CHEMWATCH

Bulletin Board

Contents

JUN. 10, 2022

(click on page numbers for links)

CONTACT US

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

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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Contents

CURIOSITIES

TECHNICAL NOTES

CHEMWATCH
Bulletin Board

Regulatory Update

JUN. 10, 2022

ASIA PACIFIC

FSANZ Public consultations

2022-05-20

Proposal P1028 - Infant Formula

FSANZ invites written submissions for the assessment to revise and clarify infant formula standards relating to category definitions, composition, labelling and representation of products. The deadline for submissions has been extended to 6pm (Canberra time) 17 June 2022.

Application A1246 - Phospholipase A1 from GM Aspergillus oryzae

FSANZ invites written submissions on the assessment of phospholipase A1 enzyme preparation produced by a genetically modified strain of Aspergillus oryzae as a processing aid. Submissions close 6pm (Canberra time) 29 June 2022.

Application A1240 - Polygalacturonase from GM Aspergillus oryzae as a processing aid

FSANZ invites written submissions on the assessment of polygalacturonase from a genetically modified strain of Aspergillus oryzae containing the polygalacturonase gene from Aspergillus tubingensis as a processing aid. Submissions close 6pm (Canberra time) 1 July 2022.

Application A1241 - Pectinesterase from GM Aspergillus oryzae as a processing aid

FSANZ invites written submissions on the assessment of pectinesterase from a genetically modified strain of Aspergillus oryzae containing the pectinesterase gene from Aspergillus tubingensis as a processing aid. Submissions close 6pm (Canberra time) 1 July 2022.

For more information and to have your say, see our website.

Read More

Food Standards Australia New Zealand, 20-05-22

https://www.foodstandards.gov.au/code/changes/Pages/Documents-for-public-comment.aspx

The deadline for submissions has been extended to 6pm (Canberra time) 17 June 2022.

Thailand publishes new standards for food contact plastics

2022-06-02

Thai Industrial Standards Institute (TISI) officially publishes standards for plastic utensils and microwaveable containers that come into contact with food; standards set migration limits for plastic food contact materials and defines how compliant packaging must be tested and marked; new standards effective January 3, 2023; improperly marked food contact articles will not be allowed on the market after the effective date

In April 2022, the Thai Industrial Standards Institute (TISI) officially published five standards concerning plastic utensils and microwaveable plastic containers that will go into effect January 3, 2023. Three regulations pertain to plastic utensils used for food preparation, storage, or consumption as well as defining the materials and safety standards for single-use and reuse under different application scenarios for different polymers. The second two regulations establish similar standards for plastic bags made of virgin plastics and for microwavable plastic bags.

Read More

Food Packaging Forum, 02-06-22

https://www.foodpackagingforum.org/news/thailand-publishes-new-standards-for-food-contact-plastics

FSANZ A1232 - Food derived from drought-tolerant and herbicide-tolerant wheat line IND-00412-7

2022-05-06

Food Standards Australia New Zealand (FSANZ) has approved an application to permit food derived from wheat line IND-00412-7, also known as 'HB4 wheat'. This wheat has been genetically modified (GM) to have tolerance to drought and the herbicide glufosinate. The Approval Report and assessment documents are available below. Also on this page is more information on HB4 wheat.

Read More

Food Standards Australia New Zealand, 06-05-22

https://www.foodstandards.gov.au/code/applications/Pages/A1232-%20Food%20derived%20from%20drought-tolerant%20and%20herbicide-tolerant%20wheat%20line%20IND-00412-7%e2%80%99.aspx

Thai Industrial Standards Institute (TISI) officially publishes standards for plastic utensils and microwaveable containers that come into contact with food

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 10, 2022

China Sets out a Regulatory Roadmap to Control New Chemicals

2022-06-01

On May 24, 2022, China State Council issued an Action Plan on New Pollutants Governance ("Plan") to set out a regulatory roadmap to control new chemicals and outline an enhanced enforcement framework for compliance. The Plan establishes a framework, which will be developed by decrees and regulations to come, for an environmental risk management system for chemicals, and integration and expansion of China's existing regulatory programs on chemicals. It also encourages local governments to implement a risk assessment system and promulgate local control plans, rules, and standards on the management of key chemicals to supplement the regulatory programs specified in the Plan.

Companies manufacturing chemicals, importing chemicals, using chemicals in their production, and any facility that releases or discharges the new pollutants, as well as companies manufacturing or importing toys, student supplies, and major consumer products, are likely to be directly and indirectly affected by this new roadmap.

Background

New pollutants, according to the China Ministry of Ecology and Environment ("MEE"), refer to "toxic and hazardous chemicals with the characteristics of biological toxicity, environmental persistence, bioaccumulation, etc. which pose great risks to the ecological environment or human health, but have not been included in environmental management or existing management measures are not sufficient." See the Transcript of MEE Monthly Press Conference in March 2022. The precise scope of new pollutants covered by this roadmap will be clarified in forthcoming lists.

Read More

JD Supra, 01-06-22

https://www.jdsupra.com/legalnews/china-sets-out-a-regulatory-roadmap-to-4912574/

New Pollutants Governance to set out a regulatory roadmap to control new chemicals and outline an enhanced enforcement framework for compliance.

AMERICA

EPA Activates Emergency Viral Pathogen Guidance for Monkeypox Virus

2022-06-01

The U.S. Environmental Protection Agency (EPA) announced on May 26, 2022, that on Monday, May 23, 2022, it has activated its Emerging Viral Pathogen (EVP) Guidance for Antimicrobial Pesticides (Guidance) in response to monkeypox, which had been considered to be a rare disease caused by infection with the monkeypox virus. According to the U.S. Centers for Disease Control and Prevention (CDC), monkeypox was first discovered in 1958 when two outbreaks of a pox-like disease occurred in colonies of monkeys kept for research, hence the name "monkeypox." The first human case of monkeypox was recorded in 1970 in the Democratic Republic of Congo during a period of intensified effort to eliminate smallpox. CDC states that its scientists are tracking multiple cases of monkeypox that have been reported in several countries that do not normally report monkeypox, including the United States.

EPA developed its Guidance in 2016 to address emerging pathogens. Under this Guidance, EPA provides pesticide registrants with a voluntary "two-stage process to enable use of certain EPA-registered disinfectant products against emerging viral pathogens not identified on the product label." These pathogens may not be identified on a label because the occurrence of EVPs is less common and predictable than that of established pathogens and because the pathogens are often unavailable commercially and standard methods for laboratory testing may not exist. EPA's intent is for the Guidance to "expedite the process for registrants to provide useful information to the public" regarding products that may be effective against EVPs associated with certain human or animal disease outbreaks. Registrants with a pre-qualified EVP designation can include an efficacy statement in technical literature distributed to health care facilities, physicians, nurses, public health officials, non-label-related websites, consumer information services, and social media sites. Additional information on the EVP Guidance is available here and here.

Read More

FIFRA Blog, 01-06-22

https://pesticideblog.lawbc.com/entry/epa-activates-emergency-viral-pathogen-guidance-for-monkeypox-virus

According to the U.S. Centers for Disease Control and Prevention (CDC), monkeypox was first discovered in 1958 when two outbreaks of a pox-like disease occurred in colonies of monkeys kept for research, hence the name "monkeypox."

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 10, 2022

States take new PFAS policy steps as waste industry awaits federal guidelines

2022-06-01

"Proactive" reductions of PFAS in packaging, clothing and biosolids are among the state-level actions that could have long-term implications for waste.

As the waste industry awaits new federal guidance, states are developing regulations and laws on how to manage PFAS in everything from packaging to clothing to biosolids. The question for waste companies is how these decisions could affect daily facility operations down the line.

The U.S. EPA is not expected to develop standards for certain per- and polyfluoroalkyl substances until next year, but the waste industry has asked Congress to grant MSW landfills a narrow exemption from liability if certain PFAS eventually are designated as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA.

Read More

Waste Dive, 01-06-22

https://www.wastedive.com/news/pfas-waste-state-law-packaging-biosolids-disposal/624690/

EUROPE

The huge problem of microplastics

2022-06-02

Microplastics are a growing concern, and they are everywhere: in oceans and on mountain peaks, in food chains and ecosystems, in the most remote locations – even in our lungs and blood. Meanwhile, EU's proposal to restrict at least intentionally added microplastics in an effort to reduce pollution has been delayed an entire year.

Microplastics can now be found everywhere: at the peak of Mount Everest, in the depths of the Mariana Trench, as well as in the blood, lungs, and placenta of humans. Studies show that an average person consumes about five grams of microplastics a week – roughly the weight of a credit card.

Microplastics are a growing concern, and they are everywhere: in oceans and on mountain peaks, in food chains and ecosystems, in the most remote locations – even in our lungs and blood.

Yes, you read that right: You are consuming the equivalent of a credit card in microplastics each week.

We know very little about these tiny pieces

Apart from the highly troubling fact that microplastics don't biodegrade, making them a physiological nuisance in the environment and all living things, we don't know much about the chemical contents of plastics, or their effects on our health.

Current legislation requiring plastics producers to disclose information about substances added to enhance or alter the properties of the plastic, so called additives, is limited – to say the least.

Read More

Chemsec, 02-06-22

https://chemsec.org/the-huge-problem-of-microplastics/

INTERNATIONAL

ISO Publishes Standard on Characterization of CNT and CNF Aerosols for Inhalation Toxicity Tests

2022-05-26

The International Organization for Standardization (ISO) recently published ISO/TR 23463:2022, "Nanotechnologies — Characterization of carbon nanotube and carbon nanofibre aerosols to be used in inhalation toxicity tests." The standard reviews characterization of carbon nanotube (CNT) and carbon nanofiber (CNF) aerosols for inhalation exposure studies. According to the standard, the framework for material characterization for inhalation studies consists of:

- Characterization of as-produced (pristine) or supplied material;
- Characterization of administered material;
- Characterization of material following administration; and
- Human exposure characterization.

The standard focuses on the first two characterization needs, which include physicochemical properties (e.g., size, size distribution, aggregation/agglomeration, and shape) and measurement of concentration (e.g., mass, number, surface area, and volume). The standard states that these parameters can be measured by direct (on-line) or

The standard reviews characterization of carbon nanotube (CNT) and carbon nanofiber (CNF) aerosols for inhalation exposure studies.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 10, 2022

indirect (off-line) methods and each technique needs specific sampling procedures. The standard notes that the limited technologies in the generation and characterization of nanofibers make it difficult to perform inhalation toxicity studies, however, "although the inhalation exposure to CNT and CNF is highly likely in the workplace, and research facilities, where they are in use." The standard provides the current status of CNT and CNF aerosol characterization used in the inhalation toxicity tests, as well as the physicochemical properties of CNTs and CNFs and their relationship with toxicity end points. ISO notes that the standard neither provides guidance on aerosol characterization for other carbon nanomaterials, nor provides guidance for characterization of CNT and CNF aerosols in the workplace or ambient air.

Read More

Nano and Other Emerging Chemical Technologies Blog, 26-05-22

https://nanotech.lawbc.com/2022/05/iso-publishes-standard-on-characterization-of-cnt-and-cnf-aerosols-for-inhalation-toxicity-tests/

HCF 2022: How can we speed up the regulation of harmful chemicals?

2022-05-26

From the EU's REACH to TSCA in the US to international treaties to ban substances, regulating harmful chemicals has never been quick or easy. The UN's second edition of the Global Chemicals Outlook, released in 2019, acknowledges that current approaches to advance sound chemicals management, including those for identifying hazards and assessing exposure, are "at times complex and slow and do not result in the progress needed".

Building on this, a recent study by NGO the European Environmental Bureau (EEB) said that even EU regulators – considered among the most progressive on chemicals – take an average of five and a half to nine and a half years to put measures in place under REACH and CLP to manage a single hazardous chemical.

Adding to the problem is the speed at which new chemicals enter the market. The global chemical industry's production capacity almost doubled between 2000 and 2017 and is expected to roughly double again by 2030.

Barriers

From the EU's REACH to TSCA in the US to international treaties to ban substances, regulating harmful chemicals has never been quick or easy.

But what's holding things up? It starts with a lack of information, says Mark Blainey, head of Echa's prioritisation unit, and one of the panellists at this year's HCF. This is particularly the case with hazards and uses, which has "slowed down regulation," he says.

Otto Linher from the European Commission's DG Grow REACH unit echoes this, adding that lack of information prevents adequate classification and risk assessment of chemicals.

Read More

Chemical Watch, 26-05-22

https://chemicalwatch.com/491167/hcf-2022-how-can-we-speed-up-the-regulation-of-harmful-chemicals

Drafting of the international plastics treaty now underway

2022-05-30

First meeting to draft the international plastics treaty in Dakar, Senegal taking place from May 30 to June 1, 2022 with representatives from government, industry, and civil society; technical briefing on May 29, 2022 shares information on the relationship between plastics, chemical exposure, and human health

In March 2022, 175 countries signed a resolution to begin negotiations on an international, legally binding agreement to end plastic pollution, the Plastic Treaty (FPF reported). From May 30 to June 1, 2022, representatives from government, industry, and civil society organizations across the world are meeting in Dakar, Senegal to discuss what will and will not be included in the treaty. In addition to the plenary, multistakeholder dialogues on how to create a just transition to a plastic pollution free economy, the role of civic and youth groups to "transform the plastic value chain," and redirecting financial incentives and trade were also scheduled.

On May 29 before the official start of the meeting, the International Pollutants Elimination Network (IPEN) along with the governments of Senegal, Switzerland, and Uruguay organized a technical briefing side event to share the latest research on the relationship between plastics, chemicals, and health.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 10, 2022

Read More

Food Packaging Forum, 30-05-22

https://www.foodpackagingforum.org/news/drafting-of-the-international-plastics-treaty-now-underway

First meeting to draft the international plastics treaty in Dakar, Senegal taking place from May 30 to June 1, 2022.

REACH Update

JUN. 10, 2022

Glyphosate not a carcinogen, EU panel affirms

2022-06-01

Glyphosate, the main ingredient in Bayer's Roundup and many generic herbicides, is not a carcinogen, a panel of European Union chemical safety experts concluded May 30.

After reviewing scientific evidence, the European Chemical Agency (ECHA) Committee for Risk Assessment agreed that classifying glyphosate as a carcinogen "is not justified." The committee's conclusion on the hazards of glyphosate upholds a 2021 assessment by France, Hungary, the Netherlands, and Sweden in support of renewed authorization for glyphosate use in the EU.

In addition to finding that glyphosate is not a carcinogen, the ECHA committee determined that the chemical doesn't meet the criteria for EU classification as a mutagen or a substance that is toxic for reproduction. However, it can cause serious eye damage and is toxic to aquatic life, the panel said.

The ECHA panel ignored scientific arguments from independent experts about glyphosate's carcinogenicity and genotoxicity, says Angeliki Lyssimachou, senior science policy officer at the Health and Environmental Alliance, a coalition of advocacy organizations in Europe. "The failure to recognize the carcinogenic potential of glyphosate is a mistake, and should be considered as a big step backwards in the fight against cancer," she says in a statement.

The committee's report will be sent to the European Food Safety Authority in August, ECHA says. The food safety agency will conduct a risk assessment of glyphosate, with conclusions expected in July 2023. Later, the European Commission, the executive branch of the EU, will determine whether to propose reauthorizing use of glyphosate.

Read More

Chemical & Engineering News, 01-06-22

https://cen.acs.org/environment/pesticides/Glyphosate-carcinogen-EU-panel-affirms/100/i20

Glyphosate, the main ingredient in Bayer's Roundup and many generic herbicides, is not a carcinogen, a panel of European Union chemical safety experts concluded May 30.

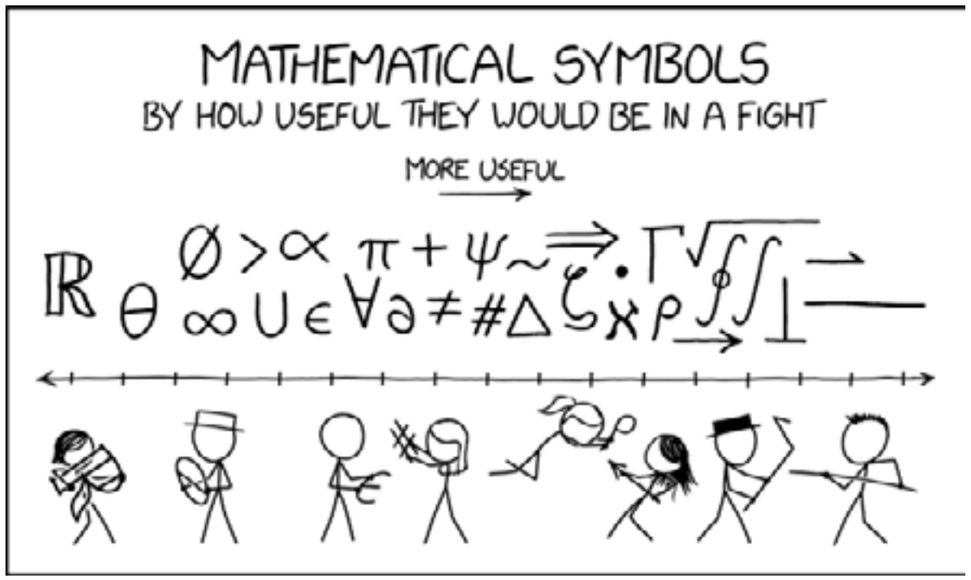
CHEMWATCH
Bulletin Board

Janet's Corner

JUN. 10, 2022

Mathematical Symbol Fight

2022-06-10



https://xkcd.com/2343/

Methyl Parathion

2022-06-10

Parathion is an insecticide with the molecular formula $C_{10}H_{14}NO_5PS$.[1] At room temperature, parathion is a yellow-to-brown liquid with an odour of garlic. It is often dissolved in a hydrocarbon solvent before use. Parathion itself is not volatile. It is almost insoluble in water, slightly soluble in petroleum oils, and miscible with many organic solvents. [2]

USES [2]

Parathion is prepared by the reaction of diethyl phosphorothionchloridate with sodium p-nitrophenate. It is widely used as an agricultural insecticide. It has been used extensively by U.S. farmers on major crops such as wheat, fruit, vegetables, nuts, citrus fruits, alfalfa, corn, soybeans, and other field crops.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

- Humans are exposed to parathion primarily during field application and formulation; the general public may be exposed by dermal and inhalation exposure from spray drift in areas adjacent to agricultural fields.
- Exposure to parathion may occur in the workplace during its manufacture.
- Individuals may also be exposed by ingesting food containing parathion residues.

Routes of Exposure [2]

- Inhalation: Toxic inhalation of parathion vapour is unlikely at ordinary temperatures because of its low volatility, but toxic effects can occur after inhalation of parathion sprays or dusts. The hydrocarbon solvents (most commonly toluene and xylene) used to dissolve parathion are more volatile than parathion itself, and toxicity can result from inhalation of solvent vapour as well. The odour threshold of parathion is five times the OSHA PEL (0.1 mg/m^3) and does not provide adequate warning of hazardous concentrations. Children exposed to the same levels of parathion as adults may receive a larger dose because they have greater lung surface area: body weight ratios and increased minute volumes: weight ratios.

Parathion is an insecticide with the molecular formula C10H14NO5PS.[1] At room temperature, parathion is a yellow-to-brown liquid with an odour of garlic.

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 10, 2022

- Skin/Eye Contact: Parathion is not irritating to the skin or eyes, but is rapidly absorbed through intact skin and eyes, contributing to systemic toxicity. Children are more vulnerable to toxicants absorbed through the skin because of their relatively larger surface area: body weight ratio.
- Ingestion: Acute toxic effects, including rapidly fatal systemic poisoning, can result from ingestion of parathion.

HEALTH EFFECTS [4]

Acute Exposure

Parathion, like all organophosphate pesticides, inhibits acetylcholinesterase and alters cholinergic synaptic transmission at neuroeffector junctions (muscarinic effects), at skeletal myoneural junctions and autonomic ganglia (nicotinic effects), and in the CNS. Inhibition occurs when a metabolite of parathion binds to acetylcholinesterase; thus, symptoms may be delayed after exposure. Signs and symptoms of poisoning vary according to age, dose, and concentration. Muscarinic effects include: pinpoint pupils; blurred vision; hypersecretion by salivary, lacrimal, sweat, and bronchial glands; narrowing of the bronchi; nausea, vomiting, diarrhoea, and crampy abdominal pains; urinary and faecal incontinence; and slow heart rate. Nicotinic effects include muscle twitching, cramping, and weakness. Nicotinic stimulation can obscure certain muscarinic effects and produce rapid heart rate and high blood pressure.

Central Nervous System

Central Nervous System (CNS) effects are often the earliest manifestations of poisoning in adults and constitute the major signs and symptoms in children. CNS effects include irritability, nervousness, giddiness, fatigue, lethargy, impairment of memory, confusion, slurred speech, visual disturbance, depression, impaired gait, convulsions, loss of consciousness, coma, and respiratory depression.

Peripheral Neurologic

Peripheral neurologic effects include muscle twitching and weakness due to inhibition of acetylcholinesterase at neuromuscular junctions.

Respiratory

Respiratory failure is the most common cause of death due to parathion poisoning. Narrowing of the bronchi and markedly increased bronchial secretions can occur. Respiratory failure results from respiratory depression coupled with paralysis of the respiratory muscles and progressive airway obstruction from bronchorrhea. In addition, pulmonary aspiration of the hydrocarbon solvents found in many commercial preparations can cause inflammation of the lungs. Children may be more vulnerable because of relatively increased minute ventilation per kg and failure to evacuate as area promptly when exposed.

Cardiovascular

Most exposure victims experience bradycardia, but pulse rate may be increased initially and tachycardia is more common in very severe poisoning. Irregular heartbeat may occur.

Gastrointestinal

Nausea, vomiting, abdominal cramps, diarrhoea, and faecal incontinence are common manifestations, regardless of the exposure route. These are generally the earliest symptoms to occur.

Metabolic

Profuse sweating is likely to occur and may lead to profound dehydration. This is somewhat less common in children.

Dermal

Parathion is not generally irritating, but is readily absorbed through the skin. Skin contact can result in systemic poisoning. Because of their relatively larger surface area: body weight ratio, children are more vulnerable to toxicants absorbed through the skin.

Ocular

Systemic poisoning typically causes pinpoint pupils and spasm of the muscle of visual accommodation (i.e., ciliary muscle) leading to blurred vision and aching pain in the eye. However, organophosphate poisoning may still be present without pinpoint pupils, and dilation of the pupils may even be noted occasionally. Eye irritation, if it occurs, is most likely caused by the hydrocarbon solvents used in commercial pesticide preparations.

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 10, 2022

Potential Sequelae

Complete recovery generally occurs within 10 days unless severe lack of oxygen has caused residual brain damage. CNS effects such as confusion, fatigue, irritability, nervousness, and impairment of memory can occasionally last for several weeks. Six to twenty-one days after acute exposure to some organophosphate compounds, onset of nerve disorders of mixed sensory-motor type may occur; peripheral nerve recovery may never be complete. It is uncertain if parathion produces this delayed polyneuropathy.

Chronic Exposure

Persistent weakness and impaired memory have been reported to occur from low-level exposures to organophosphates in the absence of acute cholinergic effects.

Carcinogenicity

The International Agency for Research on Cancer has determined that parathion is not classifiable as to its carcinogenicity to humans. However, EPA lists parathion as a possible human carcinogen.

Reproductive and Developmental Effects

Studies have been reported in which parathion was embryo-toxic and fetotoxic in rodents. There are no studies addressing reproductive or developmental effects in humans exposed to parathion. Parathion is not included in Reproductive and Developmental Toxicants, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 other chemicals of concern because of widely acknowledged reproductive and developmental consequences.

SAFETY [5]

First Aid Measures

- If inhaled: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- In case of skin contact: Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
- In case of eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

- If swallowed: Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Exposure Controls & Personal Protection

Exposure controls

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

Personal Protective Equipment

The following personal protective equipment is recommended when handling parathion:

- Eye/face protection: Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
- Skin protection: Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Body Protection: Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
- Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 10, 2022

REGULATION [6,7,8]

United States

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

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 0.1 mg/m^3; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A -- 0.1 mg/m^3; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 0.1 mg/m^3

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for parathion of 0.05 mg/m^3 TWA - Inhalable fraction, Vapour and aerosol; Skin; Appendix A4 - Not Classifiable as a Human Carcinogen; BEI

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for parathion of 0.05 mg/m^3 TWA; Skin

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average concentration for parathion of 0.1 mg/m^3 for a 40-hour workweek.

Australia Drinking Water Guidelines specify an allowable concentration of 0.02 mg/L of parathion in drinking water.

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Sharp cut in methane now could help avoid worst of climate crisis

2022-05-24

Cutting methane sharply now is crucial, as focusing on carbon dioxide alone will not be enough to keep rising temperatures within livable limits, scientists have warned.

CO2 is the greenhouse gas most responsible for heating the planet, with most of it coming from the burning of fossil fuels. As a result, it has been the major focus of international efforts to prevent climate breakdown.

However, other greenhouse gases also have a sizeable warming effect, and if we ignore them we will fail to keep temperatures within globally accepted limits, according to research published on Monday.

The study found that cuts to CO2 alone could not achieve the reductions needed to stay within 1.5C of pre-industrial temperatures.

But cutting methane and other "short-lived climate pollutants" (SLCPs) such as soot would reduce the global heating effect in the near term, thus giving the world "a fighting chance" of staving off climate catastrophe, the scientists said. Methane warming effect is as much as 80 times that of C02, although it quickly degrades in the atmosphere.

Prof Durwood Zaelke, the president of the Washington-based Institute for Governance and Sustainable Development (IGSD), and co-author of the paper, said cutting methane offered a quick way to reduce global heating while the world pursued longer term cuts in CO2.

"We can't solve the fast-moving climate problem with slow-moving solutions. Like Maverick [the Tom Cruise character in Top Gun], we'd better start feeling the need for speed," he said.

Zaelke called on European governments to stipulate that any gas they import to replace supplies from Russia should come from sources with low rates of methane leaks. "This is the fastest and most promising way to protect the planet while we decarbonise," he said.

Plugging the methane leaks from oil and gas operations, including shale wells, and stopping harmful practices such as venting or flaring the gas, is not only technically feasible but can also be highly profitable at today's gas prices.

Focussing on carbon dioxide alone will not keep world within 1.5C limit of global heating, warn scientists

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

Dr Gabrielle Dreyfus, chief scientist for the IGSD, and lead author of the paper, said: "This is an optimistic message, as we have low or no-cost strategies available, with no or low-cost interventions, that can slow global warming in the critical near-term."

Emissions of methane have been soaring in recent years, the result of leaks and venting from oil and gas exploration, and shale gas wells, and from the intensive rearing of livestock for food. Earlier this year, the International Energy Agency said many countries were drastically under-reporting their emissions of methane, and that the global problem was far worse than previously thought.

The IGSD paper, which was published in the Proceedings of the National Academy of Sciences, showed the huge potential for "buying time" to change the world's energy systems by concentrating on cutting methane, and other SLCPs including soot, hydrofluorocarbons, ground-level ozone and nitrous oxide.

These substances contribute almost as much to global heating as CO2, according to the study, though most of them last only a short time in the atmosphere.

Cutting CO2 is still essential for the long term, but must be accompanied by strategies to reduce the levels of SLCPs. If not, then temperatures are likely to exceed 2C above pre-industrial levels, the upper limit set in the 2015 Paris climate agreement, even if there are stiff cuts to CO2 emissions.

Dreyfus said sharp cuts to methane and other SLCPs could result in temperatures lower by 0.26C by 2050, which is almost four times greater than the benefit of pursuing CO2 cuts alone, which the scientists estimated would result in temperature cuts of 0.07C by 2050.

She said: "These non-CO2 targeted measures when combined with decarbonisation can provide net cooling by 2030, reduce the rate of warming from 2030 to 2050 by about 50%, roughly half of which comes from methane, significantly larger than decarbonisation alone over this timeframe."

The paper found the importance of "non-carbon dioxide pollutants" had been "underappreciated by scientists and policymakers alike and largely neglected in efforts to combat climate change".

Last year, before the Cop26 climate summit, the US and the EU launched a global pledge to cut methane emissions by 30% by 2030, to which more than 100 governments responsible for more than half of those emissions

are now committed. However, Russia – which has some of the world's highest methane emissions, owing to its leaky oil and gas infrastructure – is not among them.

The Guardian, 24 May 2022

https://theguardian.com

Viruses that were on hiatus during Covid are back — and behaving in unexpected ways

2022-05-25

For nearly two years, as the Covid pandemic disrupted life around the globe, other infectious diseases were in retreat. Now, as the world rapidly dismantles the measures put in place to slow spread of Covid, the viral and bacterial nuisances that were on hiatus are returning — and behaving in unexpected ways.

Consider what we've been seeing of late.

The past two winters were among the mildest influenza seasons on record, but flu hospitalizations have picked up in the last few weeks — in May! Adenovirus type 41, previously thought to cause fairly innocuous bouts of gastrointestinal illness, may be triggering severe hepatitis in healthy young children.

Respiratory syncytial virus, or RSV, a bug that normally causes disease in the winter, touched off large outbreaks of illness in kids last summer and in the early fall in the United States and Europe.

And now monkeypox, a virus generally only found in West and Central Africa, is causing an unprecedented outbreak in more than a dozen countries in Europe, North America, the Middle East, and Australia, with the United Kingdom alone reporting more than 70 cases as of Tuesday.

These viruses are not different than they were before, but we are. For one thing, because of Covid restrictions, we have far less recently acquired immunity; as a group, more of us are vulnerable right now. And that increase in susceptibility, experts suggest, means we may experience some … wonkiness as we work toward a new post-pandemic equilibrium with the bugs that infect us.

Larger waves of illness could hit, which in some cases may bring to light problems we didn't know these bugs triggered. Diseases could circulate at times or in places when they normally would not.

For one thing, because of Covid restrictions, we have far less recently acquired immunity; as a group, more of us are vulnerable right now.

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

"I think we can expect some presentations to be out of the ordinary," said Petter Brodin, a professor of pediatric immunology at Imperial College London. "Not necessarily really severe. I mean it's not a doomsday projection. But I do think slightly out of the normal."

Marion Koopmans, head of the department of viroscience at Erasmus Medical Center in Rotterdam, the Netherlands, said she believes we may be facing a period when it will be difficult to know what to expect from the diseases that we thought we understood.

"I do think that's possible," Koopmans said.

This phenomenon, the disruption of normal patterns of infections, may be particularly pronounced for diseases where children play an important role in the dissemination of the bugs, she suggested.

Little kids are normally germ magnets and germ amplifiers. But their lives were profoundly altered during the pandemic. Most went for stretches of time without attending day care, or in-person school. Many had far less exposure to people outside their households, and when they did encounter others, those people may have been wearing masks.

And babies born during the pandemic may have entered the world with few antibodies passed on by their mothers in the womb, because those mothers may have been sheltered from RSV and other respiratory pathogens during their pregnancies, said Hubert Niesters, a professor of clinical virology and molecular diagnostics at the University Medical Center, in Groningen, the Netherlands.

Koopmans said a study her team did looking for antibodies in the blood of young children showed the impact of what she calls an "infection honeymoon."

"You really see that children in the second year of the pandemic have far less antibodies to a set of common respiratory viruses. They just got less exposed," she said.

Such factors may help explain the recent rash of unusual hepatitis cases in young children. Scientists investigating the cases think they may be caused, at least in part, by adenovirus type 41, because it has been found in a significant number of the affected children. The possibility is puzzling, because the virus hasn't been seen to cause this type of illness in the past.

But some scientists theorize that this virus may have always been responsible for a portion of the small number of unexplained pediatric

hepatitis cases that happen every year. Maybe, the thinking goes, there have been a lot more adenovirus type 41 infections over the past eight months because of increased susceptibility among children. That, in turn, could be making visible something that wasn't spotted before.

"I think sometimes to connect the dots of rare complications of common illnesses you just need enough cases out there to start to put the pieces together," said Kevin Messacar, a pediatric infectious diseases specialist at Children's Hospital Colorado. "And there is some suspicion that that could be going on with the hepatitis cases."

The pandemic-induced disruption of normal mixing patterns means that even adults haven't been generating the levels of antibodies that would normally be acquired through the regular exposure we have to bugs, creating ever larger pools of susceptible people.

Flu experts, for instance, worry that when influenza viruses return in a serious way, a buildup of people who haven't had a recent infection could translate into a very bad flu season.

Koopmans said some studies suggest that after a one- or two-year period in which flu transmission is low, there could be a sizeable reduction in the number of people who have flu antibodies that are at levels high enough to be considered protective. "So also, potentially, a bigger, more susceptible group in adults," she said.

"We're talking about endemic diseases that had a certain pattern of predictability. And that pattern in part was seasonal but in part was also driven by the size of the immune or non-immune population. And the last bit has, of course, increased," Koopmans said.

How will this play out? All eyes will be trained this fall on children's hospitals to see whether there will be a surge in cases of a polio-like condition called acute flaccid myelitis, or AFM, which is thought to be caused by infection with enterovirus D68.

Messacar, who is also an associate professor at the University of Colorado, has been studying AFM for the past eight years, since the first of a series of biennial waves of cases occurred in the late summer and early autumn of 2014, 2016, and 2018.

Then in 2020, nothing. Same in 2021. Does that mean the fall of 2022 could see a much higher crest of cases, because more children are potentially susceptible to enterovirus D68? We need to be prepared for

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

that possibility, Messacar said, while stressing he doesn't know what to expect.

"Now we have four years of children who haven't seen that virus. We don't know what's going to happen. We don't know when it comes back. But when it does come back, there are more susceptible children out there that would not be expected to have immunity," he said. "That's what we're watching with a variety of different viruses."

Thomas Clark, deputy director of the division of viral diseases at the Centers for Disease Control and Prevention, said people in public health have been fearing there could be outbreaks of vaccine-preventable diseases due to the fact that many children around the world missed getting childhood vaccinations during the pandemic.

But he said he now understands that isn't the only way the pandemic may influence infectious diseases.

"We're very focused on under-vaccinated children with routine childhood immunizations because it's the set-up for introduction of measles. But then there have also been a lot of kids who haven't gotten the usual kind of viruses they might have been exposed to."

Clark said we may see differences in severity of some illnesses, because young children who were sheltered from bugs during the early stages of the pandemic may now catch them when they are older. Some illnesses cause more serious symptoms if they are contracted when one is older.

"Whether we will see that kind of thing over such a short period of time I think is a big question mark," said Koopmans. "But I think it is certainly something that is worth really watching closely."

An accumulation of susceptible people isn't the only way the pandemic may have affected patterns of disease transmission, some experts believe.

David Heymann, who chairs an expert committee that advises the Health Emergencies Program at the World Health Organization, said the lifting of pandemic control measures could have helped fuel the spread of monkeypox in the current outbreak in Europe, North America, and beyond. Many of the monkeypox cases have been diagnosed in men who have sex with men.

After two years of limited travel, social distancing and public gatherings, people are throwing off the shackles of Covid control measures and embracing a return to pre-pandemic life. Media reports have suggested

recent raves in Spain and Belgium have led to transmission of the virus among some attendees.

Heymann, who is a professor of infectious disease epidemiology at the London School of Hygiene and Tropical Medicine, mused that the monkeypox outbreak could have been smoldering at low levels in the United Kingdom or somewhere else outside of Africa for quite a while, but may have only come to public attention when international travel picked up again.

"If you look at what's been happening in the world over the past few years, and if you look at what's happening now, you could easily wonder if this virus entered the U.K. two to three years ago, it was transmitting below the radar screen, [with] slow chains of transmission," said Heymann, who worked on smallpox eradication early in his career. "And then all of a sudden everything opened up and people began traveling and mixing."

While all this could make for an unsettling time over the next couple of years, things will eventually quiet down, Brodin predicted.

"I think once you've infected a number of people herd immunity ensues and the virus goes away," he said, referring to viruses in generally. "We haven't fundamentally changed the rules of infectious diseases."

Stat News, 25 May 2022

https://statnews.com

Cambridge Engineers Develop Zero Carbon Cement

2022-05-30

Engineers at Cambridge University claim to have invented the "world's first-ever zero-emissions cement" that they're calling Cambridge Electric Cement. The team—consisting of Dr. Cyrille Dunant, Dr. Pippa Horton, and Prof. Julian Allwood—is part of UK Fires, an organization we covered for its Absolute Zero report. While Vitruvius and Roman engineers that invented pozzolanic cement might argue about priority, Cambridge Electric Cement is a real accomplishment in the modern age.

The basic problem of cement starts with chemistry and the formula CaCO3 + heat > CaO + CO2; you cook calcium carbonate at 1,450 degrees Celsius (2,642 degrees Fahrenheit) with lots of fossil fuel and you get clinker and lots of carbon dioxide (CO_2). This is what the industry has called the "chemical fact of life." Clinker is ground into powder and mixed with other ingredients to get cement. Cement is then mixed with aggregate, mainly

This could totally rewrite the story of concrete and steel.

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

gravel and sand, to make concrete, which is reinforced with steel to make buildings and structures.

You can reduce the emissions from the cooking of calcium carbonate, but you can't do anything about the chemistry. This is the fundamental reason that we have called concrete the most destructive material on earth and recently complained about concrete icebergs.

The Cambridge Electric Cement changes the equation. According to the press release, Dunant noticed that "used" cement separated from recycled concrete was virtually identical to the lime flux that is used to remove impurities from steel in both electric arc and basic oxygen furnaces, and which floats on top of molten steel to protect it from oxidizing. It ends up as slag, usually considered a waste product but that is full of calcium oxide—a key ingredient in the clinker used to make cement. The Cambridge team ground up the slag into a powder and found that it "is virtually identical to the clinker which is the basis of new Portland cement."1

In the Cambridge process, you take apart that reinforced concrete building and send the reinforcing steel to an electric arc furnace for recycling. You separate the aggregate from the cement and use that cement to replace the lime flux in the electric arc furnace, resulting in "novel slag" which replaces the clinker in the Cambridge Electric Cement.

This is then put back together with the recycled aggregate to make new concrete and the recycled reinforcing bars to make a new building. You have basically recycled the old structure into a new one. If that electric furnace is powered by clean energy, then the entire process produces almost no direct carbon emissions. It is truly what they call "a virtuous recycling loop."

Allwood says, "If Cambridge Electric Cement lives up to the promise it has shown in early laboratory trials, it could be a turning point in the journey to a safe future climate. Combining steel and cement recycling in a single process powered by renewable electricity, this could secure the supply of the basic materials of construction to support the infrastructure of a zero emissions world and to enable economic development where it is most needed."1

This could change the emissions picture for both the concrete and steel industries. Making lime for the steel industry produces a lot of CO_2; as in making cement, it involves cooking limestone—calcium carbonate—and has the same issue of chemistry, driving off 900 kilograms of CO_2 for every

metric ton produced before you even account for the fossil fuels needed to heat it, which approximately doubles the footprint.2

According to the Multidisciplinary Digital Publishing Institute (MDPI), about 40% of lime produced goes to the steel industry, between 140 and 160 million metric tons per year. If the lime is replaced by the Cambridge process, that is a huge carbon saving right there, before you even get to the replacing of Portland cement in the concrete.

There is going to be a big problem of scale; there are probably not enough buildings being demolished and the steel industry doesn't generate nearly enough slag to replace more than a fraction of the conventional cement industry.

Allwood confirmed to Treehugger:

"Roughly speaking, you're right that total CEC [Cambridge Electric Cement] production would be much less than current cement demand, although CEC produces clinker which is then 'padded' out with gypsum and supplementary cementitious materials to form cement—so the volume of cement is greater than the volume of slag. However, the material efficiency strategies that have been the core of our work for the past 15 years suggest that we could build with much less cement than we use today."

Dr. Cyrille Dunant also told Treehugger: "although the volumes of steel are not going to change very much going forward, the amount of cement we need is: on the basis of current demand, the slow down in population growth implies we'll need only about 50-60 percent of today's needs. So in effect, blending, which doubles the amount of product, plus population which halves demand, plus material efficiency, which halves it again suggests CEC could cover all future cement needs in 2050 with a margin."

These are very good points. When you look at the concrete industry's road map to net-zero carbon, they note there could be significant savings through design and reductions in the use of cement.

The UK Fires group "aims to enable a rapid transition to zero emissions based on using today's technologies differently, rather than waiting for the new energy technologies of hydrogen and carbon storage," two technologies that the conventional concrete industry is looking at to reduce their carbon footprint, to get around the "chemical fact of life" that

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

is the manufacture of cement. Cambridge Electric Cement might well be an elegant way around the problem.

Treehugger, 30 May 2022

https://treehugger.com

Researchers introduce new energy storage concept to turn high-rise buildings into batteries

2022-05-30

With the rapid reduction in the costs of renewable energy generation, such as that of wind and solar power, there is a growing need for energy storage technologies to make sure that electricity supply and demand are balanced properly. International Institute for Applied Systems Analysis (IIASA) researchers have come up with a new energy storage concept that could turn tall buildings into batteries to improve the power quality in urban settings.

IIASA researchers propose a novel gravitational-based storage solution that uses lifts and empty apartments in tall buildings to store energy.

The world's capacity to generate electricity from solar panels, wind turbines, and other renewable technologies has been steadily increasing over the last few years, and global renewable electricity capacity is expected to rise still further by more than 60% from 2020 levels by 2026. This is equivalent to the current total global power capacity of fossil fuels and nuclear combined. According to the International Energy Agency, renewables are in fact set to account for almost 95% of the increase in global power capacity through 2026, with solar PV alone providing more than half. Transitioning to a low- or zero-carbon society, however, requires innovative solutions and a different way of storing and consuming energy than traditional energy systems.

In their study published in the journal Energy, IIASA researchers propose a novel gravitational-based storage solution that uses lifts and empty apartments in tall buildings to store energy. This original idea that the authors call Lift Energy Storage Technology (LEST) stores energy by lifting wet sand containers or other high-density materials, which are transported remotely in and out of a lift with autonomous trailer devices. LEST is an interesting option, because lifts are already installed in high-rise buildings, which means there is no need for additional investment or space occupancy, but rather using what is already there in a different way to create additional value for the power grid and the building owner.

"I have always been fascinated with topics involving potential energy; in other words, generating energy with changes in altitude, such as

hydropower, pumped-storage, buoyancy, and gravity energy storage. The concept of gravity energy storage has also recently received significant attention in the scientific community and start-ups. The concept of LEST came to me after having spent a considerable amount of time going up and down in a lift since recently moving into an apartment on the 14th floor," explains lead author Julian Hunt, a researcher in the IIASA Sustainable Service Systems Research Group.

According to the authors, the main challenge in making a gravity energy storage solution viable is the power capacity cost. The most important benefit of LEST is that the power capacity is already installed in lifts with regenerative braking systems. There are over 18 million lifts in operation globally, and many of these spend a significant amount of time sitting still. The idea is that when the lifts are not being used to transport people, they can be used to store or generate electricity.

As with any new system, there are still a few details that need to be further refined before the system can be deployed. This includes finding room to store the weights the system relies on at the top of the building when the system is fully charged, and at the bottom of the building when the system is discharged. Empty apartments or corridors could be viable options in this regard. Another consideration is the ceiling bearing capacity of existing buildings where the system is installed; that is, the total mass in kilograms per square meter that the ceiling can support without collapsing. Being able to store energy where electricity is mostly consumed, such as in cities, however, will greatly benefit the energy grid, and LEST can provide affordable and decentralized ancillary services, which could in turn improve the power quality in an urban setting.

"Environmentally friendly and flexible storage technologies like LEST are set to become more and more valuable to society in a future where a large share of its electricity comes from renewables. Therefore, policymakers and power system regulators need to adopt strategies to incentivize end users, in this case, high-rise buildings, to share their distributed storage resources, such as LEST, with the central grid. The coordinated utilization of such distributed resources alleviates the need for investment in large-scale central storage systems," concludes study coauthor Behnam Zakeri, a researcher in the IIASA Integrated Assessment and Climate Change Research Group.

Tech Xplore, 30 May 2022

https://techxplore.com

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

Transparency on demand: A novel process can render artificial materials transparent or even entirely invisible

2022-05-31

Space, the final frontier. The starship Enterprise pursues its mission to explore the galaxy, when all communication channels are suddenly cut off by an impenetrable nebula. In many episodes of the iconic TV series, the valiant crew must "tech the tech" and "science the science" within just 45 minutes of airtime in order to facilitate their escape from this or a similar predicament before the end credits roll. Despite spending a significantly longer time in their laboratories, a team of scientists from the University of Rostock has succeeded in developing an entirely new approach for the design of artificial materials that can transmit light signals without any distortions by means of precisely tuned flows of energy. They have published their results in Science Advances.

"When light spreads in an inhomogeneous medium, it undergoes scattering. This effect quickly transforms a compact, directed beam into a diffuse glow, and is familiar to all of us from summer clouds and autumn fog alike," Professor Alexander Szameit of the Institute for Physics at the University of Rostock describes the starting point of his team's considerations. Notably, it is the microscopic density distribution of a material that dictates the specifics of scattering. Szameit continues, "The fundamental idea of induced transparency is to take advantage of a much lesser-known optical property to clear a path for the beam, so to speak."

This second property, known in the field of photonics under the arcane title of non-Hermiticity, describes the flow of energy, or, more precisely, the amplification and attenuation of light. Intuitively, the associated effects may seem undesirable—particularly the fading of a light beam due to absorption would seem highly counterproductive to the task of improving signal transmission. Nevertheless, non-Hermitian effects have become a key aspect of modern optics, and an entire field of research strives to harness the sophisticated interplay of losses and amplification for advanced functionalities.

"This approach opens up entirely new possibilities," reports doctoral student Andrea Steinfurth, first author of the paper. In regard to a beam of light, it becomes possible to selectively amplify or dampen specific parts of a beam at the microscopic level to counteract any onset of degradation. To stay in the picture of the nebula, its light-scattering properties could be completely suppressed. "We are actively modifying a material to tailor it for the best possible transmission of a specific light signal," Steinfurth explains.

[Scientists have] succeeded in developing an entirely new approach for the design of artificial materials that can transmit light signals without any distortions by means of precisely tuned flows of energy.

"To this end, the energy flow must be precisely controlled, so it can fit together with the material and the signal like pieces of a puzzle." In close collaboration with partners from the Vienna University of Technology, the researchers in Rostock successfully tackled this challenge. In their experiments, they were able to recreate and observe the microscopic interactions of light signals with their newly developed active materials in networks of kilometer-long optical fibers.

In fact, induced transparency is just one of the fascinating possibilities that arise from these findings. If an object is truly to be made to vanish, the prevention of scattering is not enough. Instead, light waves must emerge behind it completely undisturbed. Yet, even in the vacuum of space, diffraction alone ensures that any signal will inevitably change its shape. "Our research provides the recipe for structuring a material in such a way that light beams pass as if neither the material, nor the very region of space it occupies, existed. Not even the fictitious cloaking devices of the Romulans can do that," says co-author Dr. Matthias Heinrich, circling back to the final frontier of Star Trek.

The findings presented in this work represent a breakthrough in fundamental research on non-Hermitian photonics and provide new approaches for the active fine-tuning of sensitive optical systems, for example, sensors for medical use. Other potential applications include optical encryption and secure data transmission, as well as the synthesis of versatile artificial materials with tailored properties.

Phys Org, 31 May 2022

https://phys.org

Big tobacco's environmental impact is 'devastating': WHO

2022-05-31

The tobacco industry is a far greater threat than many realise as it is one of the world's biggest polluters, from leaving mountains of waste to driving global warming, the WHO said Tuesday.

The World Health Organization accused the industry of causing widespread deforestation, diverting badly needed land and water in poor countries away from food production, spewing out plastic and chemical waste as well as emitting millions of tonnes of carbon dioxide.

"Tobacco is not only poisoning people, it's poisoning our planet."

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

In its report released on World No Tobacco Day, the UN agency called for the tobacco industry to be held to account and foot the bill for the cleanup.

The report, "Tobacco: poisoning our planet", looks at the impacts of the whole cycle, from the growth of plants to the manufacturing of tobacco products, to consumption and waste.

While tobacco's health impacts have been well documented for decades—with smoking still causing more than eight million deaths worldwide every year—the report focuses on its broader environmental consequences.

The findings are "quite devastating," Ruediger Krech, WHO director of health promotion, told AFP, charging that the industry is "one of the biggest polluters that we know of."

Poison

He slammed tobacco companies' frequent efforts to rehabilitate their image through beach cleanups and funding environmental and disaster relief organisations as "greenwashing".

"The tobacco industry dumps toxic waste into communities and depletes natural resources," he told a press conference.

"Tobacco is not only poisoning people, it's poisoning our planet."

The industry is responsible for the loss of some 600 million trees each year—or five percent of global deforestation—while tobacco growing and production uses 200,000 hectares of land and 22 billion tonnes of water annually, the report found.

It also emits around 84 million tonnes of carbon dioxide, it said.

In addition, "tobacco products are the most littered item on the planet, containing over 7,000 toxic chemicals, which leech into our environment when discarded," Krech said.

4.5 trillion cigarette butts

He pointed out that each one of the estimated 4.5 trillion cigarette butts that end up in the oceans, rivers, sidewalks and beaches every year can pollute 100 litres of water.

And up to a quarter of all tobacco farmers contract so-called green tobacco sickness, or poisoning from the nicotine they absorb through the skin.

Farmers who handle tobacco leaves all day consume the equivalent of 50 cigarettes worth of nicotine a day, Krech said.

This is especially worrying for the many children involved in tobacco farming.

"Just imagine a 12-year-old being exposed to 50 cigarettes a day," he said.

Most tobacco is grown in poorer countries, where water and farmland are often in short supply, and where such crops are often grown at the expense of vital food production, the report said.

UN agencies have launched a project to try to help farmers transition to other crops.

Plastic pollution

At the same time the processing and transportation of tobacco account for a significant share of global greenhouse gas emissions—with the equivalent of one-fifth of the global airline industry's carbon footprint.

In addition, products like cigarettes, smokeless tobacco and e-cigarettes also contribute significantly to the global build-up of plastic pollution, WHO warned.

Cigarette filters contain microplastics—the tiny fragments that have been detected in every ocean and even at the bottom of the world's deepest trench—and make up the second-highest form of plastic pollution worldwide, the report said.

Stressing that there is no evidence filters provide any proven health benefits over smoking non-filtered cigarettes, the UN agency urged policy makers worldwide to consider banning them.

The WHO also called for governments to immediately halt the some $500 billion in subsidies the tobacco industry receives each year, and also urged them to stop allowing taxpayers to foot the bill for cleaning up the industry's mess.

Each year, China for instance dishes out around $2.6 billion and India around $766 million, while Brazil and Germany pay some $200 million each to clean up littered tobacco products, the report found.

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

It is important, Krech said, that "the industry pay actually for the mess that they are creating."

Phys Org, 31 May 2022

https://phys.org

Direct sound printing is a potential game-changer in 3D printing, according to researchers

2022-05-31

Most 3D printing methods currently in use rely either on photo (light)- or thermo (heat)-activated reactions to achieve precise manipulation of polymers. The development of a new platform technology called direct sound printing (DSP), which uses soundwaves to produce new objects, may offer a third option.

The process is described in a paper published in Nature Communications. It shows how focused ultrasound waves can be used to create sonochemical reactions in minuscule cavitation regions—essentially tiny bubbles. Extremes of temperature and pressure lasting trillionths of a second can generate pre-designed complex geometries that cannot be made with existing techniques.

"Ultrasonic frequencies are already being used in destructive procedures like laser ablation of tissues and tumors. We wanted to use them to create something," says Muthukumaran Packirisamy, a professor and Concordia Research Chair in the Department of Mechanical, Industrial and Aerospace Engineering at the Gina Cody School of Engineering and Computer Science. He is the paper's corresponding author.

Mohsen Habibi, a research associate at Concordia's Optical-Bio Microsystems Lab, is the paper's lead author. His lab colleague and Ph.D. student Shervin Foroughi and former master's student Vahid Karamzadeh are co-authors.

Ultraprecise reactions

As the researchers explain, DSP relies on chemical reactions created by fluctuating pressure inside tiny bubbles suspended in a liquid polymer solution.

"We found that if we use a certain type of ultrasound with a certain frequency and power, we can create very local, very focused chemically reactive regions," Habibi says. "Basically, the bubbles can be used as

"Ultrasonic frequencies are already being used in destructive procedures like laser ablation of tissues and tumors. We wanted to use them to create something."

reactors to drive chemical reactions to transform liquid resin into solids or semi-solids."

The reactions caused by ultrasound-wave-directed oscillation inside the micro-sized bubbles are intense, though they only last picoseconds. The temperature inside the cavity shoots up to around 15,000 Kelvin and pressure exceeds 1,000 bar (the Earth's surface pressure at sea level is around one bar). The reaction time is so brief the surrounding material is not affected.

The researchers experimented on a polymer used in additive manufacturing called polydimethylsiloxane (PDMS). They used a transducer to generate an ultrasonic field that passes through the build material's shell and solidifies the targeted liquid resin and deposits it onto a platform or another previously solidified object. The transducer moves along a predetermined path, eventually creating the desired product pixel by pixel. The microstructure's parameters can be manipulated by adjusting the duration of the ultrasound wave's frequency and the viscosity of the material being used.

Versatile and specific

The authors believe that DSP's versatility will benefit industries that rely on highly specific and delicate equipment. The polymer PDMS, for instance, is widely used in the microfluidics industry, where manufacturers require controlled environments (cleanrooms) and sophisticated lithographic technique to create medical devices and biosensors.

Aerospace engineering and repair can also benefit from DSP, as ultrasound waves penetrate opaque surfaces like metallic shells. This can allow maintenance crews to service parts located deep within an aircraft's fuselage that would be inaccessible to printing techniques reliant on photoactivated reactions. DSP could even have medical applications for remote in-body printing for humans and other animals.

"We proved that we can print multiple materials, including polymers and ceramics," Packirisamy says. "We are going to try polymer-metal composites next, and eventually we want to get to printing metal using this method."

Tech Xplore, 31 May 2022

https://techxplore.com

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

Long-banned toxic chemicals remain a global threat

2022-06-01

A new analysis by researchers at Masaryk University, the University of Toronto, and NRDC (Natural Resources Defense Council) has found most countries are not on track to remove their stocks of highly hazardous polychlorinated biphenyls (PCBs) by the 2028 deadline set forth in the Stockholm Convention, the global chemicals management treaty. The report found more than 10 million tons of PCB-containing materials remain and pose public health and environmental threats globally.

Additional findings from the report "Persistent Problem: Global Challenges to Managing PCBs," published in the journal Environmental Science & Technology, include:

- 42% of signatories to the Stockholm Convention are unaware of the amounts and locations of PCB stocks in their country.
- Only 30% of signatories to the Stockholm Convention are on track to meet the target of environmentally sound management of all PCBs by 2028.
- A lack of administrative, financial, and political capacities are key impediments to successfully managing PCB stocks, especially in low-income countries, despite these countries not being responsible for most PCB production or use.
- The U.S., the world's largest producer and user of PCBs, was found to have decreased its sizable stocks by only about 3% since 2006. Despite having the financial capacity to responsibly eliminate PCBs, the U.S. has no regulatory deadlines to do so, is not a party to the Stockholm Convention, and its PCB inventory is poorly documented compared to Canada and Czechia.
- The inability of global agreements like the Stockholm Convention to effectively manage PCBs bodes poorly for the management of other toxic chemicals that are found in myriad products, like the highly persistent PFAS (per-and poly fluoroalkyl substances) and chlorinated paraffin chemicals.

PCBs are persistent organic pollutants and carcinogens and were widely used for their insulating and flame retardant properties. PCBs were banned in the late 1970s by many countries, including the U.S. and Canada, but the chemicals are still present in transformers, capacitors, and building materials in many countries.

The report found more than 10 million tons of PCB-containing materials remain and pose public health and environmental threats globally.

"We're only six years out from the Stockholm Convention's deadline to responsibly eliminate PCB stocks, but shockingly little progress has been made," says Lisa Melymuk, assistant professor of environmental chemistry, Masaryk University.

"With effective regulations and good governance, Canada has successfully managed and destroyed its PCB stocks. However, evidence suggests that Canada has not applied this 'lesson learned' for PCBs to other highly hazardous chemicals," says Miriam Diamond, professor, Department of Earth Sciences and School of the Environment, University of Toronto.

"Global mismanagement and inequities make elimination of these persistent chemicals unlikely. This analysis is an international wake-up call to limit the production of hazardous chemicals, like PCBs. We just can't clean up the mess that they create," says Veena Singla, senior scientist, NRDC.

Phys Org, 1 June 2022

https://phys.org

Honeybee venom cures breast cancer, research finds

2022-06-02

The cancer community is buzzing over a new study that says venom from bees can kill cancer cells.

Scientists at the Harry Perkins Institute of Medical Research in Western Australia tested venom from more than 300 honeybees and bumblebees against two types of aggressive, hard to treat breast cancer: triple negative and human epidermal growth factor receptor 2 (HER2) enriched. They found that a compound in the venom called melittin could destroy breast cancer cells within an hour, without causing harm to other cells. They also found that when used in conjunction with chemotherapy drugs, the melittin helped formed pores in the cancer cell membrane which could potentially allow therapies to better penetrate the cells.

While the tests for this study were only done in a lab setting, the researchers believe the compound can be synthetically reproduced as a treatment for breast cancer.

Dr. Marilena Tauro, a breast cancer researcher at Moffitt Cancer Center, says while the discovery is impressive, more research would need to be done before it could become a viable therapy. "The good news is this study has shown that melittin can disrupt signaling pathways in breast cancer

A compound in the venom called melittin could destroy breast cancer cells within an hour.

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

cells that are responsible for growth and spread of the disease," she said. "However, there have been many studies where compounds have proved successful at killing cancer cells in the lab or animal models, but it has taken many years for those discoveries make it to patients, if at all."

Tauro added that approximately half of all current drugs are derived from natural products, which demonstrates the potential of using bee venom for drug discovery.

"Nature is a great supplier of active elements and chemical synthesis has made it possible to provide many drugs of natural origin in the dosage required for therapeutic use, despite the often very limited supply from their original sources," she said.

The Brighter Side of News, 2 June 2022

https://www.thebrighterside.news

Artificial skin gives robots sense of touch and beyond

2022-06-02

We tend to take our sense of touch for granted in everyday settings, but it is vital for our ability to interact with our surroundings. Imagine reaching into the fridge to grab an egg for breakfast. As your fingers touch its shell, you can tell the egg is cold, that its shell is smooth, and how firmly you need to grip it to avoid crushing it. These are abilities that robots, even those directly controlled by humans, can struggle with.

A new artificial skin developed at Caltech can now give robots the ability to sense temperature, pressure, and even toxic chemicals through a simple touch.

This new skin technology is part of a robotic platform that integrates the artificial skin with a robotic arm and sensors that attach to human skin. A machine-learning system that interfaces the two allows the human user to control the robot with their own movements while receiving feedback through their own skin. The multimodal robotic-sensing platform, dubbed M-Bot, was developed in the lab of Wei Gao, Caltech's assistant professor of medical engineering, investigator with Heritage Medical Research Institute, and Ronald and JoAnne Willens Scholar. It aims to give humans more precise control over robots while also protecting the humans from potential hazards.

"Modern robots are playing a more and more important role in security, farming, and manufacturing," Gao says. "Can we give these robots a sense

A new artificial skin developed at Caltech can now give robots the ability to sense temperature, pressure, and even toxic chemicals through a simple touch.

of touch and a sense of temperature? Can we also make them sense chemicals like explosives and nerve agents or biohazards like infectious bacteria and viruses? We're working on this."

The skin

A side-by-side comparison of a human hand and a robotic hand reveals glaring differences. Whereas human fingers are soft, squishy, and fleshy, robotic fingers tend be hard, metallic, plasticky, or rubbery. The printable skin developed in Gao's lab is a gelatinous hydrogel and makes robot fingertips a lot more like our own.

Embedded within that hydrogel are the sensors that give the artificial skin its ability to detect the world around it. These sensors are literally printed onto the skin in the same way that an inkjet printer applies text to a sheet of paper.

"Inkjet printing has this cartridge that ejects droplets, and those droplets are an ink solution, but they could be a solution that we develop instead of regular ink," Gao says. "We've developed a variety of inks of nanomaterials for ourselves."

After printing a scaffolding of silver nanoparticle wires, the researchers can then print layers of micrometer-scale sensors that can be designed to detect a variety of things. The fact that the sensors are printed makes it quicker and easier for the lab to design and try out new kinds of sensors.

"When we want to detect one given compound, we make sure the sensor has a high electrochemical response to that compound," Gao says. "Graphene impregnated with platinum detects the explosive TNT very quickly and selectively. For a virus, we are printing carbon nanotubes, which have very high surface area, and attaching antibodies for the virus to them. This is all mass producible and scalable."

An interactive system

Gao's team has coupled this skin to an interactive system that allows a human user to control the robot through their own muscle movements while also receiving feedback to the user's own skin from the skin of the robot.

This part of the system makes use of additional printed parts—in this case, electrodes fastened to the human operator's forearm. The electrodes are similar to those that are used to measure brain waves, but they are instead positioned to sense the electrical signals generated by the

CHEMWATCH
Bulletin Board
Gossip
JUN. 10, 2022

operator's muscles as they move their hand and wrist. A simple flick of the human wrist tells the robotic arm to move up or down, and a clenching or splaying of the human fingers prompts a similar action by the robotic hand.

"We used machine learning to convert those signals into gestures for robotic control," Gao says. "We trained the model on six different gestures."

The system also provides feedback to the human skin in the form of a very mild electrical stimulation. Bringing back the example of picking up an egg, if the operator were to grip the egg too tightly with the robotic hand and was in danger of crushing its shell, the system would alert the operator through what Gao describes as "a little tingle" to the operator's skin.

Gao hopes the system will find applications in everything from agriculture to security to environmental protection, allowing the operators of robots to "feel" how much pesticide is being applied to a field of crops, whether a suspicious backpack left in an airport has traces of explosives on it, or the location of a pollution source in a river. First though, he wants to make some improvements.

"I think we have shown a proof of concept," he says. "But we want to improve the stability of this robotic skin to make it last longer. By optimizing new inks and new materials, we hope this can be used for different kinds of targeted detections. We want to put it on more powerful robots and make them smarter, more intelligent."

The paper describing the research, titled "All-printed soft human-machine interface for robotic physicochemical sensing," appears in the June 1 issue of Science Robotics.

Tech Xplore, 2 June 2022

https://techxplore.com

The amazing benefits from three seconds of weightlifting a day

2022-05-03

Lifting weights for as little as three seconds a day can have a positive impact on muscle strength, a new study from Edith Cowan University (ECU) has discovered.

A collaboration with researchers from Niigata University of Health and Welfare (NUHW) in Japan had 39 healthy university students perform one muscle contraction at maximum effort for three seconds per day, for five days a week over four weeks.

The participants performed either an isometric, concentric or eccentric bicep curl (see definitions below) at maximum effort, while researchers measured the muscles' maximum voluntary contraction strength before and after the four-week period.

Another 13 students performed no exercise over the same period and were also measured before and after the four weeks.

Muscle strength increased more than 10 per cent for the group who performed the eccentric bicep curl after the four weeks, but less increase in muscle strength was found for the other two exercise groups.

The no exercise group saw no increase.

Lead researcher Professor Ken Nosaka from ECU's School of Medical and Health Sciences said the results showed people didn't need to spend vast amounts of time exercising to improve their muscle strength.

"The study results suggest that a very small amount of exercise stimulus – even 60 seconds in four weeks – can increase muscle strength," he said.

"Many people think you have to spend a lot of time exercising, but it's not the case. Short, good quality exercise can still be good for your body and every muscle contraction counts."

Isometric vs concentric vs eccentric

These three classifications relate to what the muscle is doing when being activated.

An isometric contraction is when the muscle is stationary under load, concentric is when the muscle is shortening and eccentric when the muscle is lengthening.

"We haven't investigated other muscles yet, but if we find the three-second rule also applies to other muscles then you might be able to do a whole-body exercise in less than 30 seconds."

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

For a bicep curl, a dumbbell held with an arm by one's side, before lifting the weight upwards towards the chest and then lowering it back down via the elbow.

Lifting the weight sees the bicep in concentric contraction, lowering the weight sees it in eccentric contraction, while holding the weight parallel to the ground is isometric.

So... which is best?

The study shows all three lifting methods had some benefit to muscle strength, however eccentric contraction easily produced the best results.

Researchers measured each group's concentric, isometric and eccentric strength.

The concentric lifting group improved slightly (6.3 per cent) in isometric strength but saw no improvement elsewhere, while the isometric group only saw an increase in eccentric strength (7.2 per cent).

However, the eccentric group saw significant improvements in strength across all three measurements: concentric increased 12.8 per cent, isometric 10.2 per cent and eccentric 12.2 per cent.

The eccentric group's overall muscle strength improved 11.5 per cent after 60 seconds of effort in total.

"Although the mechanisms underpinning eccentric contraction's potent effects are not clear yet, the fact only a three-second maximal eccentric contraction a day improves muscle strength in a relatively short period is important for health and fitness," Professor Nosaka said.

Time-poor no more

Professor Nosaka said the findings were exciting for promoting physical fitness and health, such as prevention of sarcopenia – a decrease in muscle mass and strength with aging.

"We haven't investigated other muscles yet, but if we find the three-second rule also applies to other muscles then you might be able to do a whole-body exercise in less than 30 seconds," he said.

"Also, performing only one maximal contraction per day means you don't get sore afterwards."

Professor Nosaka and NUHW's Dr Masatoshi Nakamura designed the study and the data were collected by Dr Nakamura and his PhD and Masters students.

'Effect of daily 3-s maximum voluntary isometric, concentric or eccentric contraction on elbow flexor strength' was published in the Scandinavian Journal of Medicine and Science in Sports.

The Brighter Side of News, 3 May 2022

https://thebrighterside.news

When a machine invents things for humanity, who gets the patent?

2022-05-27

The day is coming—some say has already arrived—when artificial intelligence starts to invent things that its human creators could not. But our laws are lagging behind this technology, UNSW experts say.

It's not surprising these days to see new inventions that either incorporate or have benefitted from artificial intelligence (AI) in some way, but what about inventions dreamt up by AI—do we award a patent to a machine?

This is the quandary facing lawmakers around the world with a live test case in the works that its supporters say is the first true example of an AI system named as the sole inventor.

In commentary published in the journal Nature, two leading academics from UNSW Sydney examine the implications of patents being awarded to an AI entity.

Intellectual Property (IP) law specialist Associate Professor Alexandra George and AI expert, Laureate Fellow and Scientia Professor Toby Walsh argue that patent law as it stands is inadequate to deal with such cases and requires legislators to amend laws around IP and patents—laws that have been operating under the same assumptions for hundreds of years.

The case in question revolves around a machine called DABUS (Device for the Autonomous Bootstrapping of Unified Sentience) created by Dr. Stephen Thaler, who is president and chief executive of US-based AI firm Imagination Engines. Dr. Thaler has named DABUS as the inventor of two products—a food container with a fractal surface that helps with insulation and stacking, and a flashing light for attracting attention in emergencies.

The day is coming—some say has already arrived—when artificial intelligence starts to invent things that its human creators could not. But our laws are lagging behind this technology, UNSW experts say.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

For a short time in Australia, DABUS looked like it might be recognized as the inventor because, in late July 2021, a trial judge accepted Dr. Thaler's appeal against IP Australia's rejection of the patent application five months earlier. But after the Commissioner of Patents appealed the decision to the Full Court of the Federal Court of Australia, the five-judge panel upheld the appeal, agreeing with the Commissioner that an AI system couldn't be named the inventor.

A/Prof. George says the attempt to have DABUS awarded a patent for the two inventions instantly creates challenges for existing laws which has only ever considered humans or entities comprised of humans as inventors and patent-holders.

"Even if we do accept that an AI system is the true inventor, the first big problem is ownership. How do you work out who the owner is? An owner needs to be a legal person, and an AI is not recognized as a legal person," she says.

Ownership is crucial to IP law. Without it there would be little incentive for others to invest in the new inventions to make them a reality.

"Another problem with ownership when it comes to AI-conceived inventions, is even if you could transfer ownership from the AI inventor to a person: is it the original software writer of the AI? Is it a person who has bought the AI and trained it for their own purposes? Or is it the people whose copyrighted material has been fed into the AI to give it all that information?" asks A/Prof. George.

For obvious reasons

Prof. Walsh says what makes AI systems so different to humans is their capacity to learn and store so much more information than an expert ever could. One of the requirements of inventions and patents is that the product or idea is novel, not obvious and is useful.

"There are certain assumptions built into the law that an invention should not be obvious to a knowledgeable person in the field," Prof. Walsh says.

"Well, what might be obvious to an AI won't be obvious to a human because AI might have ingested all the human knowledge on this topic, way more than a human could, so the nature of what is obvious changes."

Prof. Walsh says this isn't the first time that AI has been instrumental in coming up with new inventions. In the area of drug development, a new antibiotic was created in 2019—Halicin—that used deep learning to find

a chemical compound that was effective against drug-resistant strains of bacteria.

"Halicin was originally meant to treat diabetes, but its effectiveness as an antibiotic was only discovered by AI that was directed to examine a vast catalog of drugs that could be repurposed as antibiotics. So there's a mixture of human and machine coming into this discovery."

Prof. Walsh says in the case of DABUS, it's not entirely clear whether the system is truly responsible for the inventions, since Dr. Thaler had provided it with parameters to work within.

"There's lots of involvement of Dr. Thaler in these inventions, first in setting up the problem, then guiding the search for the solution to the problem, and then interpreting the result," Prof. Walsh says.

"But it's certainly the case that without the system, you wouldn't have come up with the inventions."

Change the laws

Either way, both authors argue that governing bodies around the world will need to modernize the legal structures that determine whether or not AI systems can be awarded IP protection. They recommend the introduction of a new "sui generis" form of IP law—which they've dubbed "AI-IP"—that would be specifically tailored to the circumstances of AI-generated inventiveness. This, they argue, would be more effective than trying to retrofit and shoehorn AI-inventiveness into existing patent laws.

Looking forward, after examining the legal questions around AI and patent law, the authors are currently working on answering the technical question of how AI is going to be inventing in the future.

Dr. Thaler has sought "special leave to appeal" the case concerning DABUS to the High Court of Australia. It remains to be seen whether the High Court will agree to hear it. Meanwhile, the case continues to be fought in multiple other jurisdictions around the world.

Tech Xplore, 27 May 2022

https://techxplore.com

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

World's fastest carbon capture system claims 99% efficiency in ambient air

2022-05-29

As carbon dioxide builds up in the atmosphere, it won't be enough to simply curb our emissions – we'll need to actively remove some of what we've already released. In a new advance, researchers from Tokyo Metropolitan University have developed a new compound that can reportedly remove carbon dioxide from ambient air with 99 percent efficiency and at least twice as fast as existing systems.

Direct air capture (DAC) technologies usually remove carbon dioxide by piping air or exhaust through some kind of filter or catalyst, including magnetic sponges, zeolite foam or materials made of clay or coffee grounds. Others bubble the air through a liquid, which can either absorb the CO2 or cause it to separate out into solid crystals or flakes.

Researchers have developed a new carbon capture system that they claim is the world's fastest, and has an efficiency of 99 percent

The new compound falls into that last category, which are known as liquid-solid phase separation systems. While studying a series of liquid amine compounds, the Tokyo Metro team discovered one, called isophorone diamine (IPDA), was particularly effective at capturing carbon dioxide.

In tests, the team found that IPDA was able to remove more than 99 percent of CO2 from air with a concentration of 400 parts per million (ppm) – about the level currently in the atmosphere. This process also happened much faster than other carbon capture techniques, removing 201 millimoles of CO2 per hour, per mole of the compound. That's at least twice as fast as other DAC lab systems, and far faster than the leading artificial leaf device.

The pollutant separated out into flakes of a solid carbamic acid material, which could be removed from the liquid relatively easily. If need be, it can be converted back into gaseous CO2 by heating it to 60 °C (140 °F), which also releases the original liquid IPDA ready for reuse. Whether the carbon is kept as a solid or a gas, it can then be stored or reused in industrial or chemical processes.

The new system shows promise but, of course, there's always the question of scale. Humanity belches about 30 billion tons of carbon dioxide into the atmosphere every year, and the world's largest direct air capture plant currently removes about 4,000 tons a year. It feels a little like bailing water out of a sinking ship with a shot glass.

But still, every glass helps, and the more technologies we have at our disposal for this huge job, the better. And there's reason for optimism too, as the US Department of Energy has recently announced US$3.5 billion in funding for DAC hubs. Hopefully this kind of attention will encourage some of the more out-there experiments, like using high-altitude balloons or big ponds of algae.

The researchers on the new study are now working on improving the system and investigating how the captured carbon could best be used.

The research was published in the journal ACS Environmental Au.

New Atlas, 29 May 2022

https://newatlas.com

Who may benefit from climate change? Rattlesnakes, study suggests

2022-05-30

Animals around the world have been feeling the negative effects of climate change, but there's one slithering creature that may be benefiting from it: rattlesnakes.

Rattlesnakes can be found in every state in the continental U.S., according to Lewis and Clark Trail Heritage Foundation, but they are commonly found in the southwest. One of the most widely known snakes in the world, rattlesnakes are relatively reserved reptiles that avoid human confrontation, but when threatened, they often will curl into striking position and begin to rattle their signature tail before they give a venomous bite.

A new study published in the journal Ecology and Evolution earlier this month suggests rattlesnakes could spend less time hibernating and more time being out in the wilderness as the planet warms.

The reasoning has to do with rattlesnakes being cold-blooded animals. Hayley Crowell, doctoral student at the University of Michigan and lead author of the study, and her team examined the Pacific rattlesnake because it can be found in desert regions like Southern California and colder climates like Washington state.

Researchers observed the snakes' preferred body temperatures of around 86-89 degrees Fahrenheit, much warmer than those found in nature.

If temperatures continue to warm, Crowell said that could mean hibernation ends earlier in the spring for rattlesnakes, and they could still be active late in the fall heading into winter.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

Also, ones taken from hotter climates appeared much larger than those in colder conditions.

"They're existing in temperatures cooler than what they would want to be at in a perfect world," Crowell told U.S. TODAY. "If there's a couple degree increase in climate, these snakes, from a physiology standpoint, might be happier because it's closer to their preferred body temperature."

If temperatures continue to warm, Crowell said that could mean hibernation ends earlier in the spring for rattlesnakes, and they could still be active late in the fall heading into winter.

"Basically just more time to grow and do rattlesnake things," she said.

Even if rattlesnakes do benefit from warmer temperatures, they still have some negative effects from it; there's projected to be less prey like squirrel and lizards, and snakes could be victim of increased wildfires and the low availability to water.

Yet, rattlesnakes do have a way of countering eating less, as Crowell's team also noted they have lower metabolisms than their counterparts, and could be content with eating only a dozen times a year.

"They just do not need a lot of food at all to survive," she said. "A rattlesnake can totally survive just on one or two big ground squirrels a year if it needed to."

Even without eating much, humans still remain a victim of rattlesnakes and other venomous snake bites.

The Centers for Disease Control and Prevention says 7,000 to 8,000 people are bitten by venomous snakes each year, with an average of five deaths in that timespan. But getting bit by a rattlesnake could leave a lasting mark, with 10%-to-44% of people bit by rattlers having last injuries, such as losing the ability to use extremities or having a disability.

Luckily, Crowell said not to panic; more rattlesnake activity won't mean "a giant boom of millions of more rattlesnakes." Instead, they might just be noticed more often and won't drastically increase the annual number of bites.

Phys Org, 30 May 2022

https://phys.org

Did NASA find Hell? Scientists brace for first glimpse of world that constantly burns

2022-06-01

Mankind's first look at conditions on a "super-Earth" 50 light years away is expected in coming weeks via the James Webb Space Telescope, and NASA is bracing to see the stuff of nightmares.

The planet, called 55 Cancri e, orbits so close to "its Sun-like star" that surface conditions could literally be like the Hell of biblical description: a dimension in a constant state of burning.

Data show 55 Cancri e is less than 1.5 million miles from its star—1/25 the distance super hot Mercury is from our sun, NASA says.

"With surface temperatures far above the melting point of typical rock-forming minerals, the day side of the planet is thought to be covered in oceans of lava," NASA reported last week.

"Imagine if Earth were much, much closer to the Sun. So close that an entire year lasts only a few hours. So close that gravity has locked one hemisphere in permanent searing daylight and the other in endless darkness. So close that the oceans boil away, rocks begin to melt, and the clouds rain lava."

Nothing like it exists in our solar system, NASA says.

Among the things the scientists hope to discover is if the planet is "tidally locked, with one side facing the star at all times" or if it rotates in a manner that would create day and night.

Initial views from NASA's less powerful Spitzer Space Telescope show something mysterious is happening on 55 Cancri e, because the hottest spot is not the part directly facing its star.

One theory is that the planet has "a dynamic atmosphere that moves heat around," NASA says.

Another idea is that 55 Cancri e rotates to create day and night, but with nightmarish results.

"In this scenario, the surface would heat up, melt, and even vaporize during the day, forming a very thin atmosphere that Webb could detect," NASA says.

The planet, called 55 Cancri e, orbits so close to "its Sun-like star" that surface conditions could literally be like the Hell of biblical description: a dimension in a constant state of burning.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

"In the evening, the vapor would cool and condense to form droplets of lava that would rain back to the surface, turning solid again as night falls."

The James Webb Space Telescope is expected to be fully operational in "just weeks" and its first observations are expected through the summer, NASA says.

The telescope is capable of detecting the presence of an atmosphere, scientists say.

Its first year will be devoted to studying 55 Cancri e and the airless planet LHS 3844 b, to try and understand "the evolution of rocky planets like Earth," NASA says.

Phys Org, 1 June 2022

https://phys.org

Electrochemical synthesis now possible without electric power source

2022-05-31

Synthesis of organic compounds and polymers is at the core of many manufacturing industries. The new "electrifying synthesis" methods that can combine conventional synthetic chemistry with electrochemistry are a step closer to a sustainable tomorrow. These reactions don't require potentially harmful chemical reagents. They achieve organic synthesis by simply using electrons from an electric power source to conduct redox reactions.

Apart from being environmentally-friendly, these reactions can also be made more or less selective by fine-tuning the electric potentials. However, their dependence on a power supply limits their application in unpowered locations such as aerospace and the deep sea.

The solution to this self-contradictory problem was presented by a team of researchers led by Prof. Shinsuke Inagi from the Tokyo Institute of Technology (Tokyo Tech), Japan. In their recent study published in Communications Chemistry, the team provided a proof-of-concept for electrochemical polymerization of organic aromatic monomers without an external power supply. Prof. Inagi explains, "We have seen a huge leap in the development of electrochemical reactors for carrying out organic synthesis, but most of them require a power source. We wanted to build a power-independent system to make the process more accessible.

The new "electrifying synthesis" methods that can combine conventional synthetic chemistry with electrochemistry are a step closer to a sustainable tomorrow.

And we found the answer to our quest in streaming potential-driven electrochemistry."

What exactly is this streaming potential that Prof. Inagi mentions?

When an electrolyte flows through a microchannel, a pressure difference is created due to this movement. This leads to a charge imbalance, which gives rise to a streaming potential. The team used a custom two-chambered polyether ether ketone (or PEEK) cell connected by platinum wires and a PEEK microtube for their experiments. This PEEK microtube was tightly filled with cotton wool to create a pressure drop. When they passed an electrolyte through the microtube, it generated a streaming potential that could provide enough energy for driving the desired chemical reactions.

When the cell was operated, the electrodes in the two-chambered cell experienced both upstream and downstream streaming potential, which enabled the cell to behave like something called a split bipolar electrode (BPE). This BPE setup, accompanied by the generated streaming potential of 2-3 volts was responsible for creating conditions conducive for the redox reactions of organic monomers.

To test the polymerization abilities of this setup, the team chose two aromatic organic compounds: Pyrrole (Py) and 3,4-Ethylenedioxythiophene (EDOT). Both these monomers were successfully electropolymerized into polypyrrole (PPy) and poly-EDOT (PEDOT) respectively, without using any external power source.

This new pressure-driven, environmentally-friendly, power supply-independent reactor opens up new avenues for electrifying synthesis reactions. The insights from this study can also prove valuable when designing new electrochemical reactors for the synthesis of useful organic compounds and polymers. "The entire world is trying to make essential industrial processes greener and cleaner. Since organic synthesis is at the heart of many chemical industries, we tried to develop an electrosynthesis process that requires minimum resources and contributes towards the sustainable development goals," concludes Prof. Inagi.

Phys Org, 31 May 2022

https://phys.org

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

Alzheimer's disease causes cells to overheat and 'fry like eggs'

2022-05-31

Researchers have shown that aggregation of amyloid-beta, one of two key proteins implicated in Alzheimer's disease, causes cells to overheat and "fry like eggs."

The researchers from the University of Cambridge used sensors small and sensitive enough to detect temperature changes inside individual cells, and found that as amyloid-beta misfolds and clumps together, it causes cells to overheat.

In an experiment using human cell lines, the researchers found the heat released by amyloid-beta aggregation could potentially cause other, healthy amyloid-beta to aggregate, causing more and more aggregates to form.

In the same series of experiments, the researchers also showed that amyloid-beta aggregation can be stopped, and the cell temperature lowered, with the addition of a drug compound. The experiments also suggest that the compound has potential as a therapeutic for Alzheimer's disease, although extensive tests and clinical trials would first be required.

The researchers say their assay could be used as a diagnostic tool for Alzheimer's disease, or to screen potential drug candidates. The results are reported in the Journal of the American Chemical Society.

Alzheimer's disease affects an estimated 44 million people worldwide, and there are currently no effective diagnostics or treatments. In Alzheimer's disease, amyloid-beta and another protein called tau build up into tangles and plaques—known collectively as aggregates—causing brain cells to die and the brain to shrink. This results in memory loss, personality changes and difficulty carrying out daily functions.

It is a difficult disease to study, since it develops over decades, and a definitive diagnosis can only be given after examining samples of brain tissue after death. It is still not known what kind of biochemical changes inside a cell lead to amyloid-beta aggregation.

In Professor Gabriele Kaminski Schierle's research group at Cambridge's Department of Chemical Engineering and Biotechnology, they have been investigating the possible link between temperature and amyloid-beta aggregation in human cells.

Alzheimer's disease affects an estimated 44 million people worldwide, and there are currently no effective diagnostics or treatments.

The field of studying temperature changes inside a cell is known as intracellular thermogenesis. It is a new and challenging field: scientists have developed sensors with which temperature changes can be measured, however, no one has ever tried to use these sensors to study conditions such as Alzheimer's disease.

"Thermogenesis has been associated with cellular stress, which may promote further aggregation," said Chyi Wei Chung, the study's first author. "We believe that when there's an imbalance in cells, like when the amyloid-beta concentration is slightly too high and it starts to accumulate, cellular temperatures increase."

"Overheating a cell is like frying an egg—as it heats up, the proteins start to clump together and become non-functional," said Kaminski Schierle, who led the research.

The researchers used tiny temperature sensors called fluorescent polymeric thermometers (FTPs) to study the link between aggregation and temperature. They added amyloid-beta to human cell lines to kickstart the aggregation process and used a chemical called FCCP as a control, since it is known to induce an increase in temperature.

They found that as amyloid-beta started to form thread-like aggregates called fibrils, the average temperature of the cells started to rise. The increase in cellular temperature was significant compared to cells that did not have any amyloid-beta added.

"As the fibrils start elongating, they release energy in the form of heat," said Kaminski Schierle. "Amyloid-beta aggregation requires quite a lot of energy to get going, but once the aggregation process starts, it speeds up and releases more heat, allowing more aggregates to form."

"Once the aggregates have formed, they can exit the cell and be taken up by neighboring cells, infecting healthy amyloid-beta in those cells," said Chung. "No one has shown this link between temperature and aggregation in live cells before."

Using a drug that inhibits amyloid-beta aggregation, the researchers were able to pinpoint the fibrils as the cause of thermogenesis. It had previously been unknown whether protein aggregation or potential damage to mitochondria—the "batteries" that power cells—was responsible for this phenomenon.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

The researchers also found that the rise in cellular temperatures could be mitigated by treating them with an aggregation inhibitor, highlighting its potential as a therapeutic for Alzheimer's disease.

The laboratory experiments were complemented by computational modeling describing what might happen to amyloid-beta in an intracellular environment and why it might lead to an increase in intracellular temperatures. The researchers hope their work will motivate new studies incorporating different parameters of physiological relevance.

Phys Org, 31 May 2022

https://phys.org

Gene therapy's comeback: how scientists are trying to make it safer

2022-05-31

Unwanted immune responses threaten to derail some gene therapies. But researchers are seeking ways to combat harmful inflammation.

After years of disappointment, gene-therapy research has undergone a renaissance, with several high-profile drug approvals and a string of promising clinical-trial results against devastating genetic diseases, including sickle-cell disease and some blood cancers.

But as researchers attempt to develop treatments for new conditions, they are also trying to work out how to cope with worrying signs that immune responses to the therapies could hinder their efforts — and generate dangerous side effects.

The concern was a popular topic at the American Society of Gene and Cell Therapy (ASGCT) annual meeting in Washington DC, held from 16 to 19 May, as presenters discussed the effects of inflammation on gene therapy and how to mitigate them. "Inflammation is par for the course, but often we don't talk about it," said Christine Kay, a surgeon at Vitreoretinal Associates in Gainesville, Florida, during a talk about gene therapies for eye disorders. "I'm glad that we're beginning to."

Safety has long been a primary concern in gene-therapy research, particularly after the death of a gene-therapy trial participant and the discovery of gene-therapy-linked cancers around the turn of the century closed clinical trials and caused investors to pull away from the burgeoning field.

But the field has resurged over the past decade, and several gene therapies have been approved by regulators around the world to treat conditions including cancer, blindness and a metabolic disorder. "We are

on a roll with gene therapy," Francis Collins, acting science adviser to US President Joe Biden, told the ASGCT meeting. "But we still have thousands of diseases that have not been approached."

Immune interference

Researchers have long been wary of how immune responses could make gene therapies less effective. The treatments often rely on a virus to ferry a gene into cells, but if the recipient already has antibodies against that virus, an immune response could hinder the treatment. As a result, participation in gene-therapy clinical trials is often limited to people who do not already have such antibodies.

In most gene-therapy studies, the gene is carried by one of several adeno-associated viruses (AAVs), a group of small viruses that have been studied for use in the field for nearly four decades. Thousands of people have received an AAV-based gene therapy, said Denise Sabatino, a haematology researcher at Children's Hospital of Philadelphia in Pennsylvania, at the meeting. Some gene therapies approved by the US Food and Drug Administration — including Zolgensma (onasemnogene abeparvovec), a treatment for spinal muscular atrophy, and Luxturna (voretigene neparvovec), which treats a form of retinal dystrophy that can cause blindness — rely on these viruses.

AAV vectors are also being used in clinical trials of gene-editing therapies, including those based on the popular CRISPR–Cas9 system. And the US National Institutes of Health (NIH) has launched a programme to study AAV vectors, in the hope of fostering a gene-therapy pipeline in which developers can simply swap a new therapeutic gene into the viral genome to treat a particular disease, without having to conduct large clinical trials to establish safety. Large clinical trials are particularly difficult when it comes to treatments for rare genetic disorders.

But as researchers push to treat more conditions and improve the effectiveness of their therapies, "this has become a real and present concern in AAV gene therapy", said Fraser Wright, a gene-therapy researcher and co-founder of Spark Therapeutics in Philadelphia, which developed Luxturna, at the meeting. "As we've gone up in AAV dosing in human subjects, we have seen more and more severe adverse events." Some of those events have included deaths, Fraser added.

Inflammatory response

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

The main concern used to be that antibodies against an AAV or its cargo would prevent the gene therapy from working or preclude the possibility of giving multiple doses, said Wright. But more recently, researchers have realized that antibodies could stimulate the production of inflammatory molecules, activate cell-death pathways and trigger the development of killer T cells that could target AAV-containing cells for destruction.

Researchers at the ASGCT meeting reported efforts to tackle this inflammation from a variety of angles. Some are looking for alternatives to AAVs, and Collins noted that the NIH's Somatic Cell Genome Editing programme is studying both viral and non-viral vectors. "I think a lot of us are worried about depending on AAV forever, and would like to have things with maybe less in the way of plausible risk," he said.

At the Wyss Institute for Biologically Inspired Engineering at Harvard University in Boston, Massachusetts, viral immunologist Ying Kai Chan is trying to engineer safer AAV vectors. Risks increase when investigators use higher amounts of AAV, he said at the meeting: "I'm a huge fan of reducing the dose." But to do so, he added, might require the development of more potent treatments that use less virus.

Some are trying to 'humanize' the AAV genome, to make it less likely to activate immune pathways. For example, in humans, when the DNA base C is followed directly in the genome sequence by the base G, it often carries a chemical group called a methyl. AAV has a higher percentage of CG groups without a methyl — a potential red flag to the immune system. Wright presented data showing that increasing the methylation of CG-rich regions decreased the activation of inflammation-promoting molecules called cytokines. But, he added, there is a potential trade-off: the same methylation, if used too heavily, might also suppress gene expression, including that of the therapeutic gene carried by the AAV.

Suppressed immunity

Others are working on ways to suppress harmful immune responses. Gene therapies are often given with immunosuppressants such as steroids, but there are concerns that such treatments are sometimes ineffective, and can render recipients vulnerable to infection. Anastasia Conti, who studies stem cells at the San Raffaele Telethon Institute for Gene Therapy in Milan, Italy, reported at the ASGCT meeting that a drug called anakinra reduced inflammation triggered by gene editing. The drug might also enhance the potency of gene-editing treatment by reducing the number of edited blood stem cells that become senescent — meaning that they are still alive but have stopped dividing.

At Selecta Biosciences in Watertown, Massachusetts, researchers are developing nanoparticles designed to be taken up by immune cells and coupled to a drug called rapamycin that is sometimes used to suppress the immune system after organ transplantation. In non-human primates, the team found that three monthly doses of the nanoparticles prevented antibody responses to the AAV's protein shell, chief scientific officer Kei Kishimoto said at the meeting. And researchers at Spark have tested a drug that inhibits an immune regulator called IL-6. They found that the treatment lowered the level of antibodies against AAV shells in non-human primates. In mice, it reduced immune responses enough to allow the animals to receive multiple rounds of gene therapy.

In the end, it will probably take a "toolbox of strategies" to tackle the inflammation problem, said Chan. And as the reach of gene therapies continues to expand, researchers need to develop tools to monitor potentially dangerous inflammation in difficult-to-access parts of the body, such as the brain, he added. Many studies on inflammation have been conducted in the eye, where researchers can relatively easily visualize changes that occur even months after therapy. "How will we really know what is happening in the central nervous system or the ear?" Chan asked. "We could fool ourselves for a long time."

Nature, 31 May 2022

https://nature.com

Your liver stays just three years old on average throughout your life

2022-06-02

The liver can regenerate itself after taking damage, but whether that ability fades as we age has long been unknown. A new study has found that age doesn't slow down the liver's regeneration, and whether you're 20 or 80, your liver is on average just three years old.

The liver has the hazardous job of detoxifying the body, and because of its regular exposure to toxins, it risks more injury than most organs. To keep us healthy throughout our lives, the liver has developed a remarkable regenerative capacity, unique among organs. But how exactly it pulls off the feat – and whether it slows with age – has remained a mystery that animal models have been unable to clarify. So for the new study, researchers at TU Dresden wanted to find out.

Researchers have calculated the average age of human liver cells and found that they remain about three years old, no matter the age of the person

CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

"Some studies pointed to the possibility that liver cells are long-lived while others showed a constant turnover," said Dr. Olaf Bergmann, corresponding author of the study. "It was clear to us that if we want to know what happens in humans, we need to find a way to directly assess the age of human liver cells."

To find their solution, the team turned to an unlikely source – the nuclear tests of the 1950s. When the nukes were detonated above ground, huge amounts of radiocarbon were blasted into the atmosphere, and subsequently taken up by plants and animals into their very DNA. After above-ground nuclear testing was banned in 1963, atmospheric levels of radiocarbon has dropped year on year – and so did the levels in the cells of organisms.

"Even though these are negligible amounts that are not harmful, we can detect and measure them in tissue samples," said Bergmann. "By comparing the values to the levels of atmospheric radiocarbon, we can retrospectively establish the age of the cells."

To put the idea into practice, the team analyzed the radiocarbon levels of the livers of 33 deceased people between the ages of 20 and 84 years. And sure enough, they found that the organ was roughly the same age – a little under three years old on average – no matter the age of the person. But not all cells in a given liver were the same age – some were found to regenerate every year or so, while others could stick around for as long as a decade. Intriguingly, the longer-living cells were those that had accumulated more sets of chromosomes.

"Most of our cells have two sets of chromosomes, but some cells accumulate more DNA as they age," said Bergmann. "In the end, such cells can carry four, eight, or even more sets of chromosomes. As this fraction [in the liver] gradually increases with age, this could be a protective mechanism that safeguards us from accumulating harmful mutations. We need to find out if there are similar mechanisms in chronic liver disease, which in some cases can turn into cancer."

The research was published in the journal Cell Systems.

New Atlas, 2 June 2022

https://newatlas.com

Tracking sleep with a self-powering smart pillow

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The human body needs sleep as much as it needs food and water. Yet many people fail to get enough, causing both mind and body to suffer. People who struggle for shut-eye could benefit from monitoring their sleep, but they have limited options for doing so. In a new study in ACS Applied Materials & Interfaces, one team describes a potential solution: a self-powering smart pillow that tracks the position of the head.

Studies have linked chronic lack of sleep to physical ailments, such as diabetes and heart disease, as well as mental health issues. Those interested in getting a better handle on what's happening to them at night have two primary options. They can take a sleep test conducted in a medical facility, or they can use an app through a smartphone or smart watch—a much more convenient, but less accurate choice.

Recognizing the need, many groups have begun developing new sleep monitoring systems using triboelectric nanogenerators (TENGs). These self-powering systems have taken the form of eye masks, belts, patches and even bed sheets. Ding Li, Zhong Lin Wang and their colleagues wanted to adapt this approach to create a less restrictive, more comfortable version that focuses on the movement of the head during sleep.

To construct this new smart pillow, the researchers formulated a flexible, porous polymer triboelectric layer. Movement between the head and this layer changes the electric field around nearby electrodes, generating a current. They strung together several of these self-powering sensors to create a flexible and breathable TENG (FB-TENG) array that can be placed atop an ordinary pillow.

This system could generate voltage that corresponded to the amount of applied pressure, and it could track the movement of a finger tracing out letters. The FB-TENG also could capture the pressure distribution of a fake human head as it shifted position. This smart pillow could have uses beyond tracking sleep, the researchers say. For example, the system could monitor patients with diseases that affect the movement of the head, such as the degenerative neck disorder cervical spondylosis. What's more, the

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CHEMWATCH
Bulletin Board
Curiosities
JUN. 10, 2022

smart pillow could be adapted to offer an early warning system for those at risk of falling out of bed, they say.

Tech Xplore, 2 June 2022

https://techxplore.com

CHEMWATCH

Bulletin Board

Technical Notes

JUN. 10, 2022

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

CHEMICAL EFFECTS

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ENVIRONMENTAL RESEARCH

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PHARMACEUTICAL/TOXICOLOGY

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