CHEMWATCH

Bulletin Board

Contents

JUN. 09, 2023

(click on page numbers for links)

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CHEMWATCH
Bulletin Board
Contents
JUN. 09, 2023

ASIA PACIFIC

Model Work Health and Safety Regulations Amendment (Engineered Stone) 2023

2023-05-26

The Model Work Health and Safety Regulations (Engineered Stone) Amendment 2023 introduces an express prohibition on the uncontrolled processing of engineered stone products. The amendments reflect the existing duty on persons conducting a business or undertaking (PCBU) to eliminate risks to the health and safety of workers from engineered stone and if that is not reasonably practicable, to minimise the risks so far as is reasonably practicable.

A PCBU that permits the uncontrolled processing of engineered stone would not be complying with their primary duty of care and the model WHS Regulations now directly prohibit such conduct.

The Explanatory Statement to the Amendment can be viewed here. The model WHS Regulations and accompanying Explanatory Statement are currently being consolidated to incorporate the new provisions. Once the consolidation is finalised, the page will be updated accordingly.

Read More

Safe Work Australia, 26-05-23

https://www.safeworkaustralia.gov.au/doc/model-work-health-and-safety-regulations-amendment-engineered-stone-2023

Removal of C.I. Solvent Blue 98 as a synonym from an Inventory listing

2023-05-31

Reason for removal

C.I. Solvent Blue 98 was incorrectly listed as a synonym of 9,10-Anthracenedione, 1,4-diamino-, N,N'-mixed 2-ethylhexyland methyl and pentyl derivatives, CAS number 74499-36-8 and we have now removed it from this listing.

The model Work Health and Safety Regulations have been amended by the Parliamentary Counsel's Committee.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

What does this mean for introducers?

Importers and manufacturers can introduce C.I. Solvent Blue 98 under CAS 71819-49-3 which is listed on the Inventory, but not CAS 74499-36-8.

Published date: 31 May 2023

Read More

AICIS, 31-05-23

https://www.industrialchemicals.gov.au/news-and-notices/removal-ci-solvent-blue-98-synonym-inventory-listing

New guidance on completing a Pre-Introduction Report: internationally assessed for the environment onlyt

2023-01-0

Our practical guide includes tips to help you successfully submit a Pre-Introduction Report (PIR) for 'internationally-assessed for human health but not the environment'.

Read the new guide:

This guide:

• has a checklist of essential information that you need before you start the PIR form

• shows you the questions that you must answer in the PIR form in AICIS Business Services for the type 'internationally-assessed for the environment but not human health'

• is designed to help you avoid common errors

Who should read this guide?

If you need to submit a PIR because you have categorised your chemical introduction and it meets the reported introduction criteria for the type 'internationally-assessed for the environment but not human health'.

Other guides for internationally-assessed reported introductions:

• PIR guide for "internationally-assessed for human health but not the environment'

• PIR guide for 'internationally-assessed for human health and the environment'

Read More

AICIS, 01-06-23

https://www.industrialchemicals.gov.au/news-and-notices/new-guidance-completing-pre-introduction-report-internationally-assessed-environment-only

Retirement of 'fast-track' option for Item 8 applications

2023-06-01

The Australian Pesticides and Veterinary Medicines Authority (APVMA) will retire the 21-day service level standard 'fast-track' option for Item 8 applications from 1 July 2023.

Item 8 applications are applications to register a product that is the same as a reference product (also known as a 'repack').

The fast-track option was introduced in 2016 for Item 8 applications that meet certain criteria. The APVMA's service level standard has been to complete assessment of these applications in 21 days instead of the 3-month statutory timeframe.

Many nominated reference product labels cannot be accepted to register a new product under an Item 8 application because the label text requires updating in accordance with contemporary standards.

Requests from the APVMA to address these amendments, including label amendments requested under subsection 8C(2A) and Regulation 8AHAA of the Agvet Code, allow applicants 14 days to respond. These provisions have made it unfeasible for the APVMA to continue to meet the 21-day service level standard where a label update may be required.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

The retirement of the fast-track option will be reflected in our Online Services Portal and on our website from 1 July 2023.

Item 8 applications that meet the fast-track option criteria and are received up to 30 June 2023 will be processed in accordance with the 21-day service level standard, provided no additional or clarifying information is required.

Item 8 applications received from 1 July 2023 onwards will be processed within the statutory 3-month timeframe.

Questions about the retirement of the fast-track option for Item 8 applications, or Item 8 applications in general may be directed to enquiries@apvma.gov.au.

Criteria for a 'fast-track' Item 8 application:

Prior to 1 July 2023, an application is considered a fast-track Item 8 if:

• the nominated reference product is your own

• there are no protected data associated with your own nominated reference product

• the manufacturer's declaration(s) are submitted at lodgement

• the full fee is paid at lodgement.

If an application is submitted as a fast-track but is found to be ineligible, it reverts to the statutory Item 8 timeframe of 3 months, which will apply to all Item 8 applications from 1 July 2023 onwards.

Content last updated: 1 Jun 2023

Content last reviewed: 1 Jun 2023

Read More

APVMA, 01-06-23

https://apvma.gov.au/node/114026

AMERICA

EPA Proposes to Eliminate TSCA Exemptions for PFAS and PBTs; Proposes Updates to Other TSCA Regulations

2023-05-28

The U.S. Environmental Protection Agency (EPA) has proposed changes to its Toxic Substances Control Act (TSCA) regulations dealing with premanufacture notices (PMNs) and certain exemptions from PMN requirements. Of particular note, EPA has proposed to codify its stated position that per- and polyfluorinated substances (PFAS) are ineligible for low volume exemptions (LVEs) and low release and exposure (LoREX) exemptions. EPA has also proposed to make persistent, bioaccumulative, and toxic (PBT) substances ineligible for these exemptions. EPA is also soliciting comments on whether to revoke previously granted LVE applications for PFAS. In addition, EPA has proposed:

• Updating regulations to reflect the 2016 Lautenberg Amendments to TSCA stating that EPA must make an affirmative determination on PMNs, significant new use notices (SNUNs), and microbial commercial activity notices (MCANs) – as well as LVE and LoREX applications – before the proposed activity can commence.

• Updating regulations and EPA's PMN form to specify the level of detail EPA expects as part of a notification.

• Updating regulations regarding pre-screening processes, incomplete submissions, and new information for PMNs and other notifications.

EPA requests comments on these proposed changes by July 25, 2023.

Read More

The National Law Review, 28-05-23

https://www.natlawreview.com/article/epa-proposes-to-eliminate-tsca-exemptions-pfas-and-pbts-proposes-updates-to-other

Plastic containers still distributed across the US are a potential health disaster

2023-06-01

Consumer groups are condemning the Environmental Protection Agency (EPA) for allowing plastic containers made with toxic PFAS "forever chemicals" to continue being distributed across the economy – even

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

though the agency is suing a top manufacturer over the dangerous compounds leaching into containers' contents, such as food or personal care products.

The groups are now intervening in the lawsuit and regulatory proceedings between the EPA and Inhance Technologies, which they estimate produces about 200m PFAS-contaminated plastic containers annually.

A review of regulatory documents, court filings and patent applications shows Inhance appears to have repeatedly lied to regulators and customers about whether its containers shed PFAS (per- and polyfluoroalkyl substances) into products stored in them.

Still, the EPA and the Department of Justice have not pointed out the company's inconsistencies in court, and the groups have questioned whether industry influence at the EPA is playing a role in the agency's decision-making.

Last week, the groups formally asked the EPA to order Inhance to stop distributing the containers, and will soon file a motion asking a judge to do the same while highlighting the company's inconsistent statements.

Read More

The Guardian, 01-06-23

https://www.theguardian.com/environment/2023/jun/01/pfas-lawsuit-epa-plastic-containers-health-danger

EPA Issues Final Rule to Accelerate Use of Plant-Incorporated Biotechnologies

2023-05-31

On May 31, 2023, the U.S. Environmental Protection Agency (EPA) released a final rule exempting a class of plant-incorporated protectants (PIP) created using genetic engineering, from registration requirements under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and from the food or feed residue tolerance requirements under the Federal Food, Drug, and Cosmetic Act (FFDCA). 88 Fed. Reg. 34756. PIPs are pesticidal substances produced by plants and the genetic material necessary for the plant to produce the substance. According to EPA's May 25, 2023, press release, this rule will reduce costs for the regulated community and result in increased research and development activities, consistent with Executive Order 14081 on advancing biotechnology. EPA states that the rule also may result in the commercialization of new pest control options

and reduced use of conventional pesticides. The final rule will be effective on July 31, 2023.
EPA states the final rule will allow PIPs to be exempt from FIFRA registration and FFDCA tolerance requirements in cases where they both pose no greater risk than PIPs that EPA has already concluded meet safety requirements, and when they could have otherwise been created through conventional breeding. The final rule reflects the biotechnological advances made since 2001, when EPA first exempted PIPs derived through conventional breeding from FIFRA registration and FFDCA tolerance requirements but did not at that time exempt PIPs created through biotechnology.

In the rule, EPA provides criteria and definitions that identify two categories of PIPs that are exempted through this action from FIFRA registration and FFDCA tolerance requirements:

• "PIPs created through genetic engineering from a sexually compatible plant" in which genetic engineering has been used to insert or modify a gene to match a gene found in a sexually compatible plant (to be codified at 40 C.F.R. Section 174.26); and

• "Loss-of-function PIPs" in which the genetically engineered modification reduces or eliminates the activity of a gene, which then helps make the plant resistant to pests (to be codified at 40 C.F.R. Section 174.27).

Read More

FIFRA Blog, 31-05-23

https://pesticideblog.lawbc.com/entry/epa-issues-final-rule-to-accelerate-use-of-plant-incorporated-biotechnologi

EUROPE

Upcoming GB active substance renewal submission deadlines

2023-05-31

Apply for active substance renewal by the deadlines to keep products on the GB market
Under the GB Biocidal Products Regulation (GB BPR), active substance approvals will expire unless a renewal application is submitted at least 550 days before their expiry date.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

The 550-day deadlines are coming up for the following active substance/product type combinations under GB BPR:

• (RS)-α-cyano-3phenoxybenzyl-(1RS)-cis, trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate (Cypermethrin) (CAS 52315-07-8 EC 257-842-9) in product type 08

28 November 2023

• 1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole (Propiconazole) (CAS 60207-90-1 EC 262-104-4) in product type 09

28 November 2023

• Carbon dioxide (CAS 124-38-9 EC 204-696-9) in product type 15

28 November 2023

Any person, company or taskforce/consortium can support an active substance/product type combination for renewal – it doesn't have to be the original supporter.

Check the GB Article 95 List to see who the original supporters were.

If any of these active substance/product type combinations are important to you, consider contacting your supplier to let them know.

If a renewal application is not submitted for the above active substance/product type combinations under GB BPR, the approvals will expire. This means the active substances can no longer be used in biocidal products of the relevant product types in Great Britain.

Read More

HSE.gov.uk, 31-5-23

https://www.hse.gov.uk/biocides/index.htm

Upcoming GB active substance open invitation deadline

2023-05-31

Submit a notification by the deadline to keep active substances in the GB Review Programme

HSE has published an open invitation (.pdf) to provide an opportunity for a person, company or task force/consortium to notify an intention to take up or take over the role of participant in the GB Review Programme for the following active substance/product type combinations.

Anyone wishing to support one of the active substance/product type combinations listed below in Great Britain (GB) will need to submit a notificationto HSE by the following deadline:

• Active chlorine generated from sodium chloride by electrolysis (CAS 7782-50-5 EC n/a) in product types 02, 03, 04 and 05

12 August 2023
If a notification to take over the role of participant is not received, this active substance/product type combinations will be subject to a GB non-approval decision. Biocidal products containing active substances with GB non-approval decisions for the relevant product types will have to be removed from the GB market.

HSE will provide separate updates on these where relevant.

Read More

HSE.gov.uk, 31-5-23

https://www.hse.gov.uk/biocides/index.htm

ANSES Calls for the EC to Adopt a "More Protective" Definition of Nanomaterials

2023-05-31

The French Agency for Food, Environmental and Occupational Health and Safety (ANSES) issued a May 17, 2023, news item stating that it believes that the European Commission's (EC) revised Recommendation on the definition of nanomaterial, published in June 2022, "is too restrictive and could lead to a regression in the protection of public health and the environment." ANSES "is therefore urging the French authorities to take a more inclusive definition into account and work towards its integration in the revision of sectoral regulations at [the] European level," including the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and Classification, Labeling, and Packaging (CLP) regulations. According to ANSES, the EC's revised definition "tend[s] to restrict the number and type of objects that will ultimately be considered as such. Applied as it stands, this definition will, for example, lead to some nanoscale objects being overlooked, such as micellar nanovectors (vesicles, liposomes, lipid particles, etc.) designed to carry substances of interest in medicine, nutrition or agriculture, which are currently stimulating a great deal of interest and development." Instead, ANSES recommends providing the "broadest possible definition" of the term

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

"nanomaterial" based solely on dimensional criteria. ANSES also recommends establishing a uniform definition, regardless of the sector in which nanomaterials are used. ANSES calls for a broader definition of "nanomaterial" than that recommended by the EC, to consider nanomaterials more comprehensively and not overlook any that could be a health concern. ANSES states that it developed a guide detailing the various parameters of such a definition, "pointing out those that may require choices to be made by the public authorities because they go beyond the strictly scientific field." ANSES notes that in practice, it "invites the public authorities to take advantage of the revision of the European regulations on chemicals (REACH and CLP) and cosmetics to propose a broader definition. They will be able to do so once the review of other sectoral regulations has begun."

Read More

Nano and Other Emerging Chemical Technologies Blog, 31-05-23

https://nanotech.lawbc.com/2023/05/anses-calls-for-the-ec-to-adopt-a-more-protective-definition-of-nanomaterials/

European Digital Product Passport | Redefining sustainability in business

2023-05-31

The European Digital Product Passport (DPP; sometimes known as the EDPP) is a proposed initiative by the European Union that aims to provide consumers with access to information about the environmental and social impact of products. The DPP is part of the European Union's broader efforts to promote sustainability and circularity in the economy.
While the DPP's exact implementation timeline and requirements are still under discussion, the initiative represents a significant step towards a more transparent, sustainable, and circular European market, the essence of which is already in force under the French AGEC law.

Key features of the European Digital Product Passport

The European Digital Product Passport aims to provide consumers with a standardised digital certificate that provides information about the environmental and social impact of products, including those discussed below.

Environmental information

The DPP will provide information about the environmental impact of products, including their carbon footprint, water footprint, and energy consumption. This information will enable consumers to make more informed choices about the products they purchase and promote sustainable consumption.

Social information

The DPP will also provide information about the social impact of products, including information about labour conditions in the supply chain. This information will enable consumers to make choices that promote social justice.

Standardisation

The DPP will be a standardised certificate that provides consistent and comparable information about products. This will enable consumers to compare the environmental and social impact of different products and make informed choices.

Transparency and accountability

The DPP aims to create a single platform where information about a product's entire lifecycle, from raw materials, through manufacturing, to end-of-life disposal or recycling, can be easily accessed by consumers, businesses, and regulators. This will allow for more informed decision-making and facilitate better tracking and monitoring of products throughout their entire lifecycle.

Read More

Eurofins, 31-05-23

https://sustainabilityservices.eurofins.com/news/european-digital-product-passport-redefining-sustainability-in-business/

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 09, 2023

INTERNATIONAL

Pesticide firms withheld brain toxicity studies from EU regulators, study finds

2023-06-01

Pesticide companies failed to disclose a series of studies assessing brain toxicity to European regulators, according to new research, despite the same studies having been submitted to US regulators.

When the EU authorities were made aware of the studies, between 14 and 21 years after they were conducted, new safety limits were applied in some cases and evaluation is still under way in other cases.

The researchers described the omissions as "outrageous", concluding that "apparently non-disclosure is a problem that is not rare" and that there could be "no reliable safety evaluation of pesticides by EU authorities without full access to all performed toxicity studies".

The new research is the first systematic assessment of non-disclosure and focused only on developmental neurotoxicity (DNT) studies. The researchers found 35 DNT studies submitted to the US Environmental Protection Agency as part of the pesticide approval process but found that nine of these had not been included in dossiers sent to the EU authorities for the same pesticides.

Among the findings in the undisclosed studies were changes in brain size, delayed sexual maturation and reduced weight gain in the offspring of laboratory rats exposed to a pesticide when pregnant. The pesticides identified in the new study include the insecticides abamectin, ethoprophos and pyridaben and the fungicide fluazinam. These are, or have been, used on a range of crops including tomatoes, strawberries, potatoes and aubergines.

Read More

The Guardian, 01-06-23

https://www.theguardian.com/environment/2023/jun/01/pesticide-firms-withheld-brain-toxicity-studies-from-eu-regulators-study-finds

Recycling plastics "extremely problematic" due to toxic chemical additives: Report

2-23-05-31

Plastics contain toxic chemicals that can enter products and interact to create new harmful substances during the recycling process, a new report from Greenpeace and the International Pollutants Elimination Network (IPEN) shows.
The report comes as negotiators from more than 180 nations meet in Paris this week to discuss a global plastics treaty, developing regulations to address the plastic pollution crisis. The backdrop is stark: Plastics production is currently on track to triple by 2060, causing harm to human health and the environment throughout its lifecycle from creation to disposal.
Capping plastics production is a key point of debate. Fifty-eight countries, aligned in a group called the High Ambition Coalition to End Plastic Pollution, want to see a treaty that slows production. Industry groups and countries that stand to profit from plastic production want to focus on waste management and recycling instead, according to scientists and advocates.

Plastics manufacturing is one of the largest industries in the U.S., but the country is still committed to a treaty with "strong binding provisions, not only voluntary actions," said Jose Fernandez, under secretary of state for economic growth, energy and environment, at a High Ambition Coalition briefing. The U.S. is not a member of the coalition, instead calling for the treaty to direct nations to develop individual action plans.

Current plastic recycling systems "mold this unknown cocktail of potentially harmful substances together," Melanie Bergmann, a biologist at the Alfred Wegener Institute and a member of the Scientists' Coalition for an Effective Plastics Treaty, who was not speaking on behalf of the coalition, told Environmental Health News (EHN).

That chemical cocktail can harm workers and communities around recycling sites and leach from recycled plastic products, the Greenpeace and IPEN report found.

Read More

The Daily Climate, 31-05-23

https://www.dailyclimate.org/plastic-recycling-2660765055/chemical-additives-in-plastic

New IUCLID version – improvements for SCIP users

2023-05-23

Helsinki, 23 May 2023 - The new release of IUCLID 6 (version 7) includes improvements for SCIP users:

• Update of the article category picklist (based on the updated TARIC database):

- Many codes have become obsolete to avoid SCIP submissions with article categories of items that aren't articles

• Update of mixture category list (based on the Eu PCS list)

• Technical update (XML validation): Every document included in the dossier must include the "documentType", "creationDate" and "lastModificationDate". The dates need to be defined using ISO-8601

You can access the full release notes and download the new version of IUCLID from the IUCLID website. Installations for users of ECHA Cloud services will be automatically upgraded.
The new IUCLID version also includes changes on the validation rules for SCIP notifications.
FURTHER INFORMATION

• IUCLID

• SCIP IUCLID format and new version of validation rules for SCIP notifications

Read More

ECHA, 23-05-23

https://echa.europa.eu/-/new-iuclid-version-improvements-for-scip-users-1#msdynttrid=n5xzIfRVa9kGo0tWIX5tel4lPGC_UIDaF1HITCOCdRw

New OECD QSAR Toolbox version available

2023-05-24

QSAR Toolbox 4.6 enhances connectivity with IUCLID, increases capacity to use external models and improves access to information about tested substances in ECHA's chemicals database.

Helsinki, 24 May 2023 – A significant change in QSAR Toolbox 4.6 is the improved connection with IUCLID. This allows better integration of data

REACH Update

JUN. 09, 2023

between the two platforms, making it easier for researchers to access and analyse relevant information.

The updated version also improves the use of external models that provide additional insights into chemical properties and safety. The update improves the performance and user-friendliness of the QSAR Toolbox.

Additionally, QSAR Toolbox 4.6 introduces a new feature for the REACH database, which contains experimental results submitted within REACH registrations. In the previous versions, data was organised by REACH registration only, which was good to visualise the data but not ideal for making predictions. With this update, users can now organise and use REACH data according to the actual substances which were used to generate toxicological data, making available four times more substances from REACH registrations to generate predictions.

Background

The OECD QSAR Toolbox development is a collaborative project between the European Chemicals Agency (ECHA), the Organisation for Economic Co-operation and Development (OECD), OECD member and partner countries, and the QSAR community.
This collaboration has led to a freely available software to support chemical hazard assessment. It promotes the use of assessment methods alternative to animals, minimising unnecessary animal testing without reducing the safety of human health and the environment.
The QSAR Toolbox is used worldwide in chemical hazard assessments, in both public and private sectors.

Read More

ECHA, 24-05-23

https://echa.europa.eu/-/new-oecd-qsar-toolbox-version-available#msdyntrid=vSJpeegwbfuUUh_jEAkzaJJgwCPSefV-6vKS4MX9Mwg

CHEMWATCH
Bulletin Board

Janet's Corner

JUN. 09, 2023

A physicist, chemist, and an economist are on a train……

2023-06-09

https://www.smbc-comics.com/comic/a-physicist-chemist-and-an-economist-are-on-a-train

Methyl chloride

2023-06-09

USES [1,3]

Methyl chloride is used across various industries. In the past it was used as a refrigerant and an anaesthetic. It is now used in the manufacture of silicone polymers, and as a methylating agent to attach CH3 to oxygen and nitrogen. Methyl chloride is also used as a solvent.

ROUTES OF EXPOSURE [4,5]

Routes of Exposure

The primary route of exposure for methyl chloride is via inhalation.

Methyl chloride is made in the ocean by natural processes, meaning that it is present in the air all over the world. The outside air contains less than 1ppb of methyl chloride.

Those who are most likely to be exposed to the chemical in the air are those who work in chemical plants where methyl chloride is being used.

HEALTH EFFECTS [6]

Methyl chloride poisoning affects a range of systems including the integumentary and nervous systems.\

Acute Health Effects

Severity of symptoms depend on the level and type of exposure.

Acute methyl chloride poisoning can result in vomiting and convulsions, followed by an apparent recovery and then recurrence of these symptoms.

Other symptoms include nausea, diarrhoea, abdominal pain.

Dermal exposure can cause irritation, vesiculation and erythema.

Dermal exposure to the liquid form of the chemical can result in frostbite.

Heavy, but acute poisoning can cause CNS depression, headaches, dizziness, weakness or paralysis, pulmonary oedema, drowsiness and a coma or death.

Methyl chloride—aka chloromethane—is a clear, colourless, and highly flammable gas. It is a naturally occurring ubiquitous gas, that has a faint, but sweet odour. Its chemical formula is CH3Cl. [1,2,3]

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 09, 2023

Chronic Effects [6]

Methyl chloride is toxic to multiple body systems. Long-term exposure to the chemical can result in blurred vision, confusion, numbness of extremities, ataxia, tremors, confusion and hallucinations. Symptoms of long-term poisoning can last several months.

SAFETY

Exposure Controls/ Personal Protection [7]

Engineering controls: Emergency eyewash fountains and safety showers should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Only use in conjunction with an explosion-proof local exhaust system, e.g., a fume hood.

Personal protection: Safety glasses, protective and dustproof clothing, gloves, an apron and an appropriate mask. Follow the PPE guidelines set in your jurisdiction.

REGULATION [8]

United States

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average (TWA) concentration limit for methyl chloride of 100ppm.

Australia

Safe Work Australia has set an 8-hour time TWA for ethyl chloride of 20ppm. They have set a Short-Term Exposure Limit (STEL) of 80ppm.

REFERENCES

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5. https://www.atsdr.cdc.gov/phs/phs.asp?id=585&tid=109#:~:text=Exposure%20to%20chloromethane%20can%20also,ability%20to%20perform%20simple%20tasks.
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CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

Chemical found in common sweetener damages DNA

2023-05-31

At issue is sucralose, a widely used artificial sweetener sold under the trade name Splenda. Previous work by the same research team established that several fat-soluble compounds are produced in the gut after sucralose ingestion. One of these compounds is sucralose-6-acetate.

"Our new work establishes that sucralose-6-acetate is genotoxic," says Susan Schiffman, corresponding author of the study and an adjunct professor in the joint department of biomedical engineering at North Carolina State University and the University of North Carolina at Chapel Hill. "We also found that trace amounts of sucralose-6-acetate can be found in off-the-shelf sucralose, even before it is consumed and metabolized.

"To put this in context, the European Food Safety Authority has a threshold of toxicological concern for all genotoxic substances of 0.15 micrograms per person per day," Schiffman says. "Our work suggests that the trace amounts of sucralose-6-acetate in a single, daily sucralose-sweetened drink exceed that threshold. And that's not even accounting for the amount of sucralose-6-acetate produced as metabolites after people consume sucralose."

For the study, researchers conducted a series of in vitro experiments exposing human blood cells to sucralose-6-acetate and monitoring for markers of genotoxicity.

"In short, we found that sucralose-6-acetate is genotoxic, and that it effectively broke up DNA in cells that were exposed to the chemical," Schiffman says.

The researchers also conducted in vitro tests that exposed human gut tissues to sucralose-6-acetate.

"Other studies have found that sucralose can adversely affect gut health, so we wanted to see what might be happening there," Schiffman says. "When we exposed sucralose and sucralose-6-acetate to gut epithelial tissues—the tissue that lines your gut wall—we found that both chemicals cause 'leaky gut.' Basically, they make the wall of the gut more permeable. The chemicals damage the 'tight junctions,' or interfaces, where cells in the gut wall connect to each other.

A new study finds a chemical formed when we digest a widely used sweetener is "genotoxic," meaning it breaks up DNA. The chemical is also found in trace amounts in the sweetener itself, and the finding raises questions about how the sweetener may contribute to health problems.

"A leaky gut is problematic, because it means that things that would normally be flushed out of the body in feces are instead leaking out of the gut and being absorbed into the bloodstream."

The researchers also looked at the genetic activity of the gut cells to see how they responded to the presence of sucralose-6-acetate.

"We found that gut cells exposed to sucralose-6-acetate had increased activity in genes related to oxidative stress, inflammation and carcinogenicity," Schiffman says.

"This work raises a host of concerns about the potential health effects associated with sucralose and its metabolites. It's time to revisit the safety and regulatory status of sucralose, because the evidence is mounting that it carries significant risks. If nothing else, I encourage people to avoid products containing sucralose. It's something you should not be eating."

The paper, "Toxicological and pharmacokinetic properties of sucralose-6-acetate and its parent sucralose: in vitro screening assays," is published in the Journal of Toxicology and Environmental Health, Part B. The paper was co-authored by Troy Nagle, Distinguished Professor of Biomedical Engineering at NC State and UNC and Distinguished Professor of Electrical and Computer Engineering at NC State; Terrence Furey, professor of genetics and biology at UNC; and Elizabeth Scholl, a former researcher at NC State who is currently at Sciome LLC.

medicalxpress, 6 June 2023

https://medicalxpress.com

Secret industry documents reveal that makers of PFAS 'forever chemicals' covered up their health dangers

2023-06-01

A new paper published May 31, 2023, in Annals of Global Health, examines documents from DuPont and 3M, the largest manufacturers of PFAS. The paper analyzes the tactics the industry used to delay public awareness of PFAS toxicity, and in turn, delay regulations governing their use. PFAS are widely used chemicals in clothing, household goods, and food products, and are highly resistant to breaking down, giving them the name "forever chemicals." They are now ubiquitous in people and the environment.

"These documents reveal clear evidence that the chemical industry knew about the dangers of PFAS and failed to let the public, regulators, and even their own employees know the risks," said Tracey J. Woodruff, Ph.D.,

The chemical industry took a page out of the tobacco playbook when they discovered and suppressed their knowledge of health harms caused by exposure to PFAS (per- and polyfluoroalkyl substances), according to an analysis of previously secret industry documents by UC San Francisco (UCSF) researchers.

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

professor and director of the UCSF Program on Reproductive Health and the Environment (PRHE), a former senior scientist and policy advisor at the Environmental Protection Agency (EPA), and senior author of the paper.

This is the first time these PFAS industry documents have been analyzed by scientists using methods designed to expose tobacco industry tactics.

Adverse effects had been known for decades

The secret industry documents were discovered in a lawsuit filed by attorney Robert Bilott, who was the first to successfully sue DuPont for PFAS contamination and whose story was featured in the film, "Dark Waters." Bilott gave the documents, which span 45 years from 1961 to 2006, to producers of the documentary, "The Devil We Know," who donated them to the UCSF Chemical Industry Documents Library.

"Having access to these documents allows us to see what the manufacturers knew and when, but also how polluting industries keep critical public health information private," said first author Nadia Gaber, MD, Ph.D., who led the research as a PRHE fellow and is now an emergency medicine resident. "This research is important to inform policy and move us towards a precautionary rather than reactionary principle of chemical regulation."

Little was publicly known about the toxicity of PFAS for the first 50 years of their use, the authors stated in the paper, "The Devil They Knew: Chemical Documents Analysis of Industry Influence on PFAS Science," despite the fact that "industry had multiple studies showing adverse health effects at least 21 years before they were reported in public findings."

The paper states, "DuPont had evidence of PFAS toxicity from internal animal and occupational studies that they did not publish in the scientific literature and failed to report their findings to EPA as required under TSCA. These documents were all marked as 'confidential,' and in some cases, industry executives are explicit that they 'wanted this memo destroyed.'"

Suppressing information to protect a product

The paper documents a timeline of what industry knew versus public knowledge, and analyzes strategies the chemical industry used to suppress information or protect their harmful products. Examples include:

- As early as 1961, according to a company report, Teflon's Chief of Toxicology discovered that Teflon materials had "the ability to increase the size of the liver of rats at low doses," and advised that the chemicals

"be handled 'with extreme care' and that 'contact with the skin should be strictly avoided.'"

- According to a 1970 internal memo, DuPont-funded Haskell Laboratory found C8 (one of thousands of PFAS) to be "highly toxic when inhaled and moderately toxic when ingested." And in a 1979 private report for DuPont, Haskell labs found that dogs who were exposed to a single dose of PFOA "died two days after ingestion."
- In 1980, DuPont and 3M learned that two of eight pregnant employees who had worked in C8 manufacturing gave birth to children with birth defects. The company did not publish the discovery or tell employees about it, and the following year an internal memo stated, "We know of no evidence of birth defects caused by C-8 at DuPont."

Despite these and more examples, DuPont reassured its employees in 1980 that C8 "has a lower toxicity, like table salt." Referring to reports of PFAS groundwater contamination near one of DuPont's manufacturing plants, a 1991 press release claimed, "C-8 has no known toxic or ill health effects in humans at concentration levels detected."

As media attention to PFAS contamination increased following lawsuits in 1998 and 2002, DuPont emailed the EPA asking, "We need EPA to quickly (like first thing tomorrow) say the following: That consumer products sold under the Teflon brand are safe and to date there are no human health effects known to be caused by PFOA."

In 2004, the EPA fined DuPont for not disclosing their findings on PFOA. The $16.45 million settlement was the largest civil penalty obtained under U.S. environmental statutes at the time. But it was still just a small fraction of DuPont's $1 billion annual revenues from PFOA and C8 in 2005.

"As many countries pursue legal and legislative action to curb PFAS production, we hope they are aided by the timeline of evidence presented in this paper," said Woodruff. "This timeline reveals serious failures in the way the U.S. currently regulates harmful chemicals."

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https://phys.org

Charge-transfer interactions during C–H activation directly observed

2023-06-05

Using time-resolved x-ray spectroscopy, researchers have directly observed the metal–alkane charge-transfer interactions that occur during C–H activation. The method offers synthetic chemists a better understanding of C–H activation reactions and could help guide the design of new catalysts.

The project, led by Raphael Jay and his team at Uppsala University, Sweden, set out to experimentally evaluate metal–ligand charge-transfer reactions during C–H activation by metal complexes.1

They carried out two 'pump–probe' experiments at the Paul Scherrer Institute in Switzerland using the Swiss Free Electron Laser facility (SwissFEL) and the Swiss Light Source synchrotron to track σ-complex formation and oxidative addition using a cyclopentadienyl rhodium carbonyl complex immersed in a dense octane solution.

'We carried out time-resolved experiments using very short light pulses. The first light pulse was from an optical laser – a UV ultraviolet pulse that triggers the reaction,' explains Jay. 'Then we used a second pulse – a very short x-ray pulse, to measure the reaction. So, we know the time zero of the reaction, and then we can go through different time steps and measure from femtoseconds in the beginning all the way to nanoseconds, where the reaction then comes to an end.'

Ambar Banerjee, who works alongside Jay at Uppsala, says the advantage of using this technique was that they were able to specifically look at the interactions from a 'metal perspective'.

'At the site of the reaction you can dissect the different modes of electron transfer,' he says. 'So, there is a C–H bond to a metal charge transfer, and then there is a back donation from the metal to the C–H bond.'

'We can basically dissect these two opposing charge transfers and look at the finer details where the reaction is actually happening; where the C–H bond is getting cleaved.'

Christina White, an organic chemist based at University of Illinois, US, says that the findings shed 'important light on the metal ligand's influence on crucial mechanistic steps governing reactivity' and could help researchers discover better catalysts for the chemical industry.

'Since the report by Milton Smith in 1999 that these types of cyclopentadienyl–late-transition metal complexes can catalytically borylate aliphatic C–H bonds2, there has been tremendous excitement about the potential synthetic utility of these systems,' she adds.

Banerjee says more work is needed to systematically evaluate the role of these effects in C–H activation. 'That will be really useful for synthetic chemists in knowing what fine tunings they need to incorporate in the spectator ligand structures so that a desired reactivity is observed,' he adds.

Chemistryworld, 5 June 2023

https://website

Scientists discover a new proton conductor for next-generation fuel cells

2023-06-06

The discovery of Ba2LuAlO5 as a promising proton conductor paints a bright future for protonic ceramic fuel cells, report scientists from Tokyo Tech. Experiments show that this novel material has a remarkably high proton conductivity even without any additional chemical modifications, and molecular dynamics simulations reveal the underlying reasons. These new insights may pave the way to safer and more efficient energy technologies.

When talking about sustainability, the ways in which a society generates energy are some of the most important factors to consider. Eager to eventually replace traditional energy sources such as coal and oil, scientists across the world are trying to develop environmentally friendly technologies that produce energy safely and more efficiently. Among them, fuel cells have been steadily gaining traction since the 1960s as a promising approach to producing electricity directly from electrochemical reactions.

However, typical fuel cells based on solid oxides have a notable drawback in that they operate at high temperatures, usually over 700°C. That is why many scientists have focused on protonic ceramic fuel cells (PCFCs) instead. These cells use special ceramics that conduct protons (H+) instead of oxide anions (O2−). Thanks to a much lower operating temperature in the range of 300 to 600°C, PCFCs can ensure a stable energy supply at a lower cost, compared to most other fuel cells. Unfortunately, only a few proton-conducting materials with reasonable performance are currently known, which is slowing down progress in this field.

To address this challenge, a team of researchers, including Professor Masatomo Yashima from Tokyo Institute of Technology (Tokyo Tech) in Japan, has been on the lookout for good proton conductor candidates for

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

PCFCs. In their latest study, published in Communications Materials, the team reported the remarkable properties of Ba2LuAlO5, a new hexagonal perovskite-related oxide that has provided interesting insights into proton conduction.

Yashima and colleagues discovered Ba2LuAlO5 while focusing on finding compounds with numerous intrinsic oxygen vacancies. This was motivated by the results of previous studies highlighting the importance of these vacancies in proton conduction. Experiments on Ba2LuAlO5 samples revealed that this material has a high proton conductivity in its bulk at low temperatures—its conductivity was 10–2 S cm–1 at 487°C and 1.5×10–3 S cm–1 at 232°C—even without additional chemical refinements, such as doping.

Later, the team sought to find out the underlying reasons for this property. Through molecular dynamics simulations and neutron diffraction measurements, they learned two important characteristics of Ba2LuAlO5. The first is that this oxide absorbs a large quantity of water (H2O), compared to other similar materials, to form Ba2LuAlO5*xH2O (with x = 0.50). This large water uptake, which occurs within two opposing layers of AlO4 tetrahedra, is made possible by a high number of intrinsic oxygen vacancies in the hexagonal close-packed h' BaO layers. In turn, the oxide's higher water content increases its proton conductivity through various mechanisms, such as higher proton concentration and enhanced proton hopping.

The second important characteristic is related to how protons move through Ba2LuAlO5. Simulations revealed that protons diffuse mainly along the interfaces of LuO6 layers, which form cubic close-packed c BaO3 layers, rather than through the AlO4 layers. This information could be critical in the search for other proton conducting materials, as Yashima explains, "Our work provides new design guidelines that open up unexplored avenues for the development of higher-performance proton conductors in the future."

The researchers expect to find other proton-conducting materials based on Ba2LuAlO5 in upcoming studies. "By modifying the chemical composition of Ba2LuAlO5, further improvements in proton conductivity can be expected," comments Prof. Yashima, "For example, the perovskite-

related oxide Ba2InAlO5 may also exhibit high conductivity since its structure is quite similar to that of Ba2LuAlO5."

Phys.org, 6 June 2023

https:// phys.org

Study discovers potential key to a cheaper and more accessible Haemophilus influenzae type b vaccine

2023-06-06

The bacterium Haemophilus influenzae type b (Hib) inhabits the human nasal cavity. It causes infections of the upper and lower respiratory tract, especially in infants and young children. But even more serious diseases such as middle ear inflammation, meningitis or blood poisoning (sepsis) can be caused by Hib. The bacterium surrounds itself with a shell consisting of many sugar chains, which are also referred to as capsule polymers. With the capsule polymers, the bacterium protects itself against the host's immune system and can thus survive in the human body.

Vaccines against Hib are available that contain the sugar polymers in the capsule and train the immune system to these antigens. However, their production is complex and expensive. This is because the antigens must be obtained directly from infectious bacterial cultures, which requires a laboratory with an adequate level of safety.

The team led by Dr. Timm Fiebig from the Institute of Clinical Biochemistry at the Hannover Medical School (MHH) has now succeeded in fully deciphering the path of formation of the capsule polymer for the first time, thus creating the potential to produce the vaccine antigen cheaply and safely by enzymatic synthesis without the use of pathogens. Their results have been published in the journal Nature Chemical Biology.

Simple synthesis could make vaccine more accessible worldwide

"The elucidation of the biosynthesis pathway enables a much more elegant production of Hib vaccine antigens from widely available and inexpensive precursors in a standard laboratory, without having to grow dangerous bacteria in bioreactors," says Dr. Fiebig, head of the working group Microbial Glycobiochemistry and Vaccine Development.

Despite the high effectiveness of the Hib vaccine introduced in Germany in the 1990s, the bacterium is still the main cause of bacterial meningitis in children under 1 year of age in unvaccinated societies. Thanks to the

The bacterium Haemophilus influenzae type b (Hib) can cause severe diseases such as meningitis and blood poisoning in young children. Researchers from the MHH Institute of Clinical Biochemistry have deciphered the pathway of the bacterial capsule and created the basis for producing an Hib vaccine that is inexpensive and safe.

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

simplicity of the newly discovered synthetic pathway, the distribution of the vaccine could be improved worldwide.

Possible approach for new vaccines and drugs against bacteria

However, the research team has not only elucidated the production path itself, but also described the enzymes that control this process. "We have now for the first time comprehensively understood how the bacterium builds its polymer capsule and which enzymes it uses as tools for this," says Dr. Fiebig. This enzyme factory can now be reproduced in the test tube under safe conditions. The most important enzyme is the so-called capsule polymerase, which produces the actual polysaccharide capsule and thus the antigen for the vaccine.

The enzyme consists of four subunits. Three of them transfer chemical building blocks that occur in the surface polymers of many other bacteria and contribute to the pathogenic effect of the pathogens. However, it was not yet known which enzymes transmit these building blocks and what these enzymes look like three-dimensional. However, this is crucial for the development of antibacterial agents and for the discovery of new enzymes that control how bacteria cheat our immune system and how infectious they are.

The researchers were also able to identify the same polymerase structures in other bacteria. These include the intestinal bacterium Escherichia coli, the most antibiotic-resistant Acinetobacter species, or even the listeria found on contaminated foods.

"Our findings could also be used to develop vaccines or drugs against these and other pathogens, for example by developing substances that block the newly discovered enzymes and thus interrupt the formation of the protective capsule," says Dr. Fiebig. In view of the increasing resistance to antibiotics, this is a promising option in the fight against bacteria. However, further research is needed to achieve this.

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https://phys.org

Quantum visualization technique gives insight into photosynthesis

2023-06-06

"It was hard to believe how simple coherence maps are," said Nancy Makri, a professor of chemistry at the U. of I. and the project head. "When dealing

Systems obeying quantum mechanics are notoriously difficult to visualize, but researchers at the University of Illinois Urbana-Champaign have developed an illustration technique that displays quantum features in an easy-to-read diagram called a coherence map. The researchers used these maps to study the quantum mechanisms that underlay photosynthesis, the process by which plants and some bacteria use sunlight to convert carbon dioxide and water into food.

with nonintuitive quantum phenomena as a part of complex processes like photosynthesis, interpreting theoretical calculations can be quite a challenge. But coherence maps tell you everything you need to know in a snapshot."

In a study published in The Journal of Physical Chemistry Letters, Makri's research group applied coherence maps to analyze earlier computer simulations of photosynthesizing bacteria in a new way. The researchers studied the molecular complex that "harvests" sunlight, absorbing it and transferring its energy to a chemical reaction site where carbon dioxide and water are processed. Coherence maps not only clearly displayed how energy was transferred to the reaction site, but they gave a clear quantum explanation for the transfer.

Makri explained that coherence maps are illustrations of the reduced density matrix, a mathematical object containing all information about a system's quantum behavior. "Even for modestly sized systems, the reduced density matrix becomes quite large, and all its components are interrelated," she said. "It's simply too much information to analyze. With coherence maps, though, there is a ton of information that pops out of the pictures just from a glance."

This information allowed the researchers to identify the energy transfer pathways in the bacterial light harvesting complex "very transparently," according to Makri. The complex contains an outer ring and an inner ring of molecules. The outer ring absorbs sunlight, and the inner ring contains the chemical reaction site. Makri's group showed that the two rings are connected by the motions of the atoms in the molecules, and coherence maps clearly illustrated that these motions focus energy from the outer ring to the inner ring.

"Looking ahead, I believe coherence maps will be an invaluable tool to theoretical analyses based on quantum mechanics," Makri said. "Just in this study, they gave important insights into the photosynthesis mechanism, one of the great mysteries of biology."

Makri's research group reported simulations of the energy transfer mechanism in photosynthesizing bacteria in Science Advances, and the group introduced coherence maps in The Journal of Physical Chemistry B.

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https://phys.org

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

Catalysis under the microscope is more complex than expected, shows new study

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At TU Wien, scientists try to identify reasons for such effects by imaging the catalytic reactions taking place on various locations on these catalysts, applying several different microscopy techniques. Such an approach yields a reliable, microscopically correct understanding of the catalytic processes.

In doing so, it appeared that even relatively "simple" catalytic systems were more complex than expected. For example, it is not only the size of the employed metal particles or the chemical nature of the support material that define the catalytic properties. Even within a single metal particle, different scenarios can prevail on the micrometer scale. In combination with numeric simulations, the behavior of different catalysts could then be explained and correctly predicted.

Not all particles are the same

"We investigate the combustion of the possible future energy carrier hydrogen with oxygen, forming pure water, by using rhodium particles as catalysts," explains Prof. Günther Rupprechter from the Institute of Materials Chemistry at TU Wien. Various parameters play an important role in this process: How big are the individual rhodium particles? Which support material do they bind to? At which temperature and which reactant pressures does the reaction take place?

"The catalyst is made from supported rhodium particles, but it does not behave like a uniform object which can be described by a few simple parameters, as often tried in the past," highlights Günther Rupprechter. "It soon became clear, that the catalytic behavior strongly varies at different catalyst locations. A given area on a given rhodium particle may be catalytically active, whereas another one, just micrometers away, may be catalytically inactive. And a few minutes later, the situation may even have reversed."

Nine catalysts at one sweep

For the experiments, Dr. Philipp Winkler, the first author of the study published in the journal ACS Catalysis, prepared a stunning catalyst sample, comprising nine different catalysts with differently sized metal particles and varying support materials. In a dedicated apparatus, all catalysts could therefore be observed and compared simultaneously in a single experiment.

Catalysts composed from tiny metal particles play an important role in many areas of technology—from fuel cells to production of synthetic fuels for energy storage. The exact behavior of catalysts depends, however, on many fine details and their interplay is often difficult to understand. Even when preparing exactly the same catalyst twice, it often occurs that these two will differ in minute aspects and therefore behave very different chemically.

"With our microscopes, we can determine if the catalyst is catalytically active, it´s chemical composition and electronic properties—and this for each and every individual spot on the sample," says Winkler. "In contrast, traditional methods usually just measure an average value for the entire sample. However, as we have demonstrated, this is often by far not sufficient."

Even more complex than anticipated

Chemical analysis on the microscopic scale has shown that the catalyst composition can vary locally even more than expected: Even within the individual metal particles strong differences were observed. "Atoms of the support material can migrate onto or in the particles, or even form surface alloys," states Rupprechter. "At some point, there is even no clear boundary anymore, but rather a continuous transition between catalyst particle and support material. It is crucial to consider this fact—because it also affects chemical activity."

In a next step, the team at TU Wien will apply the gained insights and the successful methods to tackle even more complex catalytic processes, in their continuing mission to explain processes on a microscopic scale, to contribute to the development of improved catalysts, and to search for new catalysts.

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Scientists just X-rayed a single atom for the first time

2023-06-06

Although this isn't an image, it is a huge step down the size chart. Before this, the smallest amount object that could be X-rayed would be in the realm of attograms – but that is still the size of 10,000 atoms.

"Atoms can be routinely imaged with scanning probe microscopes, but without X-rays one cannot tell what they are made of," says Argonne National Laboratory physicist, Saw Wai Hla.

"We can now detect exactly the type of a particular atom, one atom-at-a-time, and can simultaneously measure its chemical state."

"Once we are able to do that, we can trace the materials down to ultimate limit of just one atom."

A team of US researchers has taken the world's first X-ray of a single atom.

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

As you can see (below on the left) scanning tunnelling microscopy (STM) has been around since the 80s and is specifically made for imaging at the atomic level.

But STM can just see the atoms, it's harder to glean information about them.

To be able to x-ray just one atom the team started by using the technology from STM. Both STM and the new X-ray system the researchers have used get the tip of the device incredibly close to the surface, and then run a small voltage between the two. Electrons can then tunnel through the vacuum between them in what is called quantum tunnelling.

Then, in the x-ray version, the team beams special synchrotron X-rays from the side to glean information about the atoms themselves.

"This achievement connects synchrotron X-rays with quantum tunneling process to detect X-ray signature of an individual atom and opens many exciting research directions including the research on quantum and spin (magnetic) properties of just one atom," Hla said.

The research has been published in Nature.

In this paper, the team looked specifically at an iron atom and a terbium atom, gaining information about both by using this technique.

"We have detected the chemical states of individual atoms as well," Hla explained.

"By comparing the chemical states of an iron atom and a terbium atom inside respective molecular hosts, we find that the terbium atom, a rare-earth metal, is rather isolated and does not change its chemical state while the iron atom strongly interacts with its surrounding."

cosmosmagazine, 6 June 2023

https://cosmosmagazine.com

Study casts doubt on cultivated meat's low carbon promise

2023-06-06

Cultivated meat, which is produced from animal cells grown in a lab rather than raising, farming and slaughtering livestock, has been proposed as a significantly greener alternative to conventional meat. For example, an analysis by scientists from Oxford University and the University of

A new preprint study from researchers in the US has concluded that the environmental impact of cultivated meat is probably 'orders of magnitude' worse than traditional beef, based on current and near-term production methods. But experts are divided on whether the study, which has yet to undergo peer review, makes valid assumptions.

Amsterdam back in in 2011 estimated that cultivated meat would require 7–45% less energy to produce than the same volume of pork, sheep or beef. More recently, findings by the Dutch environmental consultancy CE Delft indicated that cultivated meat would cause up to 92% less global warming and 93% less air pollution compared to conventional beef, while also using up to 95% less land and 78% less water.

But now researchers at the University of California, Davis, suggest these and other studies have underestimated the environmental impact of cultivated meat, and in particular the cost of producing the highly refined growth medium that they say its near-term production methods will continue to rely on.

The UC Davis team conducted a life-cycle assessment of the energy required and greenhouse gases emitted in all stages of cultivated meat production. In scenarios where the growth medium is prepared at very high purity, carbon dioxide equivalents emitted for each kilogram of meat produced were four to 25 times greater than the median value for retail beef.

UC Davis food scientist Derrick Risner, the preprint's lead author, explains that the discrepancies in results from his paper and previous research are mostly attributable to 'differences in assumptions in our near-term production model versus future production models with some more aggressive assumptions on technology advancement'.

Overestimating energy

Hanna Tuomisto, an associate professor of sustainable food systems at the University of Helsinki who co-authored the 2011 study when she was at Oxford, says the main difference is that the new UC Davis work included the purification process to remove endotoxins from all ingredients used in the culture medium, including water, which is very energy intensive.

'Many of the cultured meat companies are saying that they are able to use food-grade ingredients so that they don't necessarily need to be pharma-grade ingredients,' Tuomisto continues. 'My view is that this paper is overestimating the energy requirements for the endotoxin removal process.' Others appear to agree.

'The reality is that the fundamental assumption in the report does not reflect actual industry plans or sourcing practices for cell feed,' Cellular Agriculture Europe, a coalition of food companies based in Brussels, stated. 'No company will scale up using expensive pharmaceutical-grade

CHEMWATCH
Bulletin Board
Gossip
JUN. 09, 2023

ingredients, and we have already proven that we do not need them.' The non-profit Good Food Institute based in Washington, DC echoed these concerns.

Steps to sustainability

Food company Eat Just, whose cultured chicken has been approved for sale in Singapore since 2020, is also sceptical about the new findings. 'The UC Davis study is largely based on arguments that nutrients fed to cells will continue to be pharmaceutical grade,' says Eat Just spokesperson Andrew Noyes. 'That assumption is flawed and doesn't align with the vision or actions of this young and rapidly evolving industry,' he adds.

Meanwhile, Cindy Tian – an animal science professor at the University of Connecticut who has co-authored a study that induced bovine pluripotent stem cells for the first time in the hopes of overcoming challenges for cultivated meat, welcomes the study. She has previously told Chemistry World that the process of making meat from animal cells remains 'extremely inefficient' and appears unsustainable.

'I am glad someone is telling the truth,' Tian states, referring to the new UC Davis preprint. 'Years of research and many breakthroughs will be necessary for cultured meat to be even close to the current beef production system,' she adds, noting that cattle domestication has an 11,000-year history while cultivated meat has only been around about a decade.

Chemistryworld, 6 June 2023

https://chemistryworld.com

Light-activated concrete scrubs air pollution out of traffic tunnels

2023-06-06

While we need to transition to greener vehicles as soon as possible, it's still going to take a few decades. In the meantime, finding other ways to slurp up that air pollution is important, so why not turn to the most common building material in the world to help? In recent years scientists have developed concrete that can convert some of the nasties in the surrounding air into harmless products.

These air-purifying concrete systems rely on a coating of titanium dioxide, which reacts to sunlight to produce molecules called reactive oxygen species (ROS). These have strong oxidizing power, which breaks down

Traffic is among the biggest sources of air pollution, but what if the very roads they drive on could help clear the air? Engineers in Korea have now demonstrated that photocatalytic concrete can help reduce pollution in tunnels.

air pollutants like volatile organic compounds (VOCs), nitrogen oxides, sulfur oxides, and ammonia and prevents the formation of fine particulate matter.

In the new study, researchers at the Korea Institute of Civil Engineering and Building Technology (KICT) developed this kind of photocatalytic concrete and tested it in a traffic tunnel, where pollution is often higher due to poor air circulation. Artificial lights were installed along the walls to fuel the light-activated reactions in the concrete.

The team found that levels of nitrogen oxides dropped by about 18% over 24 hours, and the end products of the reactions were salts, formed in part from the calcium content in the concrete. These salts were quickly washed away by rain. Better yet, the team says this process should allow the photocatalytic concrete to function indefinitely, without needing any extra maintenance beyond that of regular concrete.

The team plans to continue researching the technology to help get it commercialized and hopefully improve its effectiveness. Other examples have managed to reduce nitrogen oxide levels by 45%, or even an astonishing 70% when paired with graphene.

"Construction technology using photocatalysts can have an immediate effect on reducing fine particulate matter in the nation's living environment" said Dr. Jong-Won Kwark, head researcher on the project. "We plan to build a system of cooperation with local governments and public corporations to expand trial demonstrations to other sites to achieve commercialization and distribution with practical effects."

An earlier paper describing the photocatalytic concrete was published in the KSCE Journal of Civil and Environmental Engineering Research.

New Atlas, 6 June 2023

https://newatlas.com

CHEMWATCH
Bulletin Board

Molecular manipulation stimulates hair growth in mice

2023-06-05

Like other parts of our body, when we age, our hair follicle stem cells stiffen, making it harder for them to produce hair. Over time, almost everyone experiences some degree of hair loss. All sexes lose their hair for a variety of reasons, including hereditary traits, hormonal and thyroid disorders and nutritional deficiencies.

Hair follicles have a niche for mature stem cells, called a "bulge", near the hair root. These stem cells help regenerate epidermal (skin) cells and the structure of hair follicles and sebaceous glands, the glands that produce oil (sebum). Follicular stem cells can remain in their niche, regenerating themselves, but they can also move to the bottom of the follicle, becoming hair germ progenitor cells that can differentiate to form a hair follicle and the hair stem.

Researchers from Northwestern University, Illinois, first examined mice to determine what was happening on a cellular level with hair follicle stem cells (HFSCs) and hair germ cells. They observed that the HFSCs were stiff compared with the hair germ progenitor cells, which were relatively soft and mechanically dynamic.

They then determined whether the cells' behavior was associated with gene expression and found that a particular microRNA, miR-205, was one of the most highly expressed microRNAs in hair germ progenitor and skin stem cells. MicroRNAs (miRNAs) are small, single-stranded, non-coding molecules of RNA that play an important role in regulating gene expression. That is, whether a particular gene is making too much, too little, or the right amount of its protein at a particular time.

After genetically stimulating the mice's stem cells to produce more miR-205, the softer hair germ cells became more sensitive and rapidly mobilized to initiate hair follicle regeneration, promoting hair growth in young and old mice.

"They started to grow hair in 10 days," said Rui Yi, corresponding author of the study. "These are not new stem cells being generated. We are stimulating the existing stem cells to grow hair. A lot of times we still have stem cells, but they may not be able to generate hair."

Now that they've demonstrated that it's possible to stimulate hair growth, the researchers plan on extending their research.

Researchers have successfully stimulated hair growth in mice using microRNA to genetically manipulate hair follicle stem cells, meaning that balding pate may one day be sporting a mane of luscious locks.

"Our study demonstrates the possibility of stimulating hair growth by regulating cell mechanics," Yi said. "Because of the potential to deliver microRNA by nanoparticles directly into the skin, next we will test whether topically delivered miR-205 can stimulate hair growth first in mice. If successful, we will design experiments to test whether this microRNA can promote hair growth potentially in humans."

The study was published in the journal PNAS.

New Atlas, 5 June 2023

https://newatlas.com

Mechanochemistry makes gold salts that are soluble in organic solvents

2023-06-07

A new one-pot mechanochemistry method for processing elemental gold can provide organosoluble gold salts in under one hour. By combining potassium peroxymonosulfate, a common pool cleaner, tetraalkylammonium halide salts and metallic gold in a solvent-free ball mill reaction, the technique avoids traditional harsh and toxic reagents used for gold oxidation.

ChemistryWorld, 7 June 2023

https://chemistryworld.com

First chemical signature of a Pair-Instability Supernova from massive first stars

2023-06-07

An unusual star has provided chemical evidence of the universe's very massive first stars.

The first stars in the universe ended the period after the Big Bang, known as the cosmic 'dark ages.' The emergence of the first stars is referred to as the Cosmic Dawn, and the mass of these stellar pioneers is a mystery at the forefront of current cosmological research.

Astronomers believe that the earliest stars were up to several hundred times the mass of the sun (one of our suns = one solar mass).

No need for aqua regia, chlorine or mercury in this gold processing method

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

Stars of 140-260 solar masses undergo Pair-Instability Supernovae, or PISNe. These stellar explosions would have left unique chemical signatures in the atmosphere of the stars that formed out of the PISNe.

For the first time, just such a PISNe signature has been found.

An international study published in Nature outlines the first definitive evidence for a star formed out of a PISNe. The star, LAMOST J1010+2358, exists in the galactic halo of the Milky Way and may be the oldest second-generation star recorded.

It was already known from the Large sky Area Multi-Object fiber Spectroscopic Telescope (LAMOST) that LAMOST J1010+2358 is a very poor-metal star. These rare stars have low iron abundance.

The analysis of J1010+2358 used 2015 data from the Subaru Telescope of the National Astronomical Observatory of Japan (NAOJ), located at the Mauna Kea Observatory on Hawai–i.

Through examination of the optical and infrared spectrum of J1010+2358, the researchers determined that the star's elemental make up was even more strange than they'd known. Amounts of more than 10 elements were calculated.

It has low levels of sodium and cobalt. The level of sodium to iron is less than one-hundredth that of our sun. J1010+2358 also has a big difference in the abundance of ions with odd and even charge numbers, like sodium, magnesium, cobalt, and nickel.

"Sodium, magnesium, cobalt, and nickel abundances show a pattern unique to PISNe," says co-author and Monash University professor Alexander Heger.

"The peculiar odd-even variance, along with deficiencies of sodium and α-elements [isotopes of elements where the number of protons and neutrons is a multiple of four] in this star, are consistent with the predicted chemical fingerprint of primordial PISN from first-generation stars with 260 solar masses," says Heger.

"J1010+2358 may be the oldest star we know.

"The stars that make PISN have the shortest lifetimes, and the metal-rich gas they make can form the next generation of stars more swiftly than the metal-poorer gas that makes the stars known before. No star of the first generation has ever been found."

Heger also explains that PISNe, which were first hypothesised more than 80 years ago, are well understood theoretically, but a trace of this kind of stellar explosion had never been identified before.

"They are the only type of supernovae we fully understand how they work. Yet they are also the only type we have never uniquely identified before. This discovery is a cornerstone in our understanding of how massive stars explode."

Cosmos Magazine, 7 June 2023

https://cosmosmagazine.com

Recycling plants spew a staggering amount of microplastics

2023-05-08

An unsettling report released barely a year ago painted a grim picture of the plastics industry—only about 5 percent of the 46 million annual tons of plastic waste in the US makes it to recycling facilities. The number is even more depressing after realizing that is roughly half of experts' previous estimates. But if all that wasn't enough, new information throws a heaping handful of salt on the wound: of the plastic that does make it to recycling, a lot of it is still released into the world as potentially toxic microplastics.

According to the pilot study recently published in the Journal of Hazardous Materials Advances focused on a single, modern facility, recycling plants' wastewater contains a staggering number of microplastic particles. And as Wired explained on Friday, all those possibly toxic particulates have to go somewhere, i.e., potentially city water systems, or the larger environment.

The survey focusing on one new, unnamed facility examined its entire recycling process. This involves sorting, shredding, and melting plastics down into pellets. During those phases of recycling, however, the plastic waste is washed multiple times, which subsequently sheds particles smaller than 5 millimeters along the way. Despite factoring in the plant's state-of-the-art filtration system designed to capture particulates as tiny as 50 microns, the facility still produced as many as 75 billion particles per cubic meter of wastewater.

The silver lining here is that without the filtration systems, it could be much worse. Researchers estimated facilities that utilized filters cut

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

down their microplastic residuals from 6.5 million pounds to around 3 million pounds per year. Unfortunately, many recycling locations aren't as equipped as the modern plants used within the study. On top of that, the team only focused on microplastics as small as 1.6 microns; particles can get so small they actually enter organisms' individual cells. This implies much more plastic escapes these facilities than previously anticipated.

"I really don't want it to suggest to people that we shouldn't recycle, and to give it a completely negative reputation," Erina Brown, a plastics scientist at the University of Strathclyde, told Wired. "What it really highlights is that we just really need to consider the impacts of the solutions."

Most experts agree that the most important way to minimize coating the entire planet in microplastics is to focus on the larger issue—reducing society's reliance on plastics in general and pursuing alternative materials. In the meantime, recycling remains an important part of sustainability, as long as both facilities do everything, they can minimize microscopic waste.

Popular Science, 8 May 2023

https://popsci.com

Scientists use seaweed to create new material that can store heat for reuse

2023-06-07

Researchers from the SPECIFIC Innovation and Knowledge Centre and COATED M2A program at Swansea University have collaborated with the University of Bath to make a groundbreaking advancement in thermal storage research, developing a new efficient material that is easily scalable and can be sized and shaped to fit multiple applications.

Published in the Journal of Materials Science, the material has been made using alginate, an inexpensive, abundant, and non-toxic seaweed derivative.

The process starts with the dissolving of sodium alginate in water. Following this, expanded graphite is added, and a method of gelation is chosen:

The first method is achieved by transferring the solution into a mold for freezing. After being kept at—20°C for over two hours, beads are formed and transferred to a saturated calcium chloride solution.

The second uses a drop-cast technique, with the mixture being dropped into thermochemical calcium salt, causing gelation on contact.

Once sufficient salt diffusion has occurred, the synthesized beads are filtered and dried at 120°C.

Compared to SPECIFIC's previous carrier material, vermiculite, the alginate-based beads from both methods offer a remarkable improvement in heat storage capacity.

The new spherical beads boast increased salt capacity, achieving up to four times greater energy density than the vermiculite carrier. This is facilitated by their efficient packing in a fixed bed that maintains good airflow. As a result, the new material can achieve the same heat energy storage capacity in just a quarter of the volume.

Jack Reynolds (l) with alginate, which derives from seaweed, with Dr Jonathon Elvins (r) with beads that are produced from the alginate and that can store heat for reuse. Pictured at Swansea University, where they conducted their research. Credit: SPECIFIC, Swansea University

Jack Reynolds, who led the research as part of his doctorate at Swansea University, explains: "The ability to recover and store otherwise-wasted heat from various sources, including industrial operations and the summer sun, presents an exciting opportunity in the quest for sustainable and affordable energy resources. Our new heat storage material marks a significant step forward in realizing this potential."

Dr. Jonathon Elvins, Senior Technology Transfer Fellow and co-author, added, "SPECIFIC remains committed to driving innovation in thermal storage technology and actively collaborating with industry partners and researchers worldwide to accelerate the transition towards a greener and more sustainable future."

"To explore new applications for this latest technology, we are preparing for a trial at Tata Steel UK's Trostre steelworks to investigate ways of capturing waste heat from industrial processes for use elsewhere."

PhysOrg, 7 June 2023

https://phys.org

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

Activated partial metal sites in high entropy oxides for enhanced catalytic performance

2023-06-07

Recently, a research team led by Prof. Zhong-Shuai Wu from State Key Laboratory of Catalysis, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, reported a general in-situ modulation strategy of solid phase combustion using a thiourea addition and alkali liquor treatment to activate metal sites and lattice oxygen species of CuCoNiZnAl HEOs.

Consequently, the activated HEOs not only display higher CO2 hydrogenation and CO oxidation activity, but also have better electrocatalytic activity (discharge/charge capacities of 12,049/9,901 mAh/g) with excellent cycle stability (2,500 h) on an Li-O2 battery than that of pristine HEOs. The results were published in Chinese Journal of Catalysis.

The optimized HEOs using the thiourea addition (CuCoNiZnAl-T) and alkali liquor treatment (CuCoNiZnAl-T-NaOH) exhibit a similar crystal structure to that of CuCoNiZnAl, but higher BET surface area. Meanwhile, the reducibility of the CuCoNiZnAl-T-NaOH catalyst is much better than CuCoNiZnAl-T and CuCoNiZnAl. In addition, CuCoNiZnAl and CuCoNiZnAl-T present irregular massive morphology, whereas CuCoNiZnAl-T-NaOH shows a sheet-like morphology. The CuCoNiZnAl-T-NaOH also possessed more cationic vacancies, distorted lattice and more active lattice oxygen species.

As a result, CuCoNiZnAl-T-NaOH not only shows higher CO2 conversion than that of CuCoNiZnAl and CuCoNiZnAl-T in the temperature range from 350°C to 600°C, but also exhibits higher CO conversion than those of CuCoNiZnAl and CuCoNiZnAl-T in the whole temperature range (especially between 160 and 220 °C). More importantly, the CuCoNiZnAl-T-NaOH cathode delivers much higher discharge/charge capacities of 12,049/9,901 mAh/g than those of CuCoNiZnAl-T (11,917/8,071 mAh/g) and CuCoNiZnAl (7,260/5,224 mAh/g) with a stable stability (~2,500 h).

The excellent performance is mainly attributed to the easier electron transfer between Cu/Ni/Co sites and lattice oxygen species in the framework of CuCoNiZnAl-T-NaOH. Therefore, this present work offers a novel manner of optimizing HEOs with targeted activated metal sites as highly active heterogeneous thermal and electrochemical catalysts for

High entropy oxides (HEOs) have been tentatively and prospectively applied for catalysis and energy storage. However, it is hard to further enhance their performance due to the difficult regulation of HEOs' physical-chemical properties. Although some optimized strategies, such as the introduction of noble metal, have improved the properties and performance of HEOs in a simple and effective way, current methods do not lead to commercial preparations or industrial application.

redox reactions and energy storage in an environmentally friendly and cost-effective way.

PhysOrg, 7 June 2023

https://phys.org

Improving the quality of recyclate films by additivation

The quality of recyclate materials of plastics significantly affects their application. With the exception of slightly damaged production waste, recycled plastics cannot be used in their original form. Usually, they are sorted, cleaned, and reprocessed to form usable granules.

However, the recycled material's stability and processing ability for its intended application often require post-stabilization with suitable additives. Fraunhofer Institute of Structural Durabiity and System Reliability LBF has developed new formulations for enhance the quality of new recyclate films. At Plastics World Expo Europe, Essen, June 14-15, 2023, Booth C834, the researchers will give more information

Plastic films, such as bags and wraps, are one of the most common types of plastic waste generated by households, supermarkets, and other commercial and industrial sectors. According to the European Plastics Converters Association (EuPC), around 25 percent of all plastic packaging waste in Europe comes from plastic films.

However, these materials can be recycled and transformed into new products such as furniture, bags, and even building materials, which contributes to a circular economy. The recycling process involves collecting, sorting, and cleaning plastic films, which are then melted down and reshaped into pellets for manufacturing. In Europe, there are several companies dedicated to recycling plastic films, although they are not named here.

These companies also play a vital role in reducing plastic waste and promoting sustainability. With growing efforts to decrease plastic waste in Europe, the recycling of plastic films is becoming increasingly crucial.

Benefits by additive restabilization

The use of additives such as stabilizers, compatibilizers, and reactive agents can significantly improve the quality of recyclates, making them comparable to virgin materials. For instance, polyethylene (PE) films made from recycled plastic require no defects during their manufacture to ensure their reliability and durability.

However, the recycled material's stability and processing ability for its intended application often require post-stabilization with suitable additives.

Researchers at the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt have successfully enhanced the quality of these films through the addition of a suitable additive formulation.

Formulation development for recycling materials

The development of a formulation of multiple additives is a key approach for enhancing the properties of plastics, including those made from recycled materials. This involves combining several different additives, each with a specific function, to create a customized solution that meets the specific needs of the application.

For example, a formulation of additives may include a processing aid to improve the melt flow of the plastic, a UV stabilizer to protect the plastic from UV degradation, and an antioxidant to improve the plastic's durability. By combining these additives in the right proportions, manufacturers can create a plastic with enhanced properties that is suitable for a wide range of applications.

Developing such a formulation is a complex process that requires careful consideration of the properties of the plastic, the performance requirements of the application, and the potential environmental and health impacts of the additives used. As such, research and development efforts in this area are focused on finding sustainable and environmentally friendly solutions that can be used in the production of plastics.

By adding the appropriate formulation, which is a composition of different additives, the researchers at the Fraunhofer LBF achieved significant improvements in the quality of the recycled PE films. The resulting films are reliable, durable, and can be efficiently manufactured at a lower cost. This achievement provides a significant boost to the use of recycled plastics, making it an attractive alternative to virgin materials.

Improvement in sustainability

The successful utilization of innovative and specialized additives to enhance the quality of recycled plastics is a significant step towards sustainable and environmentally friendly production processes. It enables industries to reduce their carbon footprint by applying recycled materials instead of virgin ones.

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Therefore, the use of additives to improve recyclate properties should be encouraged and promoted. Looking further down the line, the variables of the compounding (exact composition, process parameters) raise the complexity once more, because they influence the efficiency of the recycling additives.

As a result, it becomes only clear in the very late stages of the development cycle if and how all targeted properties (aging resistance, mechanics) can be achieved and if these are continuously under control considering further variables (batch-to-batch variation, incoming streams).

Despite trial and error being still widely used in this process, the best path for a successful additivation is an analytical characterization of the available recycling material. The result of such targeted screening delivers the then needed information for a tailor-made additivation.

PhysOrg, 7 June 2023

https://phys.org

Researchers harness phosphorus fluoride exchange to 'click' together new molecules

2023-06-07

In collaboration with two-time Nobel laureate K. Barry Sharpless, Moses' lab has devised a chemical transformation they call phosphorus fluoride exchange, or PFEx. PFEx efficiently snaps together chemical building blocks to form new molecules, in a reliable process known as click chemistry. Click chemistry already offers chemists a powerful set of tools. As the newest addition to that tool kit, PFEx takes a cue from biology and uses phosphorous as a chemical connector.

Inside cells, phosphorous gives structure to DNA and holds together essential energy-storing molecules. It's a versatile connector. It can readily connect multiple chemical groups. These groups can be arranged around the phosphorous hub to create three-dimensional shapes.

Moses says, "Nature has recognized its importance—it's a privileged group. If we're trying to make drugs that interact with biology, we should not ignore that fact."

Chemists can now use PFEx to click together multiple different chemical components around a single phosphorous hub. By incorporating more phosphorous connectors, they can build even more complex molecules. "We're now decorating this three-dimensional linkage. And that's going

For chemists like Cold Spring Harbor Laboratory (CSHL) Professor John Moses, diversity is a gateway to discovery. The more molecules scientists have to explore, the more likely it is they will find something useful. With the latest advancement from Moses' lab, they can now quickly assemble a vast array of complex molecules. Among those molecules, Moses hopes to find effective new cancer therapeutics. The research is published in the journal Chem.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

to allow us to access some new chemical space," says CSHL Research Investigator Joshua Homer. "When you access new space, you're accessing new function."

Shoujun Sun, seen here, is a postdoctoral fellow in Cold Spring Harbor Laboratory Professor John Moses' lab. Sun led a new Moses lab study that marks a significant breakthrough for the field of click chemistry. Credit: Moses lab/Cold Spring Harbor Laboratory

PFEx reactions might even enable drugs to latch onto their targets inside the body. Moses' team has already begun exploring PFEx as a source of cancer therapeutics. One benefit to this approach is that researchers can optimize the reactivity of the molecules involved in PFEx reactions. This could ensure potential drugs interact only with their desired targets, reducing the risk of side effects.

The researchers expect their new kind of click chemistry will help create materials with useful properties. For example, PFEx might be used to incorporate flame retardants or antimicrobials into new surfaces. Moses says PFEx materials will have an important advantage over the "forever chemicals" found in many of today's products. Phosphorous bonds are not excessively stable. This means they can be easily broken down when a product is ready for recycling.

PhysOrg, 7 June 2023

https://phys.org

Scientists discover that water molecules define the materials around us

2023-06-07

Or so the story goes.

A new paper published in Nature upends that paradigm, and argues that the character of many biological materials is actually created by the water that permeates these materials. Water gives rise to a solid and goes on to define the properties of that solid, all the while maintaining its liquid characteristics. In their paper, the authors group these and other materials into a new class of matter that they call "hydration solids," which they say "acquire their structural rigidity, the defining characteristic of the solid state, from the fluid permeating their pores." The new understanding of biological matter can help answer questions that have dogged scientists for years.

For decades, the fields of physics and chemistry have maintained that the atoms and molecules that make up the natural world define the character of solid matter. Salt crystals get their crystalline quality from the ionic bond between sodium and chloride ions, metals like iron or copper get their strength from the metallic bonds between iron or copper atoms, and rubbers get their stretchiness from the flexible bonds within polymers that constitute the rubber. The same principle applies for materials like fungi, bacteria, and wood.

"I think this is a really special moment in science," Ozgur Sahin, a professor of Biological Sciences and Physics and one of the paper's authors, said. "It's unifying something incredibly diverse and complex with a simple explanation. It's a big surprise, an intellectual delight."

Steven G. Harrellson, who recently completed doctoral studies in Columbia's physics department, and is an author on the study, used the metaphor of a building to describe the team's finding: "If you think of biological materials like a skyscraper, the molecular building blocks are the steel frames that hold them up, and water in between the molecular building blocks is the air inside the steel frames. We discovered that some skyscrapers aren't supported by their steel frames, but by the air within those frames."

"This idea may seem hard to believe, but it resolves mysteries and helps predict the existence of exciting phenomena in materials," Sahin added.

When water is in its liquid form, its molecules strike a fine balance between order and disorder. But when the molecules that form biological materials combine with water, they tip the balance toward order: Water wants to return to its original state. As a result, the water molecules push the biological matter's molecules away. That pushing force, called the hydration force, was identified in the 1970s, but its impact on biological matter was thought to be limited. This new paper's argument that the hydration force is what defines the character of biological matter almost entirely, including how soft or hard it is, thus comes as a surprise.

We have long known that biological materials absorb ambient moisture. Think, for example, of a wooden door, that expands during a humid spell. This research, however, shows that that ambient water is much more central to wood, fungi, plants, and other natural materials' character than we had ever known.

The team found that bringing water to the front and center allowed them to describe the characteristics that familiar organic materials display with very simple math. Previous models of how water interacts with organic matter have required advanced computer simulations to predict the properties of the material. The simplicity of the formulas that the team found can predict these properties suggests that they're onto something.

To take one example, the team found that the simple equation $E=Al/\lambda$ neatly describes how a material's elasticity changes based on factors including humidity, temperature, and molecule size. (E in this equation refers to the elasticity of a material; A is a factor that depends on the

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

temperature and humidity of the environment; l is the approximate size of biological molecules and λ is the distance over which hydration forces lose their strength).

"The more we worked on this project, the simpler the answers became," Harrellson said, adding that the experience "is very rare in science."

The new findings emerged from Professor Sahin's ongoing research into the strange behavior of spores, dormant bacterial cells. For years, Sahin and his students have studied spores to understand why they expand forcefully when water is added to them and contract when water is removed. Several years ago, Sahin and colleagues garnered media coverage for harnessing that capability to create small engine-like contraptions powered by spores.

Around 2012, Sahin decided to take a step back to ask why the spores behave the way they do. He was joined by researchers Michael S. DeLay and Xi Chen, authors on the new paper, who were then members of his lab. Their experiments did not provide a resolution to the mysterious behavior of spores. "We ended up with more mysteries than when we started," Sahin remembers. They were stuck, but the mysteries they encountered were hinting that there was something worth pursuing.

After years of pondering potential explanations, it occurred to Sahin that the mysteries the team continually encountered could be explained if the hydration force governed the way that water moved in spores.

"When we initially tackled the project, it seemed impossibly complicated. We were trying to explain several different effects, each with their own unsatisfying formula. Once we started using hydration forces, every one of the old formulas could be stripped away. When only hydration forces were left, it felt like our feet finally hit the ground. It was amazing, and a huge relief; things made sense," he said.

The paper's findings apply to huge amounts of the world around us: Hygroscopic biological materials—that is, biological materials that allow water in and out of them–potentially make up anywhere from 50% to 90% of the living world around us, including all of the world's wood, but also other familiar materials like bamboo, cotton, pine cones, wool, hair, fingernails, pollen grains in plants, the outer skin of animals, and bacterial and fungal spores that help these organisms survive and reproduce.

The term coined in the paper, "hydration solids," applies to any natural material that's responsive to the ambient humidity around it. With the

equations that the team identified, they and other researchers can now predict materials' mechanical properties from basic physics principles. So far that was true mainly of gases, thanks to the well-known general gas equation, which has been known to scientists since the 19th century.

"When we take a walk in the woods, we think of the trees and plants around us as typical solids. This research shows that we should really think of those trees and plants as towers of water holding sugars and proteins in place," Sahin said, "It's really water's world."

PhysOrg, 7 June 2023

https://phys.org

https://phys.org/news/2023-06-small-molecule-alleviates-arthritis-symptoms.html?utm_source=nwletter&utm_medium=email&utm_campaign=daily-nwletter

2023-06-07

The work is published in the journal Nature Chemical Biology. The findings may also have relevance to the treatment of certain cancers.

"For the first time, we were able to describe on the level of atoms how a small molecule that blocks the cellular secretion of proteins relevant to the development of diseases, such as cytokines, binds to its target protein. This way, we were able to establish a model for blocking the production of various secreted target proteins with the help of small molecules," says Research Director Ville Paavilainen from the Institute of Biotechnology, University of Helsinki.

According to Paavilainen, the finding means that, in the future, such drug-like small molecules can be developed with increased accuracy to specifically prevent the formation of proteins associated with various diseases.

"The new atom-level knowledge we have produced on the target protein and the small molecule bound to it enables the rational design of novel molecules in drug development," Paavilainen says.

The researchers used chemical biology to determine how the small molecule that inhibits the function of the Sec61 protein functions in human cells and affects the functioning of the Sec61 protein channel. Using an animal model of rheumatoid arthritis, the researchers were able

Researchers at the University of Helsinki, together with researchers from the United States, have discovered a small molecule that inhibits the formation in cells of cytokine proteins that promote inflammation. The mechanism is based on the fact that the small molecule blocks the secretion of cytokines entirely. By inhibiting a target protein known as Sec61, the researchers successfully alleviated symptoms of rheumatoid arthritis in a mouse model.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 09, 2023

to demonstrate that the small molecule alleviated arthritis symptoms without adverse side effects.

The researchers also utilized Nobel Prize–winning cryo-electron microscopy to investigate how this small molecule binds to its large target protein. At the same time, the dynamics and interactions of this complex were investigated through atomistic computer simulations carried out on the supercomputers operated by the CSC—IT Center for Science in Kajaani, central Finland.

Small molecules emergent in drug development

Many proteins formed in cells are associated with the onset of diseases. For example, proteins called cytokines, which function as mediators of inflammation, are known to underlie rheumatoid arthritis. Paavilainen's research group investigates the mechanisms by which various proteins that affect diseases are secreted in cells.

A range of small molecules have long been the subject of drug development. Most of the drugs currently available are aimed at influencing the secretion of proteins already generated, such as cytokines. In the research carried out by Paavilainen's group, the formation of proteins that contribute to the onset of diseases diseases is entirely blocked.

"Collecting more research knowledge on which proteins are associated with various diseases will enable the development of entirely new kinds of drugs. Of course, further research is needed. Our group will continue working on targeted small molecules," Paavilainen says.

The study was carried out in collaboration with Kezar Life Sciences, a United States pharmaceutical company. The company is currently investigating the effectiveness of blocking protein secretion in the treatment of certain solid and easily spreading malignant tumors.

PhysOrg, 7 June 2023

https://phys.org

CHEMWATCH

Bulletin Board

Technical Notes

JUN. 09, 2023

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

CHEMICAL EFFECTS

An extra-chelator-free fenton process assisted by electrocatalytic-induced in-situ pollutant carboxylation for target refractory organic efficient treatment in chemical-industrial wastewater

The influence of size and surface chemistry on the bioavailability, tissue distribution and toxicity of gold nanoparticles in zebrafish (Danio rerio)

ENVIRONMENTAL RESEARCH

Aging, characterization and sorption behavior evaluation of tire wear particles for tetracycline in aquatic environment

PHARMACEUTICAL/TOXICOLOGY

A rapid systematic scoping review of research on the impacts of water contaminated by chemicals on very young children

Progression-free survival and safety at 3.5years of follow-up: results from the randomised phase 3 PRIMA/ENGOT-OV26/GOG-3012 trial of niraparib maintenance treatment in patients with newly diagnosed ovarian cancer

Research progress and trend of effects of organophosphorus pesticides on aquatic organisms in the past decade

OCCUPATIONAL

Dose additive maternal and offspring effects of oral maternal exposure to a mixture of three PFAS (HFPO-DA, NBP2, PFOS) during pregnancy in the Sprague-Dawley rat

Health symptoms, inflammation, and bioaerosol exposure in workers at biowaste pretreatment plants

Water consumption patterns impact hydration markers in males working in accordance with the National Institute for Occupational Safety and Health recommendations

PIG-A gene mutation as a mutagenicity biomarker among coke oven workers