CHEMWATCH

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ASIA PACIFIC

Council applies to send in the wasps to stop wattle invasion

2022-08-24

Horizons Regional Council in the Manawatū-Whanganui region has applied for approval to import and release the bud-galling wasp (Trichilogaster acaciaelongifoliae) as a biological control agent for Sydney golden wattle (Acacia longifolia).

The application has been made on behalf of the National Biocontrol Collective, a group of regional and district councils and the Department of Conservation (DOC).

Native to Australia, this wattle is a fast-growing shrub or small tree that was introduced in New Zealand as an ornamental and became naturalised before 1897. It has since become widespread throughout coastal areas of the North Island, and is considered a threat to biodiversity and to the conservation of dune and other ecosystems. The dense thickets it can form also increase the frequency and intensity of fires.

The proposed biological control agent is a small Australian wasp that lays its eggs in flower buds, inducing abnormal growths (galls) that prevent flowers forming and seed production. Galls can also form in growing points, preventing shoot growth.

Bud-galling wasps do not bite or sting, and there are no native New Zealand insects that are closely related. There are no native insect species known to form galls in Sydney golden wattle.

Horizons Regional Council notes that this host-specific wasp has been introduced in South Africa and Portugal, "achieving a high degree of control of Sydney golden wattle within a few years of establishment".

Read More

EPA New Zealand, 24-08-22

https://www.epa.govt.nz/news-and-alerts/latest-news/council-applies-to-send-in-the-wasps-to-stop-wattle-invasion/

The Environmental Protection Authority (EPA) is calling for submissions on an application to introduce a new wasp to control the spread of an invasive acacia species.

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India: CAQM's Revised Graded Response Action Plan For Delhi NCR

2022-08-31

The Commission for Air Quality Management in the National Capital Region and Adjoining Areas ("CAQM") has issued the revised Graded Response Action Plan ("GRAP") for the National Capital Region of Delhi ("NCR") under the provisions of the Commission for Air Quality Management in National Capital Region and Adjoining Areas Act, 2021 ("Act"). The revised guidelines will come into effect from 01 October, 2022. The Supreme Court of India had directed CAQM in December, 2021 to invite suggestions from the general public and experts for finding permanent solutions to the air pollution menace. In compliance with the order CAQM has issued the revised GRAP based on recommendations by its expert group, thus replacing the plan released in 2017.

The revised GRAP provides an action plan to address air pollution in Delhi-NCR based on four different stages of adverse air quality. Stage – I denotes 'poor' air quality (Air Quality Index is from 201 to 300); Stage - II denotes 'very poor' air quality (Air Quality Index is from 301 to 400); Stage – III denotes 'severe' air quality (Air Quality Index is from 401 to 450); and Stage – IV denotes 'severe+' air quality (Air Quality Index exceeds >450) respectively. For each stage of adverse air quality, GRAP prescribes different measures to deal with various sources of pollution along with the names of agencies responsible for the implementation of such measures.

It is noteworthy that restrictive measures prescribed under the subsequent stages of adverse air quality will be implemented in addition to the action already being taken under the previous stages. This means that when the air quality reaches 'severe+' stage, steps taken under the previous stages, i.e., 'poor', 'very poor' and 'severe' will continue to be implemented and all measures mentioned in GRAP will become effective until air the quality improves.

Read More

Mondaq, 31-08-22

https://www.mondaq.com/india/clean-air-pollution/1225938/caqm39s-revised-graded-response-action-plan-for-delhi-ncr

AMERICA

Assembly Passes bill to End Use of PFAS Chemicals in New Fabrics and Textiles

2022-08-31

A bill to end the use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) "forever" chemicals in new fabrics and textiles in California was passed by the Assembly Tuesday.

Assembly Bill 1817, authored by Assemblyman Phil Ting (D-San Francisco), would prohibit any person from manufacturing, distributing, selling, or offering for sale in the state any new, not previously owned, textile articles that contain regulated PFAS and requires a manufacturer to use the least toxic alternative when removing regulated PFAS in textile articles to comply with the bill. AB 1817, also known as The Safer Clothes and Textiles Act, would also require manufacturers to provide those that offer the product for sale or distribution in the state with a certificate of compliance stating that the textile article is in compliance with these provisions and does not contain any regulated PFAS.

Exemptions to the bill would include many textiles and fabrics used for safety reasons where PFAS fire retardant qualities and other benefits would prove to be invaluable, including vehicle component parts, PPE, military clothing, industrial filters, and lab clothing. Should AB 1817 be signed into law, it would become active beginning January 1, 2025.

Assemblyman Ting wrote the bill due to growing concern over the use of PFAS chemicals, which are used in everything from fire retardants to non-stick pans, and how they relate to increased environmental and health risks including kidney and liver damage, decreased immune system function, interference with vaccine uptake, developmental and reproductive harm, and increased risk of cancer and asthma. While PFAS regulations in California have been growing in the last several years, including bills limiting the chemical from being in everything from food packaging to cosmetics, fabrics and textiles had only seen a few limitations, such as having PFAS in things intended for infants and babies. However, with concerns over PFAS still growing, Ting decided to have a bill cover all clothing and textiles due to safer alternatives being available that aren't PFAS.

"California has already enacted a series of laws to protect consumers and the environment from the hazardous impacts of PFAS, including a bill I

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successfully championed just last year prohibiting its use in paper-based food packaging," said Assemblyman Ting earlier this year. "These efforts center on the premise that prevention is the best cure, and my bill would extend this same logic to the textile industry to reduce the harm these substances can cause. There are safer alternatives manufacturers can use."

Read More

California Globe, 31-08-22

https://californiaglobe.com/articles/assembly-passes-bill-to-end-use-of-pfas-chemicals-in-new-fabrics-and-textiles/

Back to school with safe drinking water

2022-08-31

While school was out, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) helped them make sure drinking water was safe upon students' return to the classroom. Throughout the school year – and especially during summer break – EGLE works with schools to provide technical assistance, guidance and resources for schools who reach out for help or want more information on their drinking water quality.

EGLE created the school drinking water program to promote healthy drinking water in school and childcare buildings," says Holly Gohlke, school drinking water coordinator. Funds for the program are geared toward schools and childcare facilities.

Since September of 2020 when the program started, 206 schools and childcare facilities have participated in it. "Since this is entirely a volunteer program, I applaud the facilities that have reached out to EGLE to get their water tested for lead, and for those that had elevated test results, pursued reducing the risk of lead for the health and welfare of the children they serve," Gohlke added.

Gohlke explained the program in detail on an episode of Central Michigan University's Charter Central Podcast.

Read More

Michigan.gov, 31-08-22

https://www.michigan.gov/egle/newsroom/mi-environment/2022/08/31/back-to-school-with-safe-drinking-water

A Design Flaw in the Clean Air Act

2022-09-01

The Clean Air Act has two kinds of standards. It sounds like having two kinds of standards should improve air quality more than a single standard. But in reality, one type of standard can result in canceling out the benefits of the other type. If you understand the statute, this is actually pretty obvious once you stop to think about. I have to admit, however, that I hadn't stopped to think about it until today, even though I've taught this stuff dozens of time.

What are the two types of standards? First, the Act tells EPA to issue national air quality standards for major air pollutants and requires states (or as a back-up, the Feds) to create plans to meet those standards by certain deadlines. Second, it sets national pollution controls standards for new cars, factories, and power plants. The air quality standards are based on public health, while the national requirements for new sources are based on the best available technology for controlling emissions.

There are some significant pollutants that aren't covered by air quality standards, most notably toxic chemicals and carbon dioxide. My argument doesn't apply to them.

What's the problem? The problem is that, if the air quality requirements are working, they cancel out the air pollution benefits of the technology requirements.

Here's why: Suppose a state has to cut emissions by 10%. A new factory is being built. If it weren't for the new source standards, it would add 2% to the state's pollution. So now the state would have to cut 12% of its existing pollution. Instead, the new source standards cut the emissions from the plant in half, so it now only adds 1%. It sounds like that's good for air quality, right? Well, not really. Now the state only needs to cut existing emissions by 11%, not 12%. In other words, the decreased pollution from the new source allows the state to ease up on controlling existing sources by exactly the same amount. The net effect or the new source standards on air quality is zero. On the other hand, the state might have been able to use lower costs reductions instead of the technology-based standards, so that's a disadvantage.

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Legal Planet, 01-09-22

https://legal-planet.org/2022/09/01/a-design-flaw-in-the-clean-air-act/

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New Mexico officials want more funding to enforce oil and gas rules amid high pollution

2022-09-01

Lawmakers in New Mexico were asked to provide more resources to oil and gas regulators during the upcoming legislative session, after the state recently enacted multiple new requirements intended to curb air pollution from fossil fuel operations.

The next session, scheduled to start in January, will run for the first 60 days of the year and will be focused on new policy, compared to 2022's 30-day, budget-drive session.

That means 2023 could see more bills introduced by lawmakers to alter state environmental laws that could affect the oil and gas industry.

State officials pointed to staff vacancies at regulatory agencies impeding the State's efforts to enforce such policies enacted or that could be proposed during the upcoming session.

Read More

Carlsbad Current-Argus, 01-09-22

https://www.currentargus.com/story/news/2022/09/01/new-mexico-funding-oil-gas-fossil-fuel-permian-basin-air-pollution-environment-energy-legsilature/65465070007/

Will the EPA crack down on pollution from buildings?

2022-08-23

The Clean Air Act gives the U.S. government broad power to protect public health by regulating major sources of pollutants. Rules developed under the law have, for example, required power plants to install filters and scrubbers to limit the release of sulfur dioxide and particulate matter. The Environmental Protection Agency, or EPA, has also used the law to phase lead out of gasoline and issue vehicle standards to reduce tailpipe emissions.

But there's one significant source of pollution that the agency has so far ignored: all of the consumer appliances that burn natural gas or fuel oil in homes and businesses. The direct combustion of fossil fuels like these within the country's buildings is responsible for roughly 10 percent of total U.S. greenhouse gas emissions. On Tuesday, the Sierra Club and 25 other

environmental and public health groups filed a petition asking the EPA to use its authority to crack down on fuel-burning appliances.

"Emissions from buildings have a harmful, and frankly scary, impact on human health and contribute significantly to the climate crisis," Amneh Minkara, the deputy director of the Sierra Club's building electrification campaign, said in a written statement accompanying the announcement. "It is the duty of the EPA to keep the American public safe from breathing in these pollutants."

Read More

Grist, 23-08-22

https://grist.org/buildings/epa-pollution-gas-appliances-buildings/

EUROPE

The WHO Air Quality Guidelines should be used to set air pollution reduction targets in our cities

2022-08-31

Decades of important scientific studies have revealed the strong connection between exposure to air pollution and adverse health outcomes like respiratory infections, heart disease and lung cancer. Both short- and long-term exposure to air pollutants has been associated with health impacts, and the International Agency for Research on Cancer (IARC) has classified outdoor air pollution and particulate matter (PM) as carcinogenic to humans.

As a result, the last decades saw an increase in policies aiming to reduce air pollution and improve air quality both at the European as well as Global levels, thus reiterating the urgency for action. In September 2021, the World Health Organization (WHO) updated its global air quality guidelines for particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO) to better protect the health of populations. For instance, the WHO now recommends a maximum level of 5 µg/m3for fine particulate matter (PM2.5) for long-term exposure to protect health.

These Guidelines are addressed to all countries of the world and provide uniform targets for air quality. The new targets are much stricter than most national standards in force in many parts of the world, which in some

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cities would mean a more than threefold reduction in the current level of pollution.

Read More

European Public Health Alliance, 31-08-22

https://epha.org/the-who-air-quality-guidelines-should-be-used-to-set-air-pollution-reduction-targets-in-our-cities/

Green groups welcome microplastics restriction but warn of shortcomings

2022-08-31

The European Commission looks set to prevent the devastating effect microplastics have on nature and people. The Commission yesterday released a draft proposal to restrict intentionally-added microplastics – finally delivering on a 2017 pledge.

Microplastics are plastics less than 5mm in size. They are nearly impossible to remove once released into the environment, with devastating impacts on nature and people. Each year around 42,000 tonnes of microplastics end up in the environment when products containing them are used.

The restriction proposal could see a ban on the use of microplastics in sports fields, cosmetics, cleaning products, pesticides, etc.

ClientEarth and the European Environmental Bureau have been following the process leading to the current proposal. Reacting to the Commission's draft proposal, they said:

"After years of limbo, we are glad to finally see the Commission tackling this major environmental problem. It's a relief to see that the draft proposal commits to restricting the biggest source of microplastics – those used in sports pitches. Nanoplastics – the smallest type of plastics – will also be regulated.

"That said, transition periods for companies to adapt to this new law would be exceedingly long according to this draft proposal – up to 12 years for some make-up items. That's unacceptable. Reporting requirements for companies supplying microplastics used at industrial sites also need to be rock solid, which is not the case in the draft proposal.

Read More

Client Earth, 31-08-22

https://www.clientearth.org/latest/press-office/press/green-groups-welcome-microplastics-restriction-but-warn-of-shortcomings/

How will EU air pollution regulations affect the aviation industry?

2022-09-01

Recent EU regulations aimed at reducing pollution caused by the aviation industry could start to affect how the industry operates, according to a study by the Clean Aviation Joint Undertaking.

The research was carried out alongside McKinsey & Company and found that the recent regulations could make kerosene the most expensive fuel for aircraft in the near future.

It also found that kerosene will be approximately the same price as liquid hydrogen – a cleaner fuel for aircraft currently under development – by the year 2030.

Additionally, the price of synthetic fuels is predicted to drop in the next few years, as they will be mandated by EU regulations and this will increase supply and availability.

Burning kerosene for fuel pumps large amounts of carbon dioxide and other pollutants into the atmosphere, making it a leading cause of global warming.

The report predicts that changes to EU regulations and taxation could increase the price of kerosene to $300 per MWh by 2050 – six times higher than the current price.

By 2050, the report predicts that the price of synthetic fuels, also known as e-fuels or power-to-liquid, will fall to less than $250 and liquid hydrogen to reduce to around $50. These changes would remove the current advantages of using kerosene for air travel.

Read More

EU Policies, 01-09-22

http://eu-policies.com/competences/energy/will-eu-air-pollution-regulations-affect-aviation-industry/

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UK textile sector subject to new government emissions regulations

2022-09-01

The UK Government has established a new regulatory framework to boost industrial emissions standards and reduce air pollution for the textiles and chemicals industries.

The textiles and chemicals industries in the UK will be required to adopt sustainable best practices under the Best Available Techniques framework launched this week as the government looks to reduce emissions and improve the environmental performance of businesses.

"Tackling emissions is essential to reduce the damaging effects of air, water and land pollution on people and the environment," said Environment Minister Steve Double. "The new framework and collaborative approach will ensure higher standards for industrial emissions across the UK and a more effective governance structure to support industry in finding the best available techniques to meet these standards.

"This builds on the wide range of actions we are already taking through our existing legal framework to drive down pollutants and improve public health and the environment."

Read More

Just Style, 01-09-22

https://www.just-style.com/news/industry-news/uk-textile-sector-subject-to-new-government-emissions-regulations/

Guidance Risk characterisation methods

2022-08-25

1. This guidance statement provides an overview of the approaches to characterising the risks associated with exposures to chemical carcinogens. It is part of a series of guidance statements by the Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC) and should be read in conjunction with these, and in particular G01, G02 (Synthesising Epidemiology Evidence Subgroup (SEES) Report), G03 (Hazard identification and characterisation: conduct and interpretation of carcinogenicity studies), G05 (Points of departure and potency estimates) and G09 (COC set of principles for consideration of risk due to less than lifetime exposure).

2. Risk characterisation is the fourth stage of the risk assessment paradigm and brings together the hazard identification and characterisation stages and the exposure assessment process. For carcinogenic effects, the risk characterisation approach used depends on the mechanisms of carcinogenicity and the relationship between dose and carcinogenic response. For most non-genotoxic carcinogens, it is accepted that there is a threshold dose, below which no effect is observed.

In contrast, for compounds which are genotoxic and carcinogenic and for which there are no mechanistic data to suggest a threshold for genotoxicity, or for substances where no mode of action or threshold for effect has been identified, it is currently considered prudent to assume that no threshold for carcinogenicity exists. The processes of hazard identification and hazard characterisation are therefore key to determining the approach to be taken in risk characterisation.

Read More

UK HSE, 25-08-22

https://www.gov.uk/government/publications/cancer-risk-characterisation-methods/risk-characterisation-methods

UK sewage turning Channel and North Sea into dumping ground, say French MEPs

2022-08-25

Britain is threatening human health, marine life and fishing by releasing raw sewage into the Channel and the North Sea, three French Euro MPs have said.

They have asked the European Commission to seek "political and legal" measures to stop the pollution, accusing the UK of abandoning international environmental regulations.

The official complaint comes after dozens of beaches in England and Wales were pinpointed as posing a pollution risk for bathers.

The three MEPs have written to the commission in Brussels saying the UK's decision to lower its water quality standards is "unacceptable" and action must be taken to stop it polluting the Channel and North Sea.

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The Guardia, 25-08-22

https://www.theguardian.com/environment/2022/aug/25/uk-sewage-in-channel-waters-unacceptable-say-french-meps

Echa round-up

2022-09-02

Benpat, 1,3-dioxolane substance evaluation conclusions available

Echa has published Germany's substance evaluation conclusion documents for 1,4-benzenediamine, n,n'-mixed phenyl and tolyl derivatives (benpat), and 1,3-dioxolane.

Germany's Federal Institute for Occupational Safety and Health (Baua) has concluded that there is a need for follow-up regulation action at EU level, and harmonised classification and labelling for both substances.

Benpat is used as an antioxidant and antiozonant in rubber products and tyres and is suspected of being persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB).

1,3-dioxolane is mainly used for the manufacture of polymers, or as part of plastic products as a monomer bound in polymers. It is also used as a co-monomer in the manufacture of polyoxymethylene (POM), and serves as a typical solvent for a range of wide dispersive uses and products. It is suspected of being mutagenic and reprotoxic.

New intentions to harmonise classification and labelling

Sweden has informed Echa of its intention to submit CLH proposals for eight chemicals. The member state will seek harmonised classification as reprotoxic 1B, H360F for the following:

- 4-isopropylbenzaldehyde;
- 3-(p-cumenyl)propionaldehyde;
- 3-p-cumenyl-2-methylpropionaldehyde;
- 3-(4-tert-butylphenyl)propionaldehyde;
- methyl 4-tert-butylbenzoate;
- 4-tert-butylbenzaldehyde; and
- 4-tert-butyltoluene.

Sweden also plans to submit a proposal for p-cymene as:

- reprotoxic 1B, H360F;
- flammable liquid 3, H226;
- acute toxicity 3, H331;
- aspiration toxicity 1, H304; and
- aquatic toxicity chronic 2, H411.

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More than 600 chemicals added to REACH Study database

Since September last year, Echa has added 654 new substances to its REACH Study Results database – a collection of non-confidential data submitted to the agency under REACH.

The data contains results from studies related to:

- physical-chemical properties;
- environmental fate and pathways; and
- ecotoxicology and toxicological information.

The current version of the database, active since March 2017, is the sixth edition.

Iceland actively using Echa poison centres portal

Iceland is now accepting poison centre notifications through Echa's submissions portal. Bulgaria and Slovakia are the only two EU/EEA states that remain unconnected to Echa's systems. The agency said they are "working through the onboarding procedure".

Rac, Seac opinions on dechlorane plus restriction proposal

The consolidated opinions of the agency's committees for risk assessment (Rac) and socio-economic analysis (Seac) on Norway's restriction proposal for dechlorane plus are now available.

Both committees support the proposed regulatory action on the flame retardant.

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Chemical Watch, 02-09-22

https://chemicalwatch.com/555961/echa-round-up

Janet's Corner

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Science Journalism

2022-09-09

https://www.smbc-comics.com/comic/science-journalism

Hazard Alert

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Cadmium

2022-09-09

Cadmium (CAS no. 7440-43-9) is a chemical element with the symbol Cd and atomic number 48. [1] It is found naturally in the earth's crust, where it commonly exists in combinations with other elements. For example, cadmium oxide (a mixture of cadmium and oxygen), cadmium chloride (a combination of cadmium and chlorine), and cadmium sulphide (a mixture of cadmium and sulphur) are commonly found in the environment. [2]

Cadmium is a lustrous, silver-white, ductile, very malleable metal. Its surface has a bluish tinge and the metal is soft enough to be cut with a knife, but it tarnishes in air. [3]

It is soluble in acids but not in alkalis. Cadmium doesn't have a distinct taste or smell. [2]

USES [4]

- Leather tanning agent/pigment in dye (until 1990's)
- Rechargeable Ni-Cd batteries • Solar cells
- Solder alloys
- Paint and plastic production
- Engraving
- Cadmium vapour lamps
- Parasite treatment in farm animals
- Old television tubes
- Electroplate other metals

IN THE ENVIRONMENT [5]

- Cadmium enters soil, water, and air from mining, industry, and burning coal and household wastes.
- Cadmium does not break down in the environment, but can change forms.
- Cadmium particles in air can travel long distances before falling to the ground or water.
- Some forms of cadmium dissolve in water.
- Cadmium binds strongly to soil particles.
- Fish, plants, and animals take up cadmium from the environment.

Cadmium (CAS no. 7440-43-9) is a chemical element with the symbol Cd and atomic number 48. [1]

SOURCES & ROUTES OF EXPOSURE [6,7]

Sources of Exposure

- Industry sources: Cadmium is obtained as a by-product from the treatment of zinc, copper, lead, and iron ores, therefore facilities that treat these ores may emit cadmium compounds to the environment (mainly water). Coal and oil burning power plants may emit cadmium compounds to air.
- Diffuse sources: Small industrial domestic use of cadmium products will emit low levels of cadmium to the environment.
- Natural sources: Cadmium is a naturally occurring element in the crust of the earth. Coal and other fossil fuels contain cadmium and their combustion releases the element into the atmosphere. Cadmium is found naturally in various ores: lead and copper containing zinc, some iron ores, and in sulfide ore. These can result in emissions to water. Volcanic emissions contain cadmium-enriched particles.
- Transport sources: The combustion of motor fuels (petrol) in cars, trucks, and planes result in emissions to air, and particles from tire wear may result in emissions to air, land and water.
- Consumer products: Cadmium is found in many domestic products, e.g. tobacco products, phosphate fertilisers, polyvinyl chloride (PVC) products, photocells, petrol, oils, tyres, automobile radiators, some textile dyes and colours, electronic components, heating elements in electric kettles and hot water systems, batteries, and ceramic glazes.

Routes of Exposure

The main routes of exposure to cadmium are:

- Inhalation
- Ingestion
- Skin exposure
- Eye exposure

HEALTH EFFECTS [2,8]

Acute exposure to cadmium fumes may cause flu like symptoms including chills, fever, and muscle ache sometimes referred to as "the cadmium blues." Symptoms may resolve after a week if there is no respiratory damage. More severe exposures can cause tracheo-bronchitis, pneumonitis, and pulmonary oedema. Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation

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of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain. Inhaling cadmium-laden dust quickly leads to respiratory tract and kidney problems, which can be fatal (often from renal failure). Ingestion of any significant amount of cadmium causes immediate poisoning and damage to the liver and the kidneys. The bones become soft (osteomalacia), lose bone mineral density (osteoporosis) and become weaker. This causes the pain in the joints and the back, and also increases the risk of fractures. In extreme cases of cadmium poisoning, mere body weight causes a fracture. The kidneys lose their function to remove acids from the blood in proximal renal tubular dysfunction. The kidney damage inflicted by cadmium poisoning is irreversible. The proximal renal tubular dysfunction creates low phosphate levels in the blood (hypophosphatemia), causing muscle weakness and sometimes coma. The dysfunction also causes gout, a form of arthritis due to the accumulation of uric acid crystals in the joints because of high acidity of the blood (hyperuricemia). Another side effect is increased levels of chloride in the blood (hyperchloremia). The kidneys can also shrink up to 30%. Other patients lose their sense of smell (anosmia).

CARCINOGENICITY

There is evidence that cadmium causes prostate and kidney cancer in humans, it has been shown to cause lung and testicle cancer in animals. [6] The United States Department of Health and Human Services determined that cadmium and certain cadmium compounds are probable or suspected carcinogens.[2]

SAFETY

First Aid Measures [7]

- Eye exposure: Direct contact may cause redness or pain. Wash eyes immediately with large amounts of water, lifting the upper and lower eyelids. Get medical attention immediately.
- Skin exposure: Direct contact may result in irritation. Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water. Get medical attention immediately.
- Ingestion: Ingestion may result in vomiting, abdominal pain, nausea, diarrhoea, headache and sore throat. Medical personnel must administer treatment for symptoms. Under no circumstances should the employer allow any person whom he retains, employs, supervises

or controls to engage in therapeutic chelation. Such treatment is likely to translocate cadmium from pulmonary or other tissue to renal tissue. Get medical attention immediately.

- Inhalation: If large amounts of cadmium are inhaled, the exposed person must be moved to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation. Administer oxygen if available. Keep the affected person warm and at rest. Get medical attention immediately.
- Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, attempt rescue only after notifying at least one other person of the emergency and putting into effect established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

Exposure Controls & Personal Protection [9]

Engineering Controls

- Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits.
- If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

The following personal protective equipment is recommended when

handling cadmium:

- Safety glasses;
- Lab coat;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust respirator;
- Boots;
- Gloves;

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- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATIONS [5,6]

United States

EPA: The Environmental Protection Agency has determined that exposure to cadmium in drinking water at concentrations of 0.04 ppm for up to 10 days is not expected to cause any adverse effects in a child. The Environmental Protection Agency has determined that lifetime exposure to 0.005 ppm cadmium is not expected to cause any adverse effects.

FDA: The Food & Drug Administration has determined that the cadmium concentration in bottled drinking water should not exceed 0.005 ppm.

OSHA: The Occupational Health and Safety Administration (OSHA) have limited workers' exposure to an average of 5 ìg/m3 for an 8-hour workday, 40-hour workweek.

Australia

Safe Work Australia: Safe Work Australia has established an eight-hour time weighted average (TWA) exposure limit of 0.01mg/m3. The agency has also determined that cadmium and its compounds is a 'probable carcinogen'.

Australian Drinking Water Guidelines (NHMRC and ARMCANZ, 1996): Maximum of 0.002 mg/L (i.e. 0.000002 g/L)

REFERENCES

1. http://en.wikipedia.org/wiki/Cadmium
2. http://www.epa.gov/osw/hazard/wastemin/minimize/factshts/cadmium.pdf
3. http://www.lenntech.com/periodic/elements/cd.htm
4. http://toxipedia.org/display/toxipedia/Cadmium+(Cd)\
5. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=47&tid=15
6. http://www.npi.gov.au/substances/cadmium/source.html
7. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10036&p_table=STANDARDS

8. http://en.wikipedia.org/wiki/Cadmium_poisoning
9. http://www.sciencelab.com/msds.php?msdsId=9923223

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Robo-Roach: Scientists Have Created a Remote-Control Cyborg Cockroach

2022-09-06

An international team led by researchers at the RIKEN Cluster for Pioneering Research (CPR) has engineered a system for creating remote controlled cyborg cockroaches, equipped with a tiny wireless control module that is powered by a rechargeable battery attached to a solar cell. Despite the mechanic devices, ultrathin electronics and flexible materials allow the insects to move freely. These achievements, reported in the scientific journal npj Flexible Electronics on September 5, will help make the use of cyborg insects a practical reality.

Researchers have been trying to design cyborg insects—part insect, part machine—to help inspect hazardous areas or monitor the environment. However, for the use of cyborg insects to be practical, handlers must be able to control them remotely for long periods of time. This requires wireless control of their leg segments, powered by a tiny rechargeable battery. Keeping the battery adequately charged is fundamental—nobody wants a suddenly out-of-control team of cyborg cockroaches roaming around. While it's possible to build docking stations for recharging the battery, the need to return and recharge could disrupt time-sensitive missions. Therefore, the best solution is to include an on-board solar cell that can continuously ensure that the battery stays charged.

All of this is easier said than done. To successfully integrate these devices into a cockroach that has limited surface area required the research team to develop a special backpack, ultrathin organic solar cell modules, and an adhesion system that keeps the machinery attached for long periods of time while also allowing natural movements.

Led by Kenjiro Fukuda, RIKEN CPR, the team experimented with Madagascar cockroaches, which are approximately 6 cm long. They attached the wireless leg-control module and lithium polymer battery to the top of the insect on the thorax using a specially designed backpack, which was modeled after the body of a model cockroach. The backpack was 3D printed with an elastic polymer and conformed perfectly to the curved surface of the cockroach, allowing the rigid electronic device to be stably mounted on the thorax for more than a month.

The ultrathin 0.004 mm thick organic solar cell module was mounted on the dorsal side of the abdomen. "The body-mounted ultrathin organic solar cell module achieves a power output of 17.2 mW, which is more than

Researchers at RIKEN, Japan have created remote controlled cyborg cockroaches, equipped with a tiny wireless control module that is powered by a rechargeable battery attached to a solar cell.

50 times larger than the power output of current state-of-the art energy harvesting devices on living insects," according to Fukuda.

The ultrathin and flexible organic solar cell, and how it was attached to the insect, proved necessary to ensure freedom of movement. After carefully examining natural cockroach movements, the researchers realized that the abdomen changes shape and portions of the exoskeleton overlap. To accommodate this, they interleaved adhesive and non-adhesive sections onto the films, which allowed them to bend but also stay attached. When thicker solar cell films were tested, or when the films were uniformly attached, the cockroaches took twice as long to run the same distance, and had difficulty righting themselves when on their backs.

Once these components were integrated into the cockroaches, along with wires that stimulate the leg segments, the new cyborgs were tested. The battery was charged with pseudo-sunlight for 30 minutes, and animals were made to turn left and right using the wireless remote control.

"Considering the deformation of the thorax and abdomen during basic locomotion, a hybrid electronic system of rigid and flexible elements in the thorax and ultrasoft devices in the abdomen appears to be an effective design for cyborg cockroaches," says Fukuda. "Moreover, since abdominal deformation is not unique to cockroaches, our strategy can be adapted to other insects like beetles, or perhaps even flying insects like cicadas in the future."

Technology Networks, 6 September 2022

https://technologynetworks.com

Even Moderate Drinking Found To Be Linked to Brain Changes and Cognitive Decline

2022-08-26

A study involving over 21,000 participants that was recently published in PLOS Medicine found a correlation between weekly alcohol use of seven or more units and greater levels of iron in the brain. Iron buildup in the brain has been associated with Parkinson's and Alzheimer's diseases and may be a contributing factor to the cognitive decline brought on by alcohol use.

There is increasing evidence that even moderate alcohol use can have a negative impact on brain health. Anya Topiwala of the University of Oxford

A recent study found that drinking seven or more units of alcohol a week is linked to brain changes and cognitive decline.

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in the United Kingdom and colleagues investigated the links between alcohol consumption and brain iron levels.

Their 20,965 volunteers from the UK Biobank provided information on their own alcohol consumption, and magnetic resonance imaging (MRI) was used to examine their brains. To determine the amounts of systemic iron, almost 7,000 people had their livers scanned using MRI as well. A series of basic tests were taken by each person to assess their cognitive and motor abilities.

The average age of the participants was 55, and 48.6% of them were female. Although 2.7% of respondents identified as non-drinkers, the average weekly consumption was 18 units or about 7.5 cans of beer or 6 large glasses of wine. The researchers discovered that alcohol consumption of more than seven units per week was connected with markers of increased iron in the basal ganglia, a set of brain regions involved with motor control, procedural learning, eye movement, cognition, emotion, and other functions. Iron accumulation in some brain regions was linked to worse cognitive function.

This is the largest study to date of moderate alcohol consumption and iron accumulation. Although drinking was self-reported and could be underestimated, this was considered the only feasible method to establish such a large cohort's intake. A limitation of the work is that MRI-derived measures are indirect representations of brain iron, and could conflate other brain changes observed with alcohol consumption with changes in iron levels.

Given the prevalence of moderate drinking, even small associations can have a substantial impact across whole populations, and there could be benefits in interventions to reduce consumption in the general population.

Topiwala adds, "In the largest study to date, we found drinking greater than 7 units of alcohol weekly associated with iron accumulation in the brain. Higher brain iron in turn linked to poorer cognitive performance. Iron accumulation could underlie alcohol-related cognitive decline."

Sci Tech Daily, 26 August 2022

https://scitechdaily.com

Despite international waters representing nearly two-thirds of the world's oceans, only 1.2% is protected.

Efforts to pass global ocean protection treaty fail

2022-08-28

A fifth effort to pass a global agreement to protect the world's oceans and marine life has failed.

Talks to pass the UN High Seas Treaty had been ongoing for two weeks in New York, but governments could not agree on the terms.

Despite international waters representing nearly two-thirds of the world's oceans, only 1.2% is protected.

Environmental campaigners have called it a "missed opportunity".

The last international agreement on ocean protection was signed 40 years ago in 1982 - the UN Convention on the Law of the Sea.

That agreement established an area called the high seas - international waters where all countries have a right to fish, ship and do research.

Marine life living outside of the 1.2% of protected areas are at risk of exploitation from the increasing threats of climate change, overfishing and shipping traffic.

Over the last two weeks 168 members of the original treaty, including the EU, came together to try and make a new agreement.

The International Union for the Conservation of Nature (IUCN) that documents the status of the world's biodiversity spoke to BBC News during the conference.

Their Senior High Seas Advisor, Kristina Gjerde, explained why this treaty was so important: "The high seas are the vital blue heart of the planet.

"What happens on the high seas affects our coastal communities, affects our fisheries, affects our biodiversity - things we all care so much about."

The negotiations focused on four key areas:

- Establishing marine protected areas
- Improving environmental impact assessments
- Providing finance and capacity building to developing countries
- Sharing of marine genetic resources - biological material from plants and animals in the ocean that can have benefits for society, such as pharmaceuticals, industrial processes and food

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More than 70 countries - including the UK - prior to the meeting had already agreed to put 30% of the world's oceans into protected areas.

This would put limits on how much fishing can take place, the routes of shipping lanes and exploration activities like deep sea mining.

Deep-sea mining is when minerals are taken from the sea bed that is 200m or more below the surface. These minerals include cobalt which is used for electronics, but the process could also be toxic for marine life, according to the IUCN.

As of March 2022, the International Seabed Authority, which regulates these activities, had issued 31 contracts to explore the deep sea for minerals.

- Renewables' deep-sea mining conundrum
- Nearly a quarter of Earth's seafloor now mapped

But countries failed to reach agreement on key issues of fishing rights and also funding and support for developing countries.

World Wildlife Foundation's (WWF) Senior Ocean Governance Expert Jessica Battle - who was at the negotiations - told BBC News that the Arctic was a divisive issue: "As it opens up due to climate change and we have much shorter winters, that is going to open up a whole new area of extraction."

There are concerns that without this treaty not only will marine species not be protected but also some species will never be discovered before they become extinct.

Research published earlier this year, and funded by the National Oceanic and Atmospheric Administration, suggests that between 10% and 15% of marine species are already at risk of extinction.

Sharks and rays are among the species set to lose out from the failure to pass the treaty.

According to the IUCN they are facing a global extinction crisis - and are one of the most threatened species groups in the world.

Sharks and other migratory species such as turtles and whales move through the world's oceans interacting with human activities like shipping which can cause them severe injuries and death.

All species of sharks and rays are also overfished - leading to rapid population decline.

Such reduction in animal numbers have been observed across most major marine groups.

It is not yet clear when countries will come back together to continue negotiations - but a deadline has been set for the end of the year.

They have a jam-packed calendar of international meetings on other matters between now and January - including the annual climate conference COP27 and the UN General Assembly meeting.

If the treaty does get signed there will still be further work to do.

The treaty will not outline what areas of the ocean will be placed under marine protection - just the process by which organisations and countries can apply for it.

Equally the treaty is not expected to include exact figures on what financial support developing nations will receive from developed countries, Liz Karan Project Director for the Pews High Seas Campaign told BBC News.

And Ms Karan said in the previous treaty from 1982 there were promises for support that were not fulfilled, and this has left some developing nations frustrated.

The fate of the oceans also depends on global action on climate change - which is decided as part of other UN negotiations.

The world's seas have absorbed 90% of the warming that has occurred due to increasing greenhouse gases produced by human activities, according to Nasa.

"The half of our planet which is high seas is protecting terrestrial life from the worst impacts of climate change," said Prof Alex Rogers from Oxford University, UK, who has provided evidence to inform the UN treaty process.

BBC News, 28 August 2022

https://bbc.com

In 2021 alone, global e-waste surged at 57.5 million tons, and only 17.4% of that was recycled.

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Print, recycle, repeat: Scientists demonstrate a biodegradable printed circuit

2022-08-29

According to the United Nations, less than a quarter of all U.S. electronic waste gets recycled. In 2021 alone, global e-waste surged at 57.5 million tons, and only 17.4% of that was recycled.

Some experts predict that our e-waste problem will only get worse over time, because most electronics on the market today are designed for portability, not recyclability. Tablets and readers, for example, are assembled by gluing circuits, chips, and hard drives to thin layers of plastic, which must be melted to extract precious metals like copper and gold. Burning plastic releases toxic gases into the atmosphere, and electronics wasting away in landfill often contain harmful materials like mercury, lead, and beryllium.

But now, a team of researchers from the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and UC Berkeley have developed a potential solution: a fully recyclable and biodegradable printed circuit. The researchers, who reported the new device in the journal Advanced Materials, say that the advance could divert wearable devices and other flexible electronics from landfill, and mitigate the health and environmental hazards posed by heavy metal waste.

"When it comes to plastic e-waste, it's easy to say it's impossible to solve and walk away," said senior author Ting Xu, a faculty senior scientist in Berkeley Lab's Materials Sciences Division, and professor of chemistry and materials science and engineering at UC Berkeley. "But scientists are finding more evidence of significant health and environmental concerns caused by e-waste leaching into the soil and groundwater. With this study, we're showing that even though you can't solve the whole problem yet, you can at least tackle the problem of recovering heavy metals without polluting the environment."

Putting enzymes to work

In a previous Nature study, Xu and her team demonstrated a biodegradable plastic material embedded with purified enzymes such as Burkholderia cepacian lipase (BC-lipase). Through that work, they discovered that hot water activates BC-lipase, prompting the enzyme to degrade polymer chains into monomer building blocks. They also learned that BC-lipase is a finicky "eater." Before a lipase can convert a polymer chain into monomers, it must first catch the end of a polymer chain. By

controlling when the lipase finds the chain end, it is possible to ensure the materials don't degrade until the water reaches a certain temperature.

For the current study, Xu and her team simplified the process even further. Instead of expensive purified enzymes, the biodegradable printed circuits rely on cheaper, shelf-ready BC lipase "cocktails." This significantly reduces costs, facilitating the printed circuit's entry into mass manufacturing, Xu said.

By doing so, the researchers advanced the technology, enabling them to develop a printable "conductive ink" composed of biodegradable polyester binders, conductive fillers such as silver flakes or carbon black, and commercially available enzyme cocktails. The ink gets its electrical conductivity from the silver or carbon black particles, and the biodegradable polyester binders act as a glue.

The researchers supplied a commercial 3D printer with the conductive ink to print circuit patterns onto various surfaces such as hard biodegradable plastic, flexible biodegradable plastic, and cloth. This proved that the ink adheres to a variety of materials, and forms an integrated device once the ink dries.

To test its shelf life and durability, the researchers stored a printed circuit in a laboratory drawer without controlled humidity or temperature for seven months. After pulling the circuit from storage, the researchers applied continuous electrical voltage to the device for a month and found that the circuit conducted electricity just as well as it did before storage.

Next, the researchers put the device's recyclability to test by immersing it in warm water. Within 72 hours, the circuit materials degraded into its constituent parts—the silver particles completely separated from the polymer binders, and the polymers broke down into reusable monomers, allowing the researchers to easily recover the metals without additional processing. By the end of this experiment, they determined that approximately 94% of the silver particles can be recycled and reused with similar device performance.

That the circuit's degradability continued after 30 days of operation surprised the researchers, suggesting that the enzymes were still active. "We were surprised that the enzymes 'lived' for so long. Enzymes aren't designed to work in an electric field," Xu said.

Xu attributes the working enzymes' longevity to the biodegradable plastic's molecular structure. In their previous study, the researchers

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learned that adding an enzyme protectant called random heteropolymer, or RHP, helps to disperse the enzymes within the mixture in clusters a few nanometers (billionths of a meter) in size. This creates a safe place in the plastic for enzymes to lie dormant until they're called to action.

The circuit also shows promise as a sustainable alternative to single-use plastics used in transient electronics—devices such as biomedical implants or environmental sensors that disintegrate over a period of time, said lead author Junpyo Kwon, a Ph.D. student researcher from the Xu Group at UC Berkeley.

Now that they've demonstrated a biodegradable and recyclable printed circuit, Xu wants to demonstrate a printable, recyclable, and biodegradable microchip.

"Given how sophisticated chips are nowadays, this certainly won't be easy. But we have to try and give our level best," she said.

Tech Xplore, 29 August 2022

https://techxplore.com

'Synthetic milk' made without cows may be coming to supermarket shelves near you

2022-08-29

The global dairy industry is changing. Among the disruptions is competition from food alternatives not produced using animals—including potential challenges posed by synthetic milk.

Synthetic milk does not require cows or other animals. It can have the same biochemical make up as animal milk, but is grown using an emerging biotechnology technique know as "precision fermentation" that produces biomass cultured from cells.

More than 80% of the world's population regularly consume dairy products. There have been increasing calls to move beyond animal-based food systems to more sustainable forms of food production.

Synthetic milks offer dairy milk without concerns such as methane emissions or animal welfare. But it must overcome many challenges and pitfalls to become a fair, sustainable and viable alternative to animal-based milk.

Not a sci-fi fantasy

Unlike synthetic meat—which can struggle to match the complexity and texture of animal meat—synthetic milk is touted as having the same taste, look and feel as normal dairy milk.

My recent research examined megatrends in the global dairy sector. Plant-based milks and, potentially, synthetic milks, emerged as a key disruption.

Unlike synthetic meat—which can struggle to match the complexity and texture of animal meat—synthetic milk is touted as having the same taste, look and feel as normal dairy milk.

Synthetic milk is not a sci-fi fantasy; it already exists. In the U.S., for example, the Perfect Day company supplies animal-free protein made from microflora, which is then used to make ice cream, protein powder and milk.

In Australia, start-up company Eden Brew has been developing synthetic milk at Werribee in Victoria. The company is targeting consumers increasingly concerned about climate change and, in particular, the contribution of methane from dairy cows.

CSIRO reportedly developed the technology behind the Eden Brew product. The process starts with yeast and uses "precision fermentation" to produce the same proteins found in cow milk.

CSIRO says these proteins give milk many of its key properties and contribute to its creamy texture and frothing ability. Minerals, sugars, fats and flavors are added to the protein base to create the final product.

Toward a new food system?

Also in Australia, the All G Foods company this month raised A$25 million to accelerate production of its synthetic milk. Within seven years, the company wants its synthetic milk to be cheaper than cow milk.

If the synthetic milk industry can achieve this cost aim across the board, the potential to disrupt the dairy industry is high. It could steer humanity further away from traditional animal agriculture towards radically different food systems.

A 2019 report into the future of dairy found that by 2030, the U.S. precision fermentation industry will create at least 700,000 jobs.

And if synthetic milk can replace dairy as an ingredient in the industrial food processing sector, this could present significant challenges for companies that produce milk powder for the ingredient market.

Some traditional dairy companies are jumping on the bandwagon. For example, Australian dairy co-operative Norco is backing the Eden Brew project, and New Zealand dairy cooperative Fonterra last week annouced

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a joint venture to develop and commercialize "fermentation-derived proteins with dairy-like properties."

Synthetic milk: The whey forward?

The synthetic milk industry must grow exponentially before it becomes a sizeable threat to animal-based dairy milk. This will require a lot of capital and investment in research and development, as well as new manufacturing infrastructure such as fermentation tanks and bioreactors.

Production of conventional animal-milk in the Global South now outstrips that of the Global North, largely due to rapid growth across Asia. Certainly, the traditional dairy industry is not going away any time soon.

And synthetic milk is not a panacea. While the technology has huge potential for environmental and animal welfare gains, it comes with challenges and potential downsides.

For example, alternative proteins do not necessarily challenge the corporatization or homogenization of conventional industrial agriculture. This means big synthetic milk producers might push out low-tech or small-scale dairy—and alternative dairy—systems.

What's more, synthetic milk could further displace many people from the global dairy sector. If traditional dairy co-ops in Australia and New Zealand are moving into synthetic milk, for example, where does this leave dairy farmers?

As synthetic milk gains ground in coming years, we must guard against replicating existing inequities in the current food system.

And the traditional dairy sector must recognize it's on the cusp of pivotal change. In the face of multiple threats, it should maximize the social benefits of both animal-based dairy and minimize its contribution to climate change.

Phys Org, 29 August 2022

https://phys.org

Infrared laser charger wirelessly beams power to devices 100 ft away

2022-08-30

We're all used to receiving data wirelessly, but transmitting power over the air has been much trickier. Now Korean engineers have demonstrated a

new system that uses infrared lasers to beam power as far as 100 ft (30 m), which could eventually lead to technology that automatically charges your phone as soon as you walk into a room.

Wireless charging is already a feature on current phones and other devices, but it's functionally not much better than just plugging in a cord. The device usually needs to sit in a dock or make contact with a special surface, and can't be moved far while charging.

For wireless charging to be really useful it would need to work over longer distances, sending power as seamlessly as Wi-Fi sends data. Scientists are working on that goal, experimenting with transmitting microwaves or lasers to devices, or generating electromagnetic fields that fill a room, but it often requires bulky and complex equipment.

For the new study, scientists at Sejong University developed a new wireless charging system that uses infrared light over a decent distance. It's made up of two main parts – a transmitter that can be set up in a room, and a receiver that could be incorporated into electronic devices. The transmitter is an optical power source that uses an erbium-doped fiber amplifier, which produces a beam of infrared light with a central wavelength of 1,550 nanometers (nm).

Wireless charging is already a feature on current phones and other devices, but it's functionally not much better than just plugging in a cord.

This beam is then fired through the air to hit the receiver, which is made up of a spherical lens retroreflector. This focuses the incoming light into a point in the center, where there's a photovoltaic cell waiting to absorb the light and produce electricity. If the line-of-sight between transmitter and receiver is broken, the device quickly and automatically switches to a low-intensity safe mode.

In tests, the team was able to transmit a 400-mW beam of light over a distance of 100 ft, where the 10 x 10-mm (0.4-in) receiver converted it into 85 mW of electrical power. That's not a whole lot of energy – maybe enough to power a small sensor or two – but the team says that it could be scaled up to the point of charging everyday electronics like phones. Systems that work on a similar principle are being tested on more of a grid scale, to replace power lines.

The design has a few other advantages over previous wireless power systems. For one it doesn't require a full-room renovation like some. The receiver's ball shape lets it pick up incoming beams from any direction, meaning the transmitter doesn't need to lock on or track the receiver, which is the case in things like Xiami's Mi Air Charge system. It also works

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over much longer distances than devices like Duke University's wall-mounted panels.

The team is currently working on improving the efficiency of the photovoltaic cell to boost the electrical output, as well as finding ways to charge multiple devices at once.

The research was published in the journal Optics Express.

New Atlas, 30 August 2022

https://newatlas.com

Thought To Be Impossible – New Method Could Diagnose Early-Stage Parkinson's Disease

2022-08-29

Parkinson's disease is a debilitating brain condition that worsens with time and affects sufferers' ability to walk and even talk. It's complex to diagnose, and in the early stages – impossible.

Most of us are acquainted with a method known as MRI, which is often used to visualize brain structure. However, it is currently only used to rule out other potential diagnoses since it is not sensitive enough to show the biological changes that occur in Parkinson's patients' brains.

Parkinson's disease may be detected in its early stages through the use of special brain scans.

Researchers at the Hebrew University of Jerusalem (HU), under the direction of Professor Aviv Mezer, came to the conclusion that by modifying a related method known as quantitative MRI (qMRI), it could be possible to reveal the cellular changes in Parkinson's. With the use of their technique, they were able to examine the microstructures of the striatum, an area of the deep brain that is known to degenerate as Parkinson's disease progresses.

Using a new method of analysis, developed by Mezer's doctoral student, Elior Drori, biological changes in the cellar tissue of the striatum were clearly revealed. Moreover, they were able to demonstrate that these changes were associated with the early stages of Parkinson's and patients' movement dysfunction. Their findings were recently published in the prestigious journal Science Advances.

qMRI achieves its sensitivity by taking several MRI images using different excitation energies – rather than taking the same photograph in different colors of lighting. The HU researchers were able to use their qMRI analysis to reveal changes in the tissue structure within distinct regions of the

striatum. The structural sensitivity of these measurements could only have been previously achieved in laboratories examining the brain cells of patients post-mortem. Not an ideal situation for detecting early disease or monitoring the efficacy of a drug!

"When you don't have measurements, you don't know what is normal and what is abnormal brain structure, and what is changing during the progress of the disease," explained Mezer. The new information will facilitate early diagnosis of the disease and provide "markers" for monitoring the efficacy of future drug therapies.

"What we have discovered," he continued "is the tip of the iceberg." It is a technique that they will now extend to investigate microstructural changes in other regions of the brain. Furthermore, the team is now developing qMRI into a tool that can be used in a clinical setting. Mezer anticipates that is about 3-5 years down the line.

Drori further suggests that this type of analysis will enable the identification of subgroups within the population suffering from Parkinson's disease – some of whom may respond differently to some drugs than others. Ultimately, he sees this analysis as "leading to personalized treatment, allowing future discoveries of drug with each person receiving the most appropriate drug."

Sci Tech Daily, 29 August 2022

https://scitechdaily.com

Researchers produce nanodiamonds capable of delivering medicinal and cosmetic remedies through the skin

2022-08-30

The skin is one of the largest and most accessible organs in the human body, but penetrating its deep layers for medicinal and cosmetic treatments still eludes science.

Although there are some remedies—such as nicotine patches to stop smoking—administered through the skin, this method of treatment is rare since the particles that penetrate must be no larger than 100 nanometers. Creating effective tools using such tiny particles is a great challenge. Because the particles are so small and difficult to see, it is equally challenging to determine their exact location inside the body—information necessary to ensure that they reach intended target tissue.

Although there are some remedies—such as nicotine patches to stop smoking—administered through the skin, this method of treatment is rare since the particles that penetrate must be no larger than 100 nanometers.

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Today such information is obtained through invasive, often painful, biopsies.

A novel approach, developed by researchers at Bar-Ilan University in Israel, provides an innovative solution to overcoming both of these challenges. Combining techniques in nanotechnology and optics, they produced tiny (nanometric) diamond particles so small that they are capable of penetrating skin to deliver medicinal and cosmetic remedies. In addition, they created a safe, laser-based optical method that quantifies nanodiamond penetration into the various layers of the skin and determines their location and concentration within body tissue in a non-invasive manner—eliminating the need for a biopsy.

This innovation was just published by researchers from the University's Institute of Nanotechnology and Advanced Materials, in cooperation with the Kofkin Faculty of Engineering and Department of Chemistry, in the scientific journal ACS Nano.

Nanodiamonds—a millionth of a millimeter in size—are produced by detonating explosives inside a closed chamber. Under these conditions high temperature and pressure cause the carbon atoms found in explosives to fuse together. The nanodiamonds created in the process are small enough to penetrate tissue—and even cells—without inflicting harm.

Nanodiamonds and drug delivery

Much like trucks that make deliveries, artificial diamonds can deliver various medications to intended targets, and their distance and location may be controlled due to the minute size of the nanodiamonds. The approach to drug delivery using nanoparticles has already proven successful in previous research.

The nanodiamonds newly developed at Bar-Ilan University have also been proven effective antioxidants. This property ensures that particles penetrating the body are both safe and therapeutic, as their chemical properties allow them to be coated with medication prior to their insertion into the body.

Tracking nanodiamonds through optics

The optical method developed by the research team enables them to identify relative nanodiamond concentrations of particles in the different layers of skin (epidermis, dermis and fat) through safe and non-invasive sensing based on a blue wavelength laser, a unique finding in itself given

the fact that red wavelength lasers are generally used in human medical exams and treatments. To determine their location in the skin and in what concentration, patients are briefly exposed to the blue laser beam. An optical system creates a photograph-like 3D image through which optical changes in treated tissue can be extracted and compared to adjacent, untreated tissue using a specially-created algorithm.

"This is a significant development in dermatology and in optical engineering," says Prof. Dror Fixler, Director of the Institute of Nanotechnology and Advanced Materials at Bar-Ilan University and a member of the research team. "It could open the door to developing drugs applied through the skin alongside modern cosmetic preparations using advanced nanotechnology." Fixler's research, assisted by researcher Channa Shapira and others, demonstrates the importance of optical innovation in clinical application.

Phys Org, 30 August 2022

https://phys.org

MOXIE Experiment Successfully Making Oxygen on Mars

2022-08-31

Day and night, and across seasons, the instrument reliably generates breathable oxygen from the Red Planet's thin atmosphere.

Nearly 100 million miles from Earth, on the red and dusty surface of Mars, an instrument the size of a lunchbox is proving it can reliably do the work of a small tree.

The MIT-led Mars Oxygen In-Situ Resource Utilization Experiment, or MOXIE, has been successfully producing oxygen from the Red Planet's carbon dioxide-rich atmosphere since April 2021. That was about two months after it touched down on the Martian surface as part of NASA's Perseverance rover and Mars 2020 mission.

In a study published today (August 31, 2022) in the journal Science Advances, researchers report that, by the end of 2021, MOXIE was able to produce oxygen on seven experimental runs. These were performed in a variety of atmospheric conditions, including during the day and night, and through different Martian seasons. In each experimental run, the instrument reached its target of producing six grams of oxygen per hour. This is about the rate of a modest tree on Earth.

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Scientists envision that a scaled-up version of MOXIE could be sent to Mars ahead of a human mission, where it could continuously produce oxygen at the rate of several hundred trees. At that capacity, the system should produce enough oxygen to sustain humans after they arrive, and also fuel a rocket for returning astronauts back to Earth.

MOXIE's consistent production so far is a promising first step toward that goal.

"We have learned a tremendous amount that will inform future systems at a larger scale," says Michael Hecht, principal investigator of the MOXIE mission at MIT's Haystack Observatory.

MOXIE's oxygen production on Mars also represents the first demonstration of "in-situ resource utilization." This is the idea of harvesting and using a planet's raw materials (in this case, carbon dioxide on Mars) to make resources (such as oxygen) that would otherwise have to be transported from Earth.

"This is the first demonstration of actually using resources on the surface of another planetary body, and transforming them chemically into something that would be useful for a human mission," says MOXIE deputy principal investigator Jeffrey Hoffman, a professor of the practice in MIT's Department of Aeronautics and Astronautics. "It's historic in that sense."

Hoffman and Hecht's MIT co-authors include MOXIE team members Jason SooHoo, Andrew Liu, Eric Hinterman, Maya Nasr, Shravan Hariharan, and Kyle Horn, along with collaborators from multiple institutions including NASA's Jet Propulsion Laboratory (JPL), which managed MOXIE's development, flight software, packaging, and testing prior to launch.

Seasonal air

The current version of MOXIE is small by design, in order to fit aboard the Perseverance rover. It was built to run for short periods, starting up and shutting down with each run, depending on the rover's exploration schedule and mission responsibilities. In contrast, a full-scale oxygen factory for Mars would include larger units that would ideally run continuously.

Despite the necessary constraints in MOXIE's current design, the instrument has shown it can efficiently and reliably convert Mars' atmosphere into pure oxygen. It does so by first pulling the Martian air in through a filter that cleans it of contaminants. The air is then pressurized, and sent through the Solid OXide Electrolyzer (SOXE). This instrument,

which was developed and built by OxEon Energy, electrochemically splits the carbon dioxide-rich air into oxygen ions and carbon monoxide.

The oxygen ions are then isolated and recombined to form breathable, molecular oxygen, or O2. MOXIE then measures this output for quantity and purity before releasing it harmlessly back into the air, along with carbon monoxide and other atmospheric gases.

Since the rover's landing in February 2021, MOXIE engineers have started up the instrument seven times throughout the Martian year. Each time it takes a few hours to warm up, then another hour to make oxygen before powering back down. Each run was scheduled for a different time of day or night, and in different seasons, to check whether MOXIE could accommodate shifts in the planet's atmospheric conditions.

"The atmosphere of Mars is far more variable than Earth," Hoffman notes. "The density of the air can vary by a factor of two through the year, and the temperature can vary by 100 degrees. One objective is to show we can run in all seasons."

So far, MOXIE has demonstrated that it can make oxygen at almost any time of the Martian day and year.

"The only thing we have not demonstrated is running at dawn or dusk, when the temperature is changing substantially," Hecht says. "We do have an ace up our sleeve that will let us do that, and once we test that in the lab, we can reach that last milestone to show we can really run any time."

Ahead of the game

As MOXIE continues to generate oxygen on Mars, engineers plan to push its capacity, and increase its production, particularly in the Martian spring, when atmospheric density and carbon dioxide levels are high.

"The next run coming up will be during the highest density of the year, and we just want to make as much oxygen as we can," Hecht says. "So we'll set everything as high as we dare, and let it run as long as we can."

They will also monitor the system for indications of wear and tear. Since MOXIE is just one experiment among several aboard the Perseverance rover, it cannot run continuously as a full-scale system would. Instead, the instrument must start up and shut down with each run. This causes thermal stress that can degrade the system over time.

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If MOXIE can operate successfully despite repeatedly turning on and off, this would suggest that a full-scale system, designed to run continuously, could do so for thousands of hours.

"To support a human mission to Mars, we have to bring a lot of stuff from Earth, like computers, spacesuits, and habitats," Hoffman says. "But dumb old oxygen? If you can make it there, go for it — you're way ahead of the game."

Sci Tech Daily, 31 August 2022

https://scitechdaily.com

More than 90% of identifiable trash in North Pacific Garbage Patch comes from just six countries

2022-09-02

A team of researchers with the Ocean Cleanup project and Wageningen University, both in the Netherlands, has found via sampling and testing that more than 90% of the identifiable trash swirling around in the North Pacific Garbage Patch (NPGP) comes from just six countries, all of which are major industrialized fishing nations. They have published their research in Scientific Reports.

The researchers calculated that trash in the NPGP was 10 times more likely to come from fishing activities than land-based activities.

Prior research has shown that there is a giant island of trash floating atop the subtropical gyre in the North Pacific Ocean. Scientists have estimated that there are tens of thousands of tons of the trash, most of it plastic, covering millions of square kilometers. The existence of the NPGP has garnered a lot of headlines in recent years, though the source of the trash has not been identified—until now.

In this new effort, the researchers collected, sorted and studied 6,000 pieces of trash from the NPGP. Their goal was to find its source. To that end, they looked for words printed on debris as a means of identifying a language, or identifiable symbols, including logos.

The researchers found that approximately a third of their trash pieces were unidentifiable—they could not make out what sort of purposes they might have served or where they might have come from. But they did find that 26% of their haul was fishing-equipment based. They also found that plastic buoys and floats made up approximately 3% of the objects they found but took up a disproportionate amount of the mass in NPGP—21%.

The researchers were able to identify the country of origin for 232 objects, with the largest percentage being from Japan at 33.6%. China was next

at 32.3% followed by South Korea at 9.9%. Next on the list was the U.S. at 6.5%, Taiwan at 5.6% and Canada at 4.7%. Together, these six countries accounted for over 92% of the identifiable trash found in the NPGP. The researchers also calculated that trash in the NPGP was 10 times more likely to come from fishing activities than land-based activities. They conclude that all of the top six countries identified in their work engage regularly in massive fishing operations.

Phys Org, 2 September 2022

https://phys.org

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Unfolding the secrets of origami structures

2022-08-26

While most materials – from rubber bands to steel beams – thin out as they are stretched. The interlocking ridges and folds in origami structures behave differently, growing wider when pulled apart.

Researchers from Princeton University and Georgia Tech have developed a formula which can predict the behaviour of origami-inspired structures when they are stretched, pushed or bent. Their findings are published in the Proceedings of the National Academy of Sciences.

The structural properties of origami are increasingly used in the design of spacecraft components, medical robots and to improve solar cell efficiency. However much of this work has relied on trial and error, or instinct.

The researchers developed a set of equations which apply to the ways origami parallelograms (such as a square, rhombus or rectangle) made of thin material respond to certain kinds of mechanical stress.

They were particularly interested in the behaviour of materials and structures when stretched, like a stick of chewing gum which thins as it's pulled at both ends. This property can be described by the "Poisson ratio" which is the ratio of compression along one axis, with stretching along the other.

"Most materials have a positive Poisson ratio", this means they thin out when stretched, says paper co-author and Professor of Engineering Glaucio Paulino from Princeton.

"Cork has a zero Poisson ratio, and that is the only reason you can put the cork back in a wine bottle."

Having developed a formula to predict how origami-inspired structures would behave under this kind of stress, they then used the equations to create origami structures with a negative Poisson ratio – able to grow wider instead of narrower when pulled, and structures which snapped into dome shapes when bent, instead of sagging into a saddle shape.

Zeb Rocklin, an assistant physics professor at Georgia Tech and a co-author of the paper, said that origami presented fascinating and contradictory behaviours.

"Usually, if you take a thin sheet or slab and you pull on it, it will retract in the middle. If you take the same sheet and bend it upwards, it will usually

A formula that can predict the behaviour of origami structures under stress could have wider applications in the design of spacecraft, robots and antenna arrays.

form a Pringle – or saddle – shape. Some materials instead thicken when you pull on them, and those always form domes rather than saddles. The amount of thinning always predicts the amount of bending," he says.

"The bending of these origami is exactly the opposite of all conventional materials," Rocklin says.

Many researchers have spent years trying to define rules for different classes, folding patterns and shapes of origami. Rocklin says the research team discovered the class of origami was not important, rather it was the way the folds interacted which was key.

In the future, the research team intends to build on their work by examining more complex origami systems.

"We would like to try to validate this for different patterns, different configurations; to make sense of the theory and validate it," Paulino says. "For example, we need to investigate patterns such as the blockfold pattern, which is quite intriguing."

Cosmos, 26 August 2022

https://cosmosmagazine.com

Turning Cancer Cells Into Normal Cells

2022-08-25

A recent study explains how changing the chemical modifications, or so-called epigenetics, of a specific type of leukemia cell's genetic material, the messenger RNA, leads to the transformation of highly proliferative leukemia cells into normal cells that no longer multiply.

The study, which was published in the journal Leukemia, is authored by Alberto Bueno-Costa, a researcher in the group of Dr. Manel Esteller, supervisor of the research and Director of the Josep Carreras Leukaemia Research Institute, ICREA Researcher and Professor at the University of Barcelona.

Cancer is a condition in which a healthy cell changes into a malignant one with entirely new traits, such as the ability to divide uncontrollably. Numerous molecular alterations that cause this transformation of healthy tissue into tumor tissue have been identified via extensive research in recent years. However, nothing is known about the opposite process, which involves changing a cancer cell into a normal, non-cancerous one, and the variables that may be involved in this process.

A mechanism is discovered that explains how cancer cells transform into normal, harmless ones.

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"We know that one strategy that human tumors have to dodge the effectiveness of drugs is to change their appearance, becoming another similar cancer but insensitive to the drug used. For example, leukemias of the lymphoid lineage are switched to the myeloid strain to escape treatment", explains Dr. Esteller. With this idea in mind, they wanted to know more about the molecular pathways involved in these cellular metamorphoses and studied an in vitro model where leukemia cells can be forced to turn into a type of harmless immune cells called macrophages.

Experimental results showed that the reversal of the malignant cells into macrophages involved a profound change in the chemical changes occurring on their messenger RNAs, the carriers that help proteins formation. In particular, the changes affected the distribution of an epigenetic mark called methylated adenine.

This change in the chemical accentuation of these molecules causes instability of the proteins that define leukemia while favoring the appearance of differentiated proteins characteristic of the normal cell that is being born, the macrophage. This process appears to be controlled by the METTL3 gene, a manufacturer of chemical modifications targeting messenger RNA.

This line of research, though still in the preclinical stage, looks quite promising and is worth further exploring as a new approach in the fight against leukemia. In fact, as Dr. Esteller points out, "the first preclinical drugs against this target have already been developed in experimental models of malignant blood diseases, so we provide another reason why these novel drugs could be useful in cancer therapies, particularly in the case of leukemias and lymphomas."

The more strategies being developed, the better for the thousands of patients diagnosed every year of blood malignancies. Perhaps, in the mid-term, turning leukemia cells into harmless types will be part of our arsenal against cancer.

Sci Tech Daily, 25 August 2022

https://scitechdaily.com

Temporary pacemaker can fully dissolve into the body

2022-08-23

Sometimes, durability is the last thing one might want in a medical device. Implants that dissolve into the body after they serve their purpose

save the trouble of needing to be removed. Now scientists have taken temporary implants to a new level—by making a fully biodegradable pacemaker and pairing it with a control system to make it practical.

People recovering from cardiovascular surgery often need a temporary pacemaker, which needs to be extricated several weeks later. But the second surgery is riskier than the first—by then, scar tissue will have grown on the heart around the implant. If not careful, surgeons might rip this tissue along with the healthy muscle underneath. The consequences can be fatal: astronaut Neil Armstrong died in 2012 from such complications soon after an operation to extract his pacemaker.

Materials scientist John Rogers of Northwestern University and colleagues have developed a pacemaker the size of a quarter that can dissolve away a few weeks after its installment (Science 2022, DOI: 10.1126/science.abm1703). Rogers presented the research on Monday at the American Chemical Society Fall 2022 meeting in the Division of Analytical Chemistry.

"It's a beautiful piece of work," says Helen Tran, a molecular architect at the University of Toronto who didn't participate in the research. "It's like science fiction, but reality."

The researchers fashioned their pacemaker's electrical conduits from magnesium and the interconnects from molybdenum; both metals eventually solubilize. The pacemaker's semiconductor element is a silicon chip less than 100 nm thick, which makes it amenable to full hydrolysis within the device's lifetime. Encapsulating the pacemaker is a stretchy polyurethane sheath that breaks down in the body after a few weeks.

This isn't the group's first attempt at assembling a bioresorbable pacemaker. But this version pairs with a network of wearable accessories that work in sync with the device. These wearable electronic modules collect data from different parts of the body, which they use to modulate the pacemaker's rhythm accordingly. A chest unit worn above the heart delivers power wirelessly to the pacemaker underneath.

"Everything works together," Rogers told C&EN. "This technology would allow patients to be released from the hospital earlier…because of the wireless operation and the ability to deliver this function in a home setting."

So far tested only in animal models for its function and degradability and on a human heart ex vivo, the pacemaker will need to cross regulatory hurdles before being implanted in people. Tran says she also hopes to

"It's a beautiful piece of work," says Helen Tran, a molecular architect […] "It's like science fiction, but reality."

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see toxicity studies on the pacemaker as it decomposes, to ensure that all intermediate by-products are truly harmless to the body.

At the meeting, Rogers also reported the invention of a transient electrical nerve stimulator (Nat. Med. 2018, DOI: 10.1038/s41591-018-0196-2) and a short-lasting cuff that wraps around nerves to relieve pain (Science 2022, DOI: 10.1126/science.abl8532), both intended for postsurgical care. Down the line, he hopes to extend the lifetime of his devices from weeks to months to treat slower healing injuries, such as bone fractures.

C&EN, 23 August 2022

https://cen.acs.org

The US has ruled all taxpayer-funded research must be free to read. What's the benefit of open access?

2022-08-30

Last week, the United States announced an updated policy guidance on open access that will substantially expand public access to science not just in America, but worldwide.

As per the guidance, all US federal agencies must put in place policies and plans so anyone anywhere can immediately and freely access the peer-reviewed publications and data arising from research they fund.

The policies need to be in place by the end of 2025, according to President Biden's White House Office of Science and Technology Policy (OSTP).

A substantial step

The new guidance builds on a previous memo issued by then president Barack Obama's office in 2013. That one only applied to the largest funding agencies and, in a crucial difference, allowed for a 12-month delay or embargo for the publications to be available.

Now we're seeing a substantial step forward in a lengthy effort – extending back to the beginning of this century – to open up access to the world's research.

We can expect it to act as a catalyst for more policy changes globally. It's also especially timely given UNESCO's Open Science Recommendation adopted in 2021. The new OSTP guidance emphasises the primary intention is for the US public to have immediate access to research funded by their tax dollars.

Open access matters for both the public and academics, as the fast-moving emergency of the COVID-19 pandemic amply demonstrated.

But thanks to the conditions for opening up said research, people worldwide will benefit.

A discriminatory system

It might seem obvious that with our ubiquitous internet access, there should already be immediate open access to publicly funded research. But that isn't the case for most published studies.

Changing the system has been challenging, not least because academic publishing is dominated by a small number of highly profitable and powerful publishers.

Open access matters for both the public and academics, as the fast-moving emergency of the COVID-19 pandemic amply demonstrated.

Even academics at well-funded universities can mostly only access journals their universities subscribe to – and no institution can afford to subscribe to everything published. Last year, estimates suggest some 2 million research articles were published. People outside a university – in a small company, a college, a GP practice, a newsroom, or citizen scientists – have to pay for access.

As the new guidance notes, this lack of public access leads to "discrimination and structural inequalities… [that] prevent some communities from reaping the rewards of the scientific and technological advancements". Furthermore, lack of access leads to mistrust in research.

The accompanying OSTP memo highlights that future policies should support scientific and research integrity, with the aim of increasing public trust in science.

COVID-19 is not the first rapid global emergency, and it won't be the last. For example, doctors not being able to access research on Ebola may have directly led to a 2015 outbreak in West Africa.

In the early stages of the COVID-19 pandemic, the White House led calls for publishers to make COVID-19 publications open to all. Most (but not all) did and that call led to one of the biggest databases of openly available papers ever assembled – the CORD-19 database.

But not all of those COVID-19 papers will be permanently openly available, since some publishers put conditions on their accessibility. With the current spread of monkeypox, we are potentially facing another global emergency. In August this year, the White House once again called for publishers to make relevant research open.

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The OSTP guidance will finally mean that, at least for US federally funded research, the time of governments having to repeatedly call for publishers to make research open is over.

The situation in Australia

In Australia, we don't yet have a national approach to open access. The two national research funders, the NHMRC and ARC, have policies in place similar to the 2013 US guidance of a 12-month embargo period. The NHMRC consulted last year on an immediate open access policy.

All Australian universities provide access to their research through their repositories, although that access varies depending on individual universities' and publishers' policies. Most recently, the Council of Australian University Librarians negotiated a number of consortial open access deals with publishers. Cathy Foley, Australia's Chief Scientist, is also considering a national model for open access.

So what's next? As expected, perhaps, some of the larger publishers are already making the case for more funding for them to support this policy. It will be important that this policy doesn't lead to a financial bonanza for these already very profitable companies – nor a consolidation of their power.

Rather, it would be good to see financial support for innovation in publishing, and a recognition that we need a diversity of approaches to support an academic publishing system that works for the benefit of all.

The Conversation, 30 August 2022

https://theconversation.com

China and India approve nasal COVID vaccines — are they a game changer?

2022-09-07

Two needle-free COVID-19 vaccines that are delivered through the nose or mouth have been approved for use in China and India. China's new vaccine, announced on Sunday, is inhaled through the nose and mouth as an aerosolized mist, and India's, announced on Tuesday, is administered as drops in the nose.

These mucosal vaccines target thin mucous membranes that line the nose, mouth and lungs. By prompting immune responses where SARS-CoV-2 first enters the body, mucosal vaccines could, in theory, prevent even

Scientists hope the immunizations, delivered through the nose or mouth, will prevent even mild cases of illness.

mild cases of illness and block transmission to other people — something COVID-19 shots have been unable to do. Vaccines that produce sterilizing immunity would be game changing for the pandemic.

"These approvals validate the need for mucosal vaccines," says Marty Moore, co-founder of Meissa Vaccines in Redwood City, California, which is developing a COVID-19 immunization that is delivered through the nose. "That's the direction we need to go globally, and the United States needs to catch up."

The regulatory nods from China and India bring the number of approved COVID-19 mucosal vaccines in the world to four, including one already approved in Iran and another in Russia. More than 100 mucosal vaccines against the disease are in development globally, and about 20 have reached clinical trials in humans, according to Airfinity, a health-analytics company in London. Delivery methods include sprays, drops, aerosols and pills.

New arrivals

China's inhaled vaccine, developed by CanSino Biologics in Tianjin, contains the same ingredients as the company's COVID-19 shot that is already available in the country. A device called a nebulizer turns the liquid vaccine into an aerosol spray that is inhaled. China's health department and National Medical Products Administration approved the vaccine to be used as a booster dose.

India's vaccine, developed by Bharat Biotech in Hyderabad, is approved as a two-dose primary inoculation, rather than a booster.

Both companies have produced 'viral vector' vaccines that use a harmless adenovirus to deliver SARS-CoV-2 genetic material into host cells. Neither company has published phase III clinical trial data, but both say they have completed those studies.

Data from a phase II trial of CanSino's inhaled vaccine found that, when given as a booster, the vaccine raised blood serum antibody levels significantly more than did a boost from an injection. This suggests that the inhaled vaccine will offer protection that is as good as, or better than, that provided by the shot.

Similarly, Bharat compared its intranasal vaccine to Covaxin, a COVID-19 jab available in India, by measuring antibody levels in the blood. The company did not release results of this study, but deemed the trial "successful".

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Exactly how successful these vaccines will be is unclear. Expecting a vaccine to stop transmission of a virus or prevent even mild illness — achieving what is called sterilizing immunity — is a high bar. Bharat and CanSino won't know whether their vaccines can achieve this until they have conducted further efficacy studies.

Scant data is available on the efficacy of the two other mucosal COVID-19 vaccines. Iran approved a COVID-19 vaccine administered as a nasal spray and made by Razi Vaccine and Serum Research Institute in Karaj, in October 2021. More than 5000 doses have been delivered to the public. And Russia's health ministry is reported to have approved an intranasal spray version of Sputnik V, the country's injected COVID-19 vaccine.

Mucosal vaccines have been developed for other diseases, including poliovirus, influenza and cholera. Most of these vaccines are taken orally, and one, against flu, is administered through the nose.

Nature, 7 September 2022

https://nature.com

New form of lithium reacts 20 times as fast as powdered metal

2022-08-31

rganolithium reagents are stalwarts of synthesis commonly used to forge carbon-carbon bonds. Now, researchers say they have developed an improved method for preparing the purified, highly reactive lithium metal needed to make organolithiums in the lab, an approach that could prove useful for making other lithium-based compounds (J. Am. Chem. Soc. 2022, DOI: 10.1021/jacs.2c07207).

The method came about after Andy A. Thomas of Texas A&M University began a project that required his group to make some organolithiums in-house. One common approach involves reacting an organohalide with lithium powder, sometimes sold as a dispersion in mineral oil. The high surface area of the ground-up metal particles makes them reactive enough to exchange the halogen atom for lithium. But Thomas's team soon hit a snag.

"We couldn't find any lithium powders to do these lithium-halogen exchange reactions," Thomas recalls. He speculates that the dearth of commercial lithium powder might be due to high—and growing—demand for the metal from the battery sector.

Crystallized dendrites offer high purity and surface area when preparing organo-lithium reagents

Making lithium powder themselves would be onerous, especially on a small scale, Thomas says, so the researchers came up with a different approach. They started by dissolving lithium metal in liquid ammonia at −78 °C, which forms a soluble the lithium-ammonia complex Li(NH3)4+ along with solvated electrons. As the metal dissolves, the solution turns deep blue and then fiery bronze as more electrons enter solution.

Thomas's team then warmed the solution and used a vacuum pump to remove the ammonia. Gradually, pure lithium began to crystallize from the solution, forming spindly structures called dendrites that could be removed and stored under an inert atmosphere for later use. Thomas says that it's a simpler procedure than making lithium powder, which involves mixing up molten lithium in hot oil, and it's cheaper than buying the powder from a supplier. The whole process takes a couple of hours.

It also produces a product that is 20 times more reactive than the powder because the dendrites have roughly 100 times the surface area. "To my knowledge, it's the most reactive form of lithium that's available," Thomas says. Another advantage is that this recrystallized lithium is free of the impurities that commercial lithium powders and dispersions can build up, such as lithium oxide.

The researchers used their lithium dendrites to make a wide variety of organolithium reagents from organohalides, in yields at least as good as those from lithium powder. They also prepared organolithium reagents labeled with the isotope lithium-6, useful for nuclear magnetic resonance studies. Lithium-6 is much pricier than normal lithium metal, so being able to prepare these compounds with high purity on a very small scale is a boon, Thomas says.

"It's difficult to work at a very small scale with lithium powder, so I think from a practical perspective this is an innovation," says Eva Hevia of the University of Bern, who develops and studies organolithium reagents for synthesis and was not involved in the new study. She adds that the method may not be confined to making organolithiums: "You're generating a pure lithium source that is much more reactive," Hevia says, "so this could really open the door to preparing other lithium compounds."

C&EN, 31 August 2022

https://cen.acs.org

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A Mystery Solved: Why Does Coral Glow?

2022-08-29

For the first time, a recent study from Tel Aviv University, in association with the Steinhardt Museum of Natural History and the Interuniversity Institute for Marine Sciences in Eilat, has established that the magical phenomenon in deep reefs where corals exhibit glowing colors (fluorescence) is intended to serve as a mechanism for luring prey. The research demonstrates that the marine creatures that corals feed on are drawn to fluorescent colors.

Professor Yossi Loya from the School of Zoology and the Steinhardt Museum of Natural History at Tel Aviv University supervised the research, which was led by Dr. Or Ben-Zvi, Yoav Lindemann, and Dr. Gal Eyal.

According to the researchers, the ability of aquatic organisms to glow has long attracted both scientists and those who love nature. The biological role of the phenomena, which occurs often in corals that produce reefs, has been fiercely disputed.

A variety of possibilities have been explored over the years, including: Does this phenomenon defend against radiation? improve photosynthesis? an antioxidant activity? According to the most recent research, coral fluorescence actually serves as a lure for prey.

Researchers have proved for the first time that corals' fluorescent colors are intended to attract prey.

In the study, the researchers put their hypothesis to the test; to this end, they first sought to determine whether plankton (small organisms that drift in the sea along with the current) are attracted to fluorescence, both in the laboratory and at sea. Then, in the lab, the researchers quantified the predatory capabilities of mesophotic corals (corals that live between the shallow coral reef area and the deep, completely dark zone of the ocean), which exhibit different fluorescent appearances.

In order to test the planktons' potential attraction to fluorescence, the researchers used, inter alia, the crustacean Artemia salina, which is used in many experiments as well as for food for corals. The researchers noted that when the crustaceans were given a choice between a green or orange fluorescent target versus a clear "control" target, they showed a significant preference for the fluorescent target.

Moreover, when the crustaceans were given a choice between two clear targets, their choices were observed to be randomly distributed in the experimental setup. In all of the laboratory experiments, the crustaceans vastly exhibited a preferred attraction toward a fluorescent signal. Similar

results were presented when using a native crustacean from the Red Sea. However, unlike the crustaceans, fish that are not considered coral prey did not exhibit these trends, and rather avoided the fluorescent targets in general and the orange targets in particular.

In the second phase of the study, the experiment was carried out in the corals' natural habitat, about 40 meters deep in the sea, where the fluorescent traps (both green and orange) attracted twice as many plankton as the clear trap.

Dr. Or Ben-Zvi says, "We conducted an experiment in the depths of the sea in order to examine the possible attraction of diverse and natural collections of plankton to fluorescence, under the natural currents and light conditions that exist in deep water. Since fluorescence is 'activated' principally by blue light (the light of the depths of the sea), at these depths the fluorescence is naturally illuminated, and the data that emerged from the experiment were unequivocal, similar to the laboratory experiment."

In the last part of the study, the researchers examined the predation rates of mesophotic corals that were collected at 45-meter depth in the Gulf of Eilat and found that corals that displayed green fluorescence enjoyed predation rates that were 25 percent higher than corals exhibiting yellow fluorescence.

Professor Loya: "Many corals display a fluorescent color pattern that highlights their mouths or tentacle tips, a fact that supports the idea that fluorescence, like bioluminescence (the production of light by a chemical reaction), acts as a mechanism to attract prey. The study proves that the glowing and colorful appearance of corals can act as a lure to attract swimming plankton to ground-dwelling predators, such as corals, and especially in habitats where corals require other energy sources in addition or as a substitute for photosynthesis (sugar production by symbiotic algae inside the coral tissue using light energy)."

Dr. Ben-Zvi concludes: "Despite the gaps in the existing knowledge regarding the visual perception of fluorescence signals by plankton, the current study presents experimental evidence for the prey-luring role of fluorescence in corals. We suggest that this hypothesis, which we term the 'light trap hypothesis', may also apply to other fluorescent organisms

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in the sea, and that this phenomenon may play a greater role in marine ecosystems than previously thought."

Sci Tech Daily, 29 August 2022

https://scitechdaily.com

Excessive blue light from our gadgets may accelerate the aging process

2022-08-31

Too much screen use has been linked to obesity and psychological problems. Now a new study has identified a new problem—a study in fruit flies suggests our basic cellular functions could be impacted by the blue light emitted by these devices. These results are published in Frontiers in Aging.

"Excessive exposure to blue light from everyday devices, such as TVs, laptops, and phones, may have detrimental effects on a wide range of cells in our body, from skin and fat cells, to sensory neurons," said Dr. Jadwiga Giebultowicz, a professor at the Department of Integrative Biology at Oregon State University and senior author of this study. "We are the first to show that the levels of specific metabolites—chemicals that are essential for cells to function correctly—are altered in fruit flies exposed to blue light."

"Our study suggests that avoidance of excessive blue light exposure may be a good anti-aging strategy," advised Giebultowicz.

Turn off the light

The researchers at Oregon State University have previously shown that fruit flies exposed to light "turn on" stress protective genes, and that those kept in constant darkness lived longer.

"To understand why high-energy blue light is responsible for accelerating aging in fruit flies, we compared the levels of metabolites in flies exposed to blue light for two weeks to those kept in complete darkness," explained Giebultowicz.

Blue light exposure caused significant differences in the levels of metabolites measured by the researchers in the cells of fly heads. In particular, they found that the levels of the metabolite succinate were increased, but glutamate levels were lowered.

"Our study suggests that avoidance of excessive blue light exposure may be a good anti-aging strategy," advised Giebultowicz.

"Succinate is essential for producing the fuel for the function and growth of each cell. High levels of succinate after exposure to blue light can be compared to gas being in the pump but not getting into the car," said Giebultowicz. "Another troubling discovery was that molecules responsible for communication between neurons, such as glutamate, are at the lower level after blue light exposure."

Accelerating aging

The changes recorded by the researchers suggest that the cells are operating at suboptimal level, and this may cause their premature death, and further, explain their previous findings that blue light accelerates aging.

"LEDs have become the main illumination in display screens such as phones, desktops and TVs, as well as ambient lighting, so humans in advanced societies are exposed to blue light through LED lighting during most of their waking hours. The signaling chemicals in the cells of flies and humans are the same, so the there is potential for negative effects of blue light on humans," explains Giebultowicz.

Future work hopes to study the effects directly on human cells.

"We used a fairly strong blue light on the flies—humans are exposed to less intense light, so cellular damage may be less dramatic. The results from this study suggests that future research involving human cells is needed to establish the extent to which human cells may show similar changes in metabolites involved in energy production in response to excessive exposure to blue light," concluded Giebultowicz.

Medical Xpress, 31 August 2922

https://medicalxpress.com

A sustainable battery with a biodegradable electrolyte made from crab shells

2022-09-01

Accelerating demand for renewable energy and electric vehicles is sparking a high demand for the batteries that store generated energy and power engines. But the batteries behind these sustainability solutions aren't always sustainable themselves. In a paper publishing September 1 in the journal Matter, scientists create a zinc battery with a biodegradable electrolyte from an unexpected source—crab shells.

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"Vast quantities of batteries are being produced and consumed, raising the possibility of environmental problems," says lead author Liangbing Hu, director of the University of Maryland's Center for Materials Innovation. "For example, polypropylene and polycarbonate separators, which are widely used in Lithium-ion batteries, take hundreds or thousands of years to degrade and add to environmental burden."

Batteries use an electrolyte to shuttle ions back and forth between positively and negatively charged terminals. An electrolyte can be a liquid, paste, or gel, and many batteries use flammable or corrosive chemicals for this function. This new battery, which could store power from large-scale wind and solar sources, uses a gel electrolyte made from a biological material called chitosan.

"Chitosan is a derivative product of chitin. Chitin has a lot of sources, including the cell walls of fungi, the exoskeletons of crustaceans, and squid pens," says Hu. "The most abundant source of chitosan is the exoskeletons of crustaceans, including crabs, shrimps and lobsters, which can be easily obtained from seafood waste. You can find it on your table."

A biodegradable electrolyte means that about two thirds of the battery could be broken down by microbes—this chitosan electrolyte broke down completely within five months. This leaves behind the metal component, in this case zinc, rather than lead or lithium, which could be recycled.

"Zinc is more abundant in earth's crust than lithium," says Hu. "Generally speaking, well-developed zinc batteries are cheaper and safer." This zinc and chitosan battery has an energy efficiency of 99.7% after 1,000 battery cycles, making it a viable option for storing energy generated by wind and solar for transfer to power grids.

Hu and his team hope to continue working on making batteries even more environmentally friendly, including the manufacturing process. "In the future, I hope all components in batteries are biodegradable," says Hu. "Not only the material itself but also the fabrication process of biomaterials."

Tech Xplore, 1 September 2022

https://tecxplore.com

A biodegradable electrolyte means that about two thirds of the battery could be broken down by microbes—this chitosan electrolyte broke down completely within five months.

The Earth is full of diamonds

2022-09-04

Diamonds are a world's best friend.

And Earth, it happens, is a veritable diamond factory.

But pump the brakes on your bobcat, because the diamonds we're talking about are pretty difficult to reach.

Research out of Arizona State University published in Geophysical Research Letters suggests the boundary between the planet's core and mantle is riddled with diamond and rust.

Working in the Advanced Photon Source at Argonne National Laboratory, the research team determined this by simulating the conditions present at the core-mantle boundary.

At this boundary, temperatures are more than twice as hot as molten lava – enough to release water from present iron minerals to create a rusting effect similar to that which occurs on surface-level iron.

Reactions between water and these minerals are also believed to squeeze-out carbon, which pressures into diamond due to the immense forces acting beneath the surface.

That should excite jewellers the world over, at least those with a drill capable of digging nearly three thousand kilometres beneath the planet's crust.

"It might have been going on for billions of years"

Earth's mantle is the mainly solid layer of rock immediately beneath the planet's crust. By comparison, the outer core is a hellish world of liquefied iron and other elements.

One of those is carbon.

The researchers, led by Arizona postdoctoral researcher Byeongkwan Ko, found that lab-simulated reactions between iron-carbon alloys and water results in diamond production, at least when the temperature and pressure conditions that exist deep below Earth's surface are recreated.

These reactions may also help push carbon further into the mantle, changing previous understandings of the Earth's carbon composition.

Previously, carbon was believed to be relatively low in the mantle, compared to levels present in the core.

But the recreation of these carbon processes in the lab may explain that much higher amounts of carbon are fed into the mantle from the liquid iron beneath.

Scientists say a layer of diamonds and rust exists at the boundary between mantle and core.

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It's a process that might have taken place for eons.

"The new discovery of a carbon transfer mechanism from the core to the mantle will shed light on the understanding of the carbon cycle in the Earth's deep interior," Byeongkwan says.

"This is even more exciting given that the diamond formation at the core-mantle boundary might have been going on for billions of years since the initiation of subduction on the planet."

Cosmos, 4 September 2022

https://cosmosmagazine.com

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