary volatile chemicals being trapped in the porous structure of the sandy soil. This phenomenon did not occur in the urine adhering to the surface of the block. Additionally, liquid droplets of sprayed urine can easily dry on the surface of the block, resulting in greater emissions of volatile chemicals from the scent mark rapidly as compared to from normal urine," explained Miyazaki.

In conclusion, feline sprayed urine originates solely from the bladder, without any contribution from other secretions. However, despite this exclusive source, sprayed urine emits a strong and pungent odor owing to enhanced adhesion on vertical surfaces.

The specific urinary protein, cauxin, plays a crucial role in scent marking by not only producing cat-specific odorants but also by enhancing the emission of urinary volatile chemicals by increasing the wettability of the sprayed urine.

This study may provide insights into addressing the distinct smell associated with sprayed urine.

Phys Org, 10 April 2024

https://phys.org

A simple, inexpensive way to make carbon atoms bind together

2024-04-05

In the new findings, which were published in Science on April 5, 2024, Scripps Research chemists show that it's possible to convert feedstock

chemicals into quaternary carbons using a single, inexpensive iron catalyst.

This method could benefit drug developers by making molecules cheaper and easier to produce at small and large scales.

"Quaternary carbons are ubiquitous across various areas of research -- from drug discovery to material science," says co-first author Nathan Dao, a PhD candidate at Scripps Research.

"The synthesis of quaternary carbons, however, is a long-standing challenge in the field of organic chemistry, typically requiring numerous steps and relying on harsh conditions or less accessible starting materials."

In addition to Dao, the study's co-first authors included Xu-Cheng Gan and Benxiang Zhang.

Catalysts are substances used to speed up the rate of a chemical reaction. Sometimes, several different catalysts are necessary to promote a certain reaction and obtain the desired result: a veritable 'reaction soup'. But catalysts can be very expensive, and they don't always react as intended -- and the more catalysts used, the more waste that's produced.

But the Scripps Research scientists determined that a single catalyst could perform multiple crucial rolls.

"A difficult chemical reaction often requires many interacting components," according to co-senior author, Ryan Shenvi, PhD, a professor in the Department of Chemistry at Scripps Research.

"A benefit of this work is it's incredibly simple."

The team identified simple conditions to convert carboxylic acids and olefins, two major classes of chemical feedstocks -- or raw materials that fuel a machine or industrial process -- into quaternary carbons by using an inexpensive iron-based catalyst.

In addition, these chemical feedstocks aren't only abundant, but they're also low cost.

"Similar reactions have been gaining traction lately, so this discovery was inevitable," Shenvi explains.

"The pieces were already in the literature, but no one had put them together before."

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Overall, the study, which was done in collaboration with the lab of senior co-author Phil Baran, PhD, the Dr. Richard A. Lerner Endowed Chair in the Department of Chemistry at Scripps Research, highlights the ongoing role of chemistry in the development of modern technology and pharmaceuticals.

"This work is yet another striking demonstration of the power of the collaborative atmosphere at Scripps Research to unearth new transformations that can have a dramatic impact on simplifying the practice of organic synthesis," Baran adds.

This work and the researchers involved were supported by funding from the National Institutes of Health (grants GM122606 and GM118176), the National Science Foundation (CHE1955922), Nanjing King-Pharm Co., Ltd), Pfizer and Biogen.

Science Daily, 05 April 2024

https://sciencedaily.com

Why are blueberries blue?

2024-02-19

Blueberries have a particularly distinctive color — hence their name.

But blue is a rare color in nature and few naturally occurring organic compounds give living things this color. So why exactly are blueberries blue?

It turns out that scientists recently figured out this conundrum — and it's not the fruit skin.

In a study published Feb. 7 in the journal Science Advances researchers found that tiny, randomly-arranged crystals in the fruit's waxy coating scatter light, giving blueberries their signature indigo appearance.

Blue hues rarely turn up in living things. The majority of examples, such as bluebells, butterflies and tropical frogs, rely on clever trickery to produce this shade (mainly to deter predators). Even blue rocks and minerals, like sapphires and lapis lazuli, are hard to come by.

"The blue of blueberries can't be 'extracted' by squishing — because it isn't located in the pigmented juice that can be squeezed from the fruit. That was why we knew that there must be something strange about the color," study lead researcher Rox Middleton, a researcher at the University of Bristol in the U.K., said in a statement.

While blueberries contain strong pigments called anthocyanins, these have a deep reddish-purple color, completely different from the indigo shade of the fruit skin. However, like most plants, blueberries are coated in a thin layer of protective wax which acts as a waterproof coating and barrier against infection.

Middleton's team suspected the blue hue must come from outside of the fruit. So they removed a sample of this wax and recrystallized it on a piece of cardboard. To their delight, this created an ultra-thin crystalline coating with blueberry's trademark indigo color. When they looked closely at this layer, they found a random distribution of crystal structures within the wax which scatter blue and UV light to produce the fruit's signature color.

"It shows that nature has evolved to use a really neat trick, an ultrathin layer for an important colorant," Middleton said. "It was even more exciting to be able to reproduce that color by harvesting the wax to make a new blue coating that no-one's seen before."

The discovery opens up exciting opportunities for sustainable and biocompatible blue coatings and colorants. These could be used in everything from sensors, to construction, to automotive paints, the researchers wrote in the study. But the extensive and largely unknown functions of these waxes in plants also means that these new colorants potentially have many other beneficial properties which researchers haven't even begun to explore yet.

The team is now seeing if there are simpler ways to prepare and apply the wax.

"Building all that functionality of this natural wax into artificially engineered materials is the dream!" Middleton said.

Live Science, 19 February 2024

https://livescience.com

The smallest known molecular knot is made of just 54 atoms

2024-02-05

Imagine a knot so small that it can't be seen with the naked eye. Then think even smaller.

Chemists have tied together just 54 atoms to form the smallest molecular knot yet. Described January 2 in Nature Communications, the knot is a

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chain of gold, phosphorus, oxygen and carbon atoms that crosses itself three times, forming a pretzel shape called a trefoil. The previous smallest molecular knot, reported in 2020, contained 69 atoms.

Chemist Richard Puddephatt, working with colleagues at the Chinese Academy of Sciences in Dalian, created the new knot by accident while attempting to build complex structures of interlocked ring molecules, or catenanes. Someday catenanes could be used in molecular machines — essentially, switches and motors at the molecular scale — but for now scientists are still figuring out how they work, which, in this case, resulted in producing something else by mistake.

"It was just serendipity really, one of those lucky moments in research that balances out all the hard knocks that you take," says Puddephatt, of the University of Western Ontario in London, Canada.

The new trefoil knot is also the tightest of its kind. Researchers calculate a molecular knot's tightness by dividing the number of atoms in the chain by the number of chain crossings to get what's called the backbone crossing ratio, or BCR. The smaller the BCR, the tighter the knot. The new knot has a BCR of 18. The previous tightest trefoil knot had a BCR of 23.

Studying small molecular knots could someday lead to new materials (SN: 8/27/18). But for now, the team is still trying to determine why this combination of atoms results in a knot at all.

Science News, 05 February 2024

https://sciencenews.com

Novel Antibiotics Combat Drug-Resistant Bacteria

2024-04-08

Antibiotics are the foundation of modern medicine and over the last century have dramatically improved the lives of people around the world. Nowadays we tend to take antibiotics for granted and rely heavily on them to treat or prevent bacterial infections, including for example, to reduce the risk of infections during cancer therapy, during invasive surgery and transplants, and in mothers and preterm babies. Increasingly though, the global rise in antibiotic resistance threatens their effectiveness. In order to ensure access to effective antibiotics in the future, development of novel therapeutics to which there is no existing resistance is essential.

Researchers at Uppsala University have recently published their work in the Proceedings of the National Academy of Sciences of the USA

describing a new class of antibiotics developed as a part of multi-national consortia. The class of compounds they describe target a protein, LpxH, which is used in a pathway by Gram-negative bacteria to synthesize their outermost layer of protection from the environment, called lipopolysaccharide. Not all bacteria produce this layer, but those that do include the organisms that have been identified by the World Health Organization as being the most critical to develop novel treatments for, including Escherichia coli and Klebsiella pneumoniae that have already developed resistance to available antibiotics.

The researchers were able to show that this new antibiotic class is highly active against multidrug-resistant bacteria and was able to treat bloodstream infections in a mouse model, demonstrating the promise of this class. Importantly, since this compound class is completely new and the protein LpxH has not yet been exploited as a target for antibiotics there is no pre-existing resistance to this class of compounds. This is in contrast to the many 'me-too' antibiotics of existing classes currently in clinical development. While the current results are very promising there will be considerable additional work required before compounds of this class will be ready for clinical trials.

The work to discover and develop this new class of antibiotics was supported by the EU project ENABLE which was funded through the Innovative Medicines Initiative's New Drugs 4 Bad Bugs program (ND4BB). The ENABLE project, led by researchers at Uppsala University and the pharmaceutical company GlaxoSmithKline, brought together stakeholders from across Europe representing academia and large and small pharmaceutical companies to pool resources and expertise to advance early-stage antibiotic development. This antibiotic class now continues to be developed in the follow-on project, ENABLE-2, an antibiotic drug discovery platform funded by Swedish Research Council, the National Research Programme on Antibiotic Resistance and Sweden's innovation agency Vinnova to continue the momentum generated by the original ENABLE project.

Technology Networks, 08 April 2024

https://technologynetwortks.com

Yet stumbling blocks remain for IoT, thwarting many potential applications. How do you power these devices in situations where and when reliable electrical sources are not practically available?

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New device gathers, stores electricity in remote settings

2024-04-09

Research from the University of Utah's College of Engineering points to a possible solution in the form of a novel type of battery called a pyroelectrochemical cell (PEC).

The device was developed and tested in the research labs of Roseanne Warren and Shad Roundy, both associate professors of mechanical engineering.

"It's our idea for an integrated device that could harvest ambient thermal energy and convert it directly into stored electrochemical energy in the form of a supercapacitor or battery with applications for the Internet of things and distributed sensors," said Warren, the senior author on a new study that demonstrates a proof of concept.

"We're talking very low levels of energy harvesting, but the ability to have sensors that can be distributed and not need to be recharged in the field is the main advantage," she added. "We explored the basic physics of it and found that it could generate a charge with an increase in temperature or a decrease in temperature."

The study is the cover feature in the March 21 edition of the journal Energy & Environmental Science, published by the Royal Society of Chemistry.

The device is charged by changing temperatures in the surrounding environment, whether it's inside a car or aircraft or just under the soil in an agricultural environment. In theory, the PEC could power sensors for IoT applications that would otherwise be impractical to recharge.

A solar cell would work fine in some situations, according to Roundy, a co-author of the study.

"But in a lot of environments, you run into two problems," said Roundy. "One is that it gets dirty over time. Solar cells have to be kept clean. So in these types of applications, they get dirty and their power degrades. And then there are a lot of applications where you just don't have sunlight available. For example, we work on soil sensors that we put just under the top surface of the soil. You're not going to get any sunlight."

The PEC uses a pyroelectric composite material, as the separator in an electrochemical cell. The material consists of porous polyvinylidene fluoride (PVDF) and barium titanate nanoparticles. This material's electrical

properties change as it's heated or cooled, which decreases or increases the polarization of the pyroelectric separator

Changing temperatures create an electric field inside the cell, pushing ions around and enabling the cell store to energy.

"It stores electricity in what's called an electric double layer, which stores the charge in positive and negative layers of ions. This is a glorified capacitor," said lead author Tim Kowalchik, a graduate student in Warren's lab. "When you heat and cool the system and you're storing electrochemical energy, you're changing the amount of positive or negative ions that are in those layers."

The new study tested the lab's theory of how the cell would operate.

"We had a predicted model of function that included what we called an 'orientation effect' in the paper," Kowalchik said. "If we change the reverse the orientation of separator in the cell, it should drive ions the other way. This is a change we can make to the system that will show a different result that we can gather."

The team's experiments were set up to determine if the cells would respond as they predicted. Besides the orientation effect, there were heating vs. cooling effects that needed to be tested.

"If you heat the thing one way, you should get something to happen. If you cool it first, you should get something to happen and that should show up differently," Kowalchik said. "We did that with a process called amperometry. You put a voltage across it and you hold that voltage constant and measure current. Your energy into the system is constant if nothing changes; if there is energy going into the system, the current changes."

The cell did respond as the team theorized it would, but can it work outside a lab? That's the next question Warren seeks to address. One of her students is now undertaking circuit modeling to design a cell and optimize its function.

"Now we start to change different parameters," Warren said. "How can we improve the energy harvesting and storage and the combination of the two? And then after that would be a real-world field demonstration."

The cell could produce up to 100 microjoules per square centimeter from a single heating/cooling cycle, which is not much energy, but enough to be useful for IoT purposes, according to the research.

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"You want to monitor the condition of your car, the condition of machines, the condition of plants and soil and those kinds of things. Those types of sensors are generally going to be quite a bit lower power than your smartwatch or your phone, which have a display and they're transmitting a lot of data," Roundy said. "The sensors we're talking about might just give periodic updates and they operate autonomously. They don't have an interface or a screen."

The study, titled "Direct Conversion of Thermal Energy to Stored Electrochemical Energy via a Self-Charging Pyroelectrochemical Cell," was funded by the National Science Foundation. Also contributing were Fariha Khan and Danielle Horlacher. Horlacher is an undergraduate art student who has been working for Warren's group on scientific illustrations. She created the above image that displayed on the cover of the journal.

Science Daily, 09 April 2024

https://sciencedaily.com

Recent advances in application of polysaccharides in cosmetics

2024-04-10

With the increasing application of natural ingredients in the cosmetics industry, the beneficial properties of natural polysaccharides have been effectively harnessed. Certain polysaccharides exhibit superior moisturizing capabilities compared to hyaluronic acid, while others demonstrate whitening effects equivalent to arbutin. As such, the application and development of some polysaccharides are expected to replace some artificial and expensive traditional cosmetics.

In a recent review published in the Journal of Dermatologic Science and Cosmetic Technology, a team of researchers from Inner Mongolia University and The Sorbonne University of France explore the biological mechanisms underlying the cosmetic properties of polysaccharides, including moisturizing, whitening, anti-aging, and skin repair.

"Due to the complex macromolecular structure of polysaccharides, they often contain multiple active fragments, which can promote various activities through distinct pathways," says corresponding author Yongmin Zhang. "Factors such as molecular weight, monosaccharide composition, and functional groups impact their cosmetic efficacy, with optimal results achieved when these structural parameters are controlled within specific ranges."

Moreover, the authors noted that the properties of polysaccharides can be fine-tuned by adjusting extraction methods and using polysaccharide modification techniques to enhance their cosmetic activity.

"Currently, the research on the mechanism of activity may not be comprehensive, needing further study on the monosaccharides, functional groups, and structural fragments with the highest activity among polysaccharides," adds Zhang. "Understanding how the highly active polysaccharide binds to the receptor and finally acts on the cell is important. This knowledge will enable the matching of regulated polysaccharide structures with aesthetic activity detection."

The authors concluded that by identifying the most effective structural units of polysaccharides in exerting aesthetic activity, cosmetic efficacy may be maximized, potentially further enhancing the application value of polysaccharides in the cosmetics industry.

Phys Org, 10 April 2024

https://phys.org

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Tylenol can be made without coal tar and crude oil

2024-04-09

The popular pain-killing drug paracetamol, also known as acetaminophen, has always been made from chemicals derived from environmentally damaging coal tar or crude oil. Now researchers have devised a greener way of producing the drug using wood from the poplar tree.

First synthesized in the 1800s, paracetamol, known in the US and Japan as acetaminophen, is one of the most commonly used over-the-counter drugs for pain and fever in the world. Sold as Tylenol and Panadol, it even appears on the World Health Organization's Model List of Essential Medicines.

The (bad) thing about paracetamol is that, like most pharmaceuticals, it comes from non-renewable petrochemicals. In fact, it used to be known as a 'coal tar analgesic' because the starting material for the commercial manufacture of paracetamol is phenol, derived from the distillation of coal tar, which possesses analgesic properties. These days, industrial phenol is usually synthesized from crude oil rather than coal tar, which still presents environmental issues.

Given the planet's limited fossil fuel supply and the global challenge of achieving net zero emissions, researchers from the University of Wisconsin–Madison have devised a greener way of producing paracetamol: trees.

In 2019, a team led by John Ralph, a professor of biochemistry at UW–Madison, and Steven Karlen, a staff scientist at the Great Lakes Bioenergy Research Center, was awarded a patent for their method of synthesizing paracetamol from lignin, a class of complex organic polymer that acts as a 'backbone' to certain plants. Since then, they've continued refining the process.

First, some chemistry. The paracetamol molecule (N-acetoxy-p-aminophenol) consists of a six-carbon benzene ring with two chemical groups – a hydroxyl group and an amide group – attached. The lignin found in poplar trees produces a similar compound, p-hydroxybenzoate (pHB). However, given its complex and irregular molecular structure, lignin is challenging to break down into useful components.

Rising to the challenge, the researchers developed a way of breaking down pHB into another chemical and then converting it to paracetamol (or other products that have other applications).

"You can make dyes like black ink, polymers which can be used in textiles or material application, convert it to adhesives or into stuff like that," said Karlen. "It's got a huge market and big value."

There is more chemistry here; feel free to skip it if it doesn't interest you. The method has three processing stages. In the first, the plant-based pHB is broken down to p-hydroxybenzamide (pHBA). In the second stage, a continuous reaction process converts pHBA to p-aminophenol and recovers the unreacted pHBA. (In a continuous reaction, all chemical operations occur together, and the processed material is not divided into separate portions like in a batch reaction.) The third stage involves acetylating p-aminophenol to paracetamol.

The researchers found that this process produced a pHBA-to-paracetamol yield of around 90%, with a paracetamol purity of greater than 95%. Karlen says it should be possible to boost the yield to 99% with further work.

Compared to traditional approaches, the new method has several benefits. It's cheaper, primarily water-based, relies on green solvents, and is continuous rather than a batch reaction, making it ideal for industrial applications.

"We did the R&D [research and development] to scale it and make it realizable," Karlen said. "As I'm chopping the tree up, it can feed right into a reactor that pulls out the benzamide. So you're never stopping. As fast as your trucks can come in and fill that hopper, you can keep processing."

In 2022, the global market for pHBA was around 42,500 tons and valued at US$66 to 85 million. The researchers calculate that it would take 10 biorefineries processing 1,000 tons/day of poplar wood with a pHBA level of 1.2 wt% to meet that demand. They suggest that constructing a network of smaller biorefineries to feed larger hub refineries to upconvert the products would be a viable option and would expand the scale of the product market from around $85 million to $1.5 billion. And, they say, the other valuable products that can be produced by the process have the potential to also add value.

The study was published in the journal ChemSusChem.

New Atlas, 09 April 2024

https://newatlas.com

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Popular Diabetes and Obesity Drugs Don't Increase Thyroid Cancer Risk, Study Suggests

2024-04-10

Drugs known as GLP-1 analogues have become increasingly popular to treat diabetes and obesity, but there have been concerns that they might increase the risk of thyroid cancer. Now an extensive Scandinavian study led by researchers at Karolinska Institutet has found no evidence of such a link. The study is published in The BMJ.

GLP-1 receptor agonists, also known as GLP-1 analogues, reduce blood sugar levels and appetite. They are widely used in the treatment of type 2 diabetes and obesity, with their clinical use steadily increasing. Earlier studies and adverse event data have suggested that these drugs could be associated with an increased risk of thyroid tumours. However, due to limitations in data and methodology, clear conclusions could not be drawn, leading to uncertainty about this potential side effect.

Important to study potential risks

"Many people take these medicines, so it is important to study potential risks associated with them," says Björn Pasternak, principal researcher at the Department of Medicine, Solna, at Karolinska Institutet in Sweden. "Our study covers a broad group of patients and provides strong support that GLP-1 analogues are not associated with an increased risk of thyroid cancer."

The researchers analysed national register data from Denmark, Norway, and Sweden of about 145,000 patients treated with GLP-1 analogues, mainly liraglutide or semaglutide, and 290,000 patients treated with another diabetes drug (DPP4 inhibitors). The risk of thyroid cancer was compared between the groups over an average follow-up period of just under four years.

GLP-1 treatment was not associated with an increased risk of thyroid cancer. The results were consistent also when compared to a third diabetes medication group (SGLT2 inhibitors).

There may be risks for certain groups

"We cannot rule out that the risk of certain subtypes of thyroid cancer is increased in smaller patient groups that we could not study here, for example in people with a high congenital risk of medullary thyroid cancer who are advised against using these drugs," says Peter Ueda, assistant professor at the Department of Medicine, Solna, at Karolinska Institutet.

The ongoing research program at Karolinska Institutet investigates the effects and potential side effects of newer diabetes medications such as GLP-1 analogues and SGLT2 inhibitors. These medications are now being used to treat broader patient groups, including those with obesity, heart failure, and kidney failure.

Clinical reality is different

"We know from randomised clinical trials that they have positive effects, but clinical reality is different with patients varying in disease severity, comorbidities, and adherence to treatment recommendations," says Björn Pasternak. "It's therefore essential to investigate how these medicines perform in everyday clinical settings."

Technology Networks, 10 April 2024

https://technologynetworks.com

Using CO_2 and biomass, researchers find path to more environmentally friendly recyclable plastics

2024-04-10

Modern life relies on plastic. This lightweight, adaptable product is a cornerstone of packaging, medical equipment, the aerospace and automotive industries and more. But plastic waste remains a problem as it degrades in landfills and pollutes oceans.

FAMU-FSU College of Engineering researchers have created a potential alternative to traditional petroleum-based plastic that is made from carbon dioxide (CO2) and lignin, a component of wood that is a low-cost byproduct of paper manufacturing and biofuel production. Their research was published in Advanced Functional Materials.

"Our study takes the harmful greenhouse gas CO2 and makes it into a useful raw material to produce degradable polymers or plastics," said Hoyong Chung, an associate professor in chemical and biomedical engineering at the college. "We are not only reducing CO2 emissions, but we are producing a sustainable polymer product using the CO2."

This study is the first to demonstrate the direct synthesis of what's known as a cyclic carbonate monomer—a molecule made of carbon and oxygen atoms that can be linked with other molecules—made from CO2 and lignin.

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By linking multiple monomers together, scientists can create synthetic polymers, long-chained molecules that can be designed to fill all manner of applications.

The material developed by Chung and his research team is fully degradable at the end of its life without producing microplastics and toxic substances. It can be synthesized at lower pressures and temperatures. And the polymer can be recycled without losing its original properties.

Using depolymerization, the researchers can convert polymers to pure monomers, which are the building blocks of polymers. This is the key to the high quality of the recycled material. The monomers can be recycled indefinitely and produce a high-quality polymer as good as the original, an improvement over previously developed and currently used polymer materials in which repeated heat exposure from melting reduces quality and allows for limited recycling.

"We can readily degrade the polymer via depolymerization, and the degraded product can synthesize the same polymer again," Chung said. "This is more cost-effective and keeps it from losing original properties of polymers over multiple recycling. This is considered a breakthrough in material science, as it enables the realization of a true circular economy."

The newly developed material could be used for low-cost, short-lifespan plastic products in such sectors as construction, agriculture, packaging, cosmetics, textiles, diapers and disposable kitchenware. With further development, Chung anticipates its use in highly specialized polymers for biomedical and energy storage applications.

Postdoctoral researcher Arijit Ghorai was the lead author of the study.

Phys Org, 10 April 2024

https://phys.org

Using analytical chemistry to illuminate the unlisted ingredients in tattoo inks

2024-04-09

'There are a lot of questions around safety in tattoos, and we're nowhere close to answering that,' says John Swierk, who runs an inorganic chemistry research group at Binghamton University in the US. 'The focus here is just to start with a simple question of whether labelling is accurate, because if you want to track down adverse events, you have to know what's in the ink to start working backwards.'

Swierk's group works on a broad portfolio of research, including photoredox catalysis. But about four years ago he became intrigued by the idea of using tattoos to monitor health and began to wonder why light seems to cause tattoos to fade. There wasn't a clear answer, so he built a research programme to study the photochemistry of tattoos and brought in Kelli Moseman, who is now a sixth year PhD student in his lab, to help with that effort.

'I thought it was super relevant research,' Moseman recounts. 'My mom had just gotten her first tattoo, so it all tied together,' she adds. Moseman has been researching tattoo inks ever since.

'Very early on Kelli would bring me results and say, "Look at what's in this ink, do you think this is a breakdown product?"' Swierk recalls. The scientific literature at that time, primarily from Europe, had hinted at issues with tattoo inks so he decided to back up and examine their composition.

A couple of years ago Swierk presented preliminary results from his team's earlier analysis of tattoo inks manufactured in the US. He'd found concerning ingredients that were not listed by manufacturers, including azo-containing dyes – which can degrade into carcinogenic aromatic amines – in 23 of 56 tattoo inks analysed. Now, Swierk's team has completed a study on a much wider sample of tattoo inks.

Tattoo ink is comprised of a pigment, which provides the colour and stays in the skin long-term, and a carrier package, which is usually a mix of alcohol and water. The pigment is suspended in the carrier package, and in this new study the Binghamton researchers separated the two components and used a combination of nuclear magnetic resonance and mass spectrometry to analyse both and determine whether their ingredients matched their labels.

The completed study closely examined tattoo inks from nine US manufacturers,1 including large global companies and smaller producers, and discovered that for 83% of these inks – 45 out of 54 – there were major discrepancies between their ingredients and their labels. For example, they found unlisted polyethylene glycol in more than half of the inks.

Allergens and antibiotics

Propylene glycol is another ingredient Swierk and colleagues found in many of the inks that wasn't on the labels. This common emollient and emulsifier is generally considered safe but the American Contact Dermatitis Society did name it their 'Allergen of the Year' for 2018. Additional unlisted contents the researchers uncovered included an antibiotic used to treat urinary tract infections called hexamethylenetetramine, a common moisturiser in cosmetics and lotions named dodecane, and the aromatic ether 2-phenoxyethanol.

'The fact that we found a lot of unlisted things in nearly 90% of the inks raises some eyebrows about the accuracy of the labelling and whether or not people – tattoo artists and their clients – are really adequately informed about the inks that they're using,' Swierk tells Chemistry World.

The team could not determine whether the unlisted ingredients were added intentionally to the inks, or the manufacturer received incorrectly labelled or contaminated materials. 'Your typical tattoo artists, even many of these ink manufacturers, don't have access to the expertise and the equipment that we have access to that can really pinpoint these things,' Swierk states. 'It can be a powerful tool for holding businesses accountable for what they're putting in their products.'

He suggests that it's unlikely the discrepancies his team identified are restricted to the subset of tattoo inks they studied, and asserts that his results should spur tattoo ink manufacturers to implement changes.

Informed choices

Tattoo clients deserve to make informed choices and tattoo artists deserve to have information to best serve their customers, Swierk argues. 'If they want to get a tattoo with polyethylene glycol in it, or propylene glycol or whatever, that's fine – that's their choice and everybody should have that choice,' he continued. 'But when it's not listed and not disclosed then clients and artists don't get to make that choice, and that's where we think there's a problem.'

Moseman echoes Swierk's sentiments. 'It's about giving knowledge and information to the individuals – tattoo artists and their clients – and letting them make decisions for themselves,' she says.

'If we don't understand what's in tattoo inks, then we can't adequately start asking questions about safety,' Swierk says. That's why he plans to add his lab's findings to his What's In My Ink? website once they are peer-reviewed. 'As we characterise tattoo inks, people can go and see what we're finding,' he explains.

Currently, the website contains some of Swierk's previously published data. His latest findings, along with results from subsequent studies, will be entered soon. Swierk also hopes that other university chemistry labs

can contribute to the website, and maybe flag findings that require further evaluation. 'Can we crowdsource ink characterisation and create a tool that maybe has a degree of accountability for manufacturers and can inform clients and tattoo artists?' he wonders.

Neither Swierk nor Moseman have any tattoos themselves. 'I still want a tattoo,' says Moseman. 'We're not anti-tattoo,' Swierk adds. 'While there are potential safety concerns around some of the things we found in the inks, I think that the key [word] to emphasise is "potential" – there's a lot of research that's left to be done.'

Chemistry World, 09 April 2024

https://chemistryworld.com

Study Sheds Light on Combating Drug-Resistant Prostate Cancer

2024-04-10

New research from the University of Eastern Finland sheds light on the significance of the glucocorticoid receptor in drug-resistant prostate cancer, showing that the development of drug resistance could be prevented by limiting the activity of coregulator proteins.

Glucocorticoids regulate vital biological processes by affecting gene encoding through a DNA-binding transcription factor, namely the glucocorticoid receptor. The activity of the glucocorticoid receptor is made extensive use of in medicine because glucocorticoids have a strong anti-inflammatory effect. For this reason, synthetic glucocorticoids are one of the most prescribed drugs in the world. They are used to treat inflammatory diseases, such as rheumatoid arthritis, and as adjuvant therapy for cancer patients to alleviate the side effects of cancer therapy. In blood cancer, glucocorticoids are important drugs that limit the growth of cancer cells.

However, recent studies have shown that the glucocorticoid receptor also has an oncogenic, or cancer-promoting, effect in cancers like breast and prostate cancer. In prostate cancer, the glucocorticoid receptor can replace the activity of the androgen receptor, which is main oncogenic factor in this cancer, when its activity is inhibited by drug therapy. Thus, glucocorticoids help prostate cancer develop resistance to drug therapy.

"Due to these drug resistance and cancer-promoting effects, it is important to study how the glucocorticoid receptor functions on the

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cellular and molecular level in cancer," Academy Research Fellow, Docent Ville Paakinaho of the University of Eastern Finland notes.

The Paakinaho Lab has published two recent genome-wide deep sequencing studies on the subject. The first, published in Nucleic Acids Research, explored how the glucocorticoid receptor replaces the androgen receptor on the molecular level.

"This study showed that the glucocorticoid receptor can only use regulatory regions that are already active in prostate cancer cells," says Doctoral Researcher Laura Helminen of the University of Eastern Finland.

In other words, glucocorticoid receptor-mediated drug resistance emerges through these regulatory regions, and by affecting the activity of these areas, the harmful effects of glucocorticoids in prostate cancer could be prevented. Bioinformatics analyses indicated the pioneer transcription factor FOXA1 as one possible target. FOXA1 is known to have cancer-promoting properties, which is why the researchers assumed that inhibiting its activity would limit the development of glucocorticoid receptor-mediated drug-resistant prostate cancer. Surprisingly however, the effect was exactly the opposite: inhibiting the activity of FOXA1 further increased the activity of the glucocorticoid receptor – and the development of drug resistance.

This is because FOXA1 was found to be involved in the silencing of the glucocorticoid receptor gene, and this is what increased its activity when FOXA1 was inhibited.

"Research often reveals the unexpected, and that's part of its charm," Paakinaho says.

The activity of the glucocorticoid receptor in regulatory regions can, however, be influenced in drug-resistant prostate cancer through an alternative pathway. Coregulator proteins were identified as an alternative target through which the glucocorticoid receptor affects the regulation of gene expression. These proteins include EP300 and CREBBP. Several pharmaceutical companies are developing small-molecule inhibitors targeting these proteins, and some are already being studied in patients.

In another study by the Paakinaho Lab, the researchers explored ways to inhibit glucocorticoid receptor-mediated effects by inhibiting coregulator proteins. These findings were reported in Cellular and Molecular Life Sciences.

"Silencing the EP300 and CREBBP proteins with a small-molecule inhibitor clearly prevented the activity of the glucocorticoid receptor in prostate cancer cells," Project Researcher Jasmin Huttunen of the University of Eastern Finland says.

This allowed the growth of drug-resistant prostate cancer cells to be inhibited. Furthermore, the researchers found that silencing EP300 and CREBBP also effectively inhibited the activity of the androgen receptor especially in prostate cancer cells that have an amplification of the androgen receptor gene. This amplification is found in up to half of patients with advanced prostate cancer.

Surprisingly, the EP300 and CREBBP inhibitor also inhibited the activity of FOXA1, while still preserving its ability to silence the expression of the glucocorticoid receptor gene. By using the EP300 and CREBBP inhibitor, it was possible to block the activity of FOXA1 without the development of glucocorticoid receptor-mediated drug resistance. Ultimately, inhibiting the activity of both the androgen and the glucocorticoid receptor was found to be primarily due to the limitation of FOXA1 activity. The study suggests that treatment targeting coregulator proteins could also be effective in untreated prostate cancer.

Technology Networks, 10 April 2024

https://technologynetworks.com

New molecular device unlocks potential for targeted drug delivery and self-healing materials

2024-04-10

In a new breakthrough that could revolutionize medical and material engineering, scientists have developed a first-of-its-kind molecular device that controls the release of multiple small molecules using force.

The researchers from The University of Manchester describe a force-controlled release system that harnesses natural forces to trigger targeted release of molecules, which could significantly advance medical treatment and smart materials.

The discovery, published in the journal Nature, uses a novel technique using a type of interlocked molecule known as rotaxane. Under the influence of mechanical force—such as that observed at an injured or damaged site—this component triggers the release of functional

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molecules, like medicines or healing agents, to precisely target the area in need. For example, the site of a tumor.

It also holds promise for self-healing materials that can repair themselves in situ when damaged, prolonging the lifespan of these materials. For example, a scratch on a phone screen.

Guillaume De Bo, Professor of Organic Chemistry at The University of Manchester, said, "Forces are ubiquitous in nature and play pivotal roles in various processes. Our aim was to exploit these forces for transformative applications, particularly in material durability and drug delivery.

"Although this is only a proof-of-concept design, we believe that our rotaxane-based approach holds immense potential with far reaching applications—we're on the brink of some truly remarkable advancements in health care and technology."

Traditionally, the controlled release of molecules with force has presented challenges in releasing more than one molecule at once, usually operating through a molecular "tug of war" game where two polymers pull at either side to release a single molecule.

The new approach involves two polymer chains attached to a central ring-like structure that slide along an axle supporting the cargo, effectively releasing multiple cargo molecules in response to force application. The scientists demonstrated the release of up to five molecules simultaneously with the possibility of releasing more, overcoming previous limitations.

The breakthrough marks the first time scientists have been able to demonstrate the ability to release more than one component, making it one of the most efficient release systems to date.

The researchers also show the versatility of the model by using different types of molecules, including drug compounds, fluorescent markers, catalysts and monomers, revealing the potential for a wealth of future applications.

Looking ahead, the researchers aim to delve deeper into self-healing applications, exploring whether two different types of molecules can be released at the same time. For example, the integration of monomers and catalysts could enable polymerization at the site of damage, creating an integrated self-healing system within materials.

They will also look to expand the sort of molecules that can be released.

Prof De Bo said, "We've barely scratched the surface of what this technology can achieve. The possibilities are limitless, and we're excited to explore further."

Phys Org, 10 April 2024

https://Phys.Org

Mystery of why magic mushrooms go blue solved

2019-12-10

Why do magic mushrooms turn blue when they are cut? Chemists have now unravelled this decade-old mystery, in the process revealing that the dark blue pigments at the centre of the mystery are similar to indigo, the dye used to produce blue jeans.

Magic mushrooms or Psilocybe are fungi producing the psychotropic compounds psilocybin and psilocin. They are one of several species that instantly develop a blue coloration when they are cut or bruised. In Boletales mushrooms, oxidised gyrocyanin or pulvinic acid are the source of the blue colour. But that isn't the case in Psilocybe mushrooms.

Previous research had established that the blue colour was caused by oxidised psilocybin, but the nature of the pigment and the biochemical pathway producing it had remained elusive.

Dirk Hoffmeister from the Leibniz Institute for Natural Product Research and Infection Biology, Germany and his team had been working with Psilocybe cubensis for several years. Growing the mushrooms in their lab, they had seen the mysterious blueing reaction countless times. 'We were just curious and tried to solve a phenomenon that's been known for decades,' Hoffmeister says.

But when they tried to extract and purify the blue compound, they failed. 'It puzzled and challenged us,' says Hoffmeister. 'This is where previous researchers – very talented people – had to give up, and that's where we went one step further with unconventional analytical methods.'

The researchers dug deep into the analytical toolbox with liquid chromatography–mass spectrometry, Maldi mass spectrometry, infrared spectroscopy, as well as time-resolved nuclear magnetic resonance spectroscopy to observe the compounds as they form.

The pigment, as it turns out, is not just a single compound but a complex mixture of linked psilocybin oxidation products. Most of them are quinoid

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psilocyl oligomers – compounds not unlike indigo, a deep blue pigment used to dye jeans. '[The blue compounds and indigo] share structural similarities in the indole core, and in both the basis for the colour is a quinoid,' says the study's lead author Claudius Lenz.

All of the six mushroom pigments the team identified are products of a cascade reaction starting with psilocybin. A phosphatase enzyme takes off its phosphate group, converting it into psilocin. An oxidising laccase then creates psilocyl radicals, which combine to form C-5 coupled subunits and then further polymerise via C-7. 'I think they did a beautiful job of showing the cascade reaction,' says Jaclyn Winter, who studies natural product biosynthesis in bacteria and fungi at the University of Utah, US.

What exactly the blue pigments do, however, remains a mystery. 'Our hypothesis – and we don't have any evidence for this yet – is that it might serve a protective role, like an on-demand repellent against predators,' says Hoffmeister. The compounds might produce reactive oxygen species, which are toxic to any insect nibbling on the mushrooms. 'I think we're going to see a lot of follow-up studies on the true ecological role of these molecules,' Winter says.

Hoffmeister hopes that his study not only inspires others to study fungi from a chemistry perspective but also changes people's mind about psilocybin. 'Psilocybin is looked at as this illegal, recreational drug, but it has a fantastic potential as a medication for therapy resistant depression,' he says.

Winter agrees. 'There's quite a few groups who are studying psilocybin, and especially because it's been legalised in the US in various states, and because it's in clinical trials,' she says. 'I think [this study] is going to have a huge impact in the field.'

Chemistry World, 10 December 2019

https://chemistryworld.com

Revolutionary molecular device unleashes potential for targeted drug delivery and self-healing materials

2024-04-10

The researchers from The University of Manchester describe a force-controlled release system that harnesses natural forces to trigger targeted release of molecules, which could significantly advance medical treatment and smart materials.

The discovery, published today in the journal Nature, uses a novel technique using a type of interlocked molecule known as rotaxane.

Under the influence of mechanical force -- such as that observed at an injured or damaged site -- this component triggers the release of functional molecules, like medicines or healing agents, to precisely target the area in need.

For example, the site of a tumour.

It also holds promise for self-healing materials that can repair themselves in situ when damaged, prolonging the lifespan of these materials.

For example, a scratch on a phone screen.

Guillaume De Bo, Professor of Organic Chemistry at The University of Manchester, said: "Forces are ubiquitous in nature and play pivotal roles in various processes. Our aim was to exploit these forces for transformative applications, particularly in material durability and drug delivery.

"Although this is only a proof-of-concept design, we believe that our rotaxane-based approach holds immense potential with far reaching applications -- we're on the brink of some truly remarkable advancements in healthcare and technology."

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The researchers also show versatility of the model by using different types of molecules, including drug compounds, fluorescent markers, catalyst and monomers, revealing the potential for a wealth of future applications.

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For example, the integration of monomers and catalysts could enable polymerization at the site of damage, creating an integrated self-healing system within materials.

They will also look to expand the sort of molecules that can be released.

Prof De Bo said: "We've barely scratched the surface of what this technology can achieve. The possibilities are limitless, and we're excited to explore further."

Science Daily, 10 April 2024

https://Sciencedaily.com

These are the chemicals that give teens pungent body odor

2024-03-21

Puberty changes just about everything. Bodies get taller, muscles get stronger — and often, body odor becomes more pungent. Now, scientists have identified some of the compounds that give teenagers their natural aroma.

Unlike that of infants and toddlers, teenage body odor has two smelly steroids and higher levels of carboxylic acids, researchers report March 21 in Communications Chemistry. Those chemicals form when bacteria break down armpit sweat and sebum, the oily secretions that keep our skin moist, and may contribute to the noticeable changes in BO throughout puberty.

"Body odor changes through development," says chemist Helene Loos of Friedrich-Alexander-Universität Erlangen-Nürnberg in Germany. "There is a really great diversity of different odor compounds that are present in body odors."

Loos and colleagues collected body odor samples from 18 teens age 14 to 18 and 18 young children age 0 to 3 who had slept with cotton pads under their arms for a night. Separating the body odor into individual components revealed that young children and teens have over 40 compounds in common.

While some classes of chemicals showed no difference between age groups, the scents of carboxylic acids were more prevalent in teens. These compounds were a mix of pleasant scents, described by a panel trained to evaluate olfactory cues as fruity, soapy or grassy, and less-appealing ones that smelled cheesy, musty or goatlike.

Researchers also identified two steroids present only in the teens' body odor. One, called 5α-androst-16-en-3-one, smells of sweat, urine and musk. The other, called 5α-androst-16-en-3α-ol, smells of musk and sandalwood.

A few components of scented products also turned up, despite participants avoiding deodorant and using unscented body wash and detergent for two days prior to the study.

Notably, some compounds known to contribute to strong body odor weren't detected, says biochemist Andreas Natsch of Givaudan, a fragrance and flavor manufacturer headquartered in Vernier, Switzerland. Those chemicals might require different detection techniques, or they may show up more after exercising or working up a sweat (SN: 7/13/21).

Science News,21 March 2024

https://sciencenews.org

Bismuth is so strongly repelled from magnets, it levitates. How?

2024-03-23

Bismuth is an unusual element that we don't encounter much in everyday life. But this pretty, iridescent metal, found near the bottom of the periodic table, exhibits some extraordinary properties. Magnetic levitation — bismuth's ability to seemingly float between two magnets — is perhaps one of the most interesting. The repulsion between bismuth and the magnets is so strong, it causes the metal to levitate.

But why is bismuth so strongly repelled from magnets?

According to Eric Riesel, a magnetic materials chemist at MIT, the answer comes down to the type of magnetism exhibited by bismuth. Every material has magnetic properties, determined by a quantum property of the element's electrons known as spin. But, this spin can only point in two directions — up or down — and the combination of all the spins in a material define exactly what type of magnetism the element will exhibit.

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"Most people are familiar with ferromagnets (permanent magnets) like iron, where the spins are all aligned with each other, but there are also anti-ferromagnets where the spins are pointed in opposite directions to each other," Riesel told Live Science.

However, there's also another pair of magnetic categories: paramagnetism and diamagnetism. "In paramagnets, when you apply a magnetic field, spins in that material will align with the field in proportion to its strength," he said. "Diamagnets apply a force in the opposite direction to the field, repelling it."

Bismuth is an example of a diamagnetic material, yet this is not the behavior we would expect from the element's electron configuration. The type of magnetism exhibited by a material depends on the arrangement of electrons and their corresponding spins. Electrons circle the nucleus in defined layers called shells, which are further subdivided into levels called the s, d, p and f orbitals.

Typically, diamagnetic materials have a closed shell structure. This means a particular group of orbitals are completely full and the electrons have been forced to pair, with one pointing up and the other down — essentially canceling out the spins. Conversely, paramagnetic materials usually have partially filled orbitals, meaning the electrons are unpaired and can align their spins in the same direction.

Bismuth is in Group 15 of the periodic table. The s, d and f orbitals are all full, but the p orbitals contain three out of a possible six electrons. So bismuth has partially filled orbitals and should behave as a paramagnet. However, its position in row six of the periodic table means bismuth also possesses some unusual heavy-atom properties.

"Chemical elements found after the f-block in the periodic table have their outermost electrons orbiting the nucleus at speeds that are significant fractions of the speed of light," said Ira Martyniak, also a magnetic materials chemist at MIT. "The direct relativistic effect makes the 6s and 6p orbitals contract and reside closer to the nucleus, which gives rise to anomalous physical and chemical characteristics."

These relativistic effects are responsible for many of bismuth's surprising properties, such as its unconventional superconductivity, its very low melting point (520.7 degrees Fahrenheit, or 271.5 degrees Celsius) and the unusual shape of its crystals. The unexpected diamagnetism is no exception.

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"Even though bismuth has the unpaired electrons in its 6p orbital, because of relativistic contraction of the 6s and 6p levels, the paramagnetism stemming from the 6p electrons is suppressed and the behavior of bismuth is largely dominated by the closed shells and large size of the atom, leading to strong diamagnetism," Martyniak told Live Science.

Diamagnetic materials have lots of valuable applications, including electromagnetic induction in copper coils (used to generate electricity) and the aluminum tracks of high-speed maglev trains. Bismuth itself is too heavy to be a practical material for general use, but its potent diamagnetism means it is now a common component in superconductors and quantum computing.

Live Science, 23 March 2024

https://livescience.com

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Remediation of Metal Oxide Nanotoxicity with a Functional Amyloid

Interactive impacts of photoaged micro(nano)plastics and co-occurring chemicals in the environment

Assessment of the application of selected metal-organic frameworks as advanced sorbents in passive extraction used in the monitoring of contaminants of emerging concern in surface waters

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Occupational and Environmental Exposure Influences the Inflammatory (Pro-and Anti-) Status in Benign Prostate Hyperplasia and Prostate Carcinoma Patients: A Retrospective Analysis

Personal environmental exposure to plasticizers and organophosphate flame retardants using silicone wristbands and urine: Patterns, comparisons, and correlations

PHARMACEUTICAL/TOXICOLOGY

Phase 1, first-in-human study of TYRP1-TCB (RO7293583), a novel TYRP1-targeting CD3 T-cell engager, in metastatic melanoma: active drug monitoring to assess the impact of immune response on drug exposure

Antifungal plant flavonoids identified in silico with potential to control rice blast disease caused by Magnaporthe oryzae

OCCUPATIONAL

Squalene Depletion in Skin Following Human Exposure to Ozone under Controlled Chamber Conditions

The asbestos-asbestosis exposure-response relationship: a cohort study of the general working population

Assessment of occupational musculoskeletal disorders (MSDs) among heavy vehicle drivers