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

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ASIA PACIFIC

Workplace exposure standards open for public comment – Release 6 – o-Dichlorobenzene to 1,4-dioxane

2019-11-01

Safe Work Australia is evaluating the Workplace exposure standards for airborne contaminants to ensure they are based on the highest quality evidence and supported by a rigorous scientific approach. Release 6: o-Dichlorobenzene to 1,4-dioxane is now open for public comment. Please note that this Release includes chemicals that do not currently have an Australian workplace exposure standard. These are:

- 3,3-Dichlorobenzidine
- Diesel engine emissions
- Diethyl sulfate
- Diethylene glycol monobutyl ether
- Diglycidyl resorcinol ether
- Dimethyl carbomoyl chloride
- Dimethyl sulphide
- Dimethylsulfamoyl chloride

In particular, Safe Work Australia are seeking comments of a technical nature regarding:

- the toxicological information and data that the value is based upon, and
- the measurement and analysis information provided.

To provide comments on the draft evaluation reports and recommendations for Release 6, go to the Safe Work Australia consultation platform, [Engage](#). Please note, some evaluation reports have been deferred to Release 7.

Public comment will close on 22 November 2019. The feedback we receive will be considered when making final recommendations for workplace exposure standards. The draft evaluation reports and recommendations for the remaining chemicals will be released throughout 2019 and 2020.

If you know someone who has an interest in workplace exposure standards, please forward this email and recommend they subscribe to

Safe Work Australia are calling for comments on the recommendations for Release 6 – o-Dichlorobenzene to 1,4-dioxane.

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the chemicals exposure standards mailing list to stay informed about the review and release dates.

Safe Work Australia, 28 October 2019

<http://www.safeworkaustralia.gov.au>

Public consultation—Reconsideration of 2,4-D

2019-11-01

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has released the Proposed Regulatory Decisions and Review Technical Report for the reconsideration of 2,4-D. "We make decisions based on credible scientific evidence and have been taking progressive action on 2,4-D for many years," said APVMA Chief Executive Officer, Dr Chris Parker. "It's important to get the science right, and with the publication of the APVMA spray drift management guidelines earlier this year the proposed regulatory decisions for 2,4-D can now be finalised. "The release of the Proposed Regulatory Decisions opens the three-month consultation period." Once the consultation period has ended and the final regulatory decision has been published, the APVMA will provide holders with guidance on what they need to do to comply with the outcome of the chemical review. "In the meantime users should continue to follow the APVMA issued permits PER87174 and PER87451."

Consultation on this report

Interested parties can make a submission during the consultation period (24 October 2019 to 31 January 2020). More information about the review and consultation process can be found on the APVMA website.

APVMA, 24 October 2019

<http://www.apvma.gov.au>

Department of Health Annual Report 2018–19

2019-11-01

The Department of Health has published its annual report, which includes the National Industrial Chemicals Notification and Assessment Scheme's (NICNAS) annual report in Appendix 3 and Outcomes 5. NICNAS exceeded all of its performance measures for the year. The annual report describes NICNAS' work to deliver the Government's long-term national health plan in the financial year ending 30 June 2019. It includes information about

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has released the Proposed Regulatory Decisions and Review Technical Report for the reconsideration of 2,4-D.

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reforms, operations, budget, governance and performance. A copy of the report is available at:

[Download Department of Health Annual Report 2018–19](#)

NICNAS, 25 October 2019

<http://www.nicnas.gov.au>

Consultation opens on changes to chemical classification and labelling

2019-11-01

New Zealand's Environmental Protection Authority (EPA) are proposing to internationally align New Zealand's hazardous substance classification system by adopting the Globally Harmonised System of Classification and Labelling (GHS). The GHS is an internationally agreed system developed by the United Nations to classify chemicals and communicate their hazards through labels and safety data sheets. New Zealand's current classification system was implemented in 2001. It was based on a pre-published version of the GHS that was first introduced in 2003. Whilst our system was considered world-leading at the time, the EPA has identified a number of benefits in updating to a later version of the GHS. They include reducing complexity for stakeholders, international alignment that facilitates trade, and enhanced effectiveness of the Hazardous Substances and New Organisms Act 1996 (HSNO). EPA propose to adopt revision 7 of the GHS, which was published in 2017. Adopting the GHS will not change the hazardous substance risk assessment process that is set out by the HSNO Act. Submissions close on 9 January 2020. Further information is available at:

- [Read the consultation document](#)
- [Make a submission using online form](#)

NZ EPA, 29 October 2019

<http://www.epa.govt.nz>

The Philippines Proposes to Add 31 Chemicals to PICCS LIST

2019-11-01

The Philippines issued a draft proposal to add 31 chemicals to the PICCS. Importers or manufacturers of chemicals listed in the PICCS are exempt from notification requirements as long as they are not further regulated

New Zealand's Environmental Protection Authority (EPA) are proposing to internationally align New Zealand's hazardous substance classification system by adopting the Globally Harmonised System of Classification and Labelling (GHS).

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by the PCL or CCO. In September 2019, the Philippine Environmental Management Bureau under the Department of Environment and Natural Resources (DENR-EMB) published a draft of *Additional Chemicals in Philippine Inventory of Chemical and Chemical Substances (PICCS) List*, planning to add 31 additional chemicals to the country's PICCS. The PICCS, now contains over 47,000 items, is a list of all existing chemicals and chemical substances used, sold, distributed, imported, processed, manufactured, stored, exported, treated, or transported in the Philippines. It was first published by the DENR-EMB in 1995 and later updated in 2000, 2002, 2005, 2008, 2011, 2013, 2015 and 2017. Businesses can check whether their chemicals are listed therein via the [online search tool](#) launched by the government. Chemicals which are not listed in the PICCS will be deemed as new chemicals in the Philippines, and their manufacturers or importers are required to submit a Pre-Manufacturer and Pre-Importation Notification (PMPIN) to the DENR-EMB, so as to get a new chemical notification and secure clearance. In contrast, for chemicals listed in the PICCS, their manufacturers or importers will be exempt from notification requirements as long as such chemicals are not subject to the [Priority Chemical List \(PCL\)](#) or Chemical Control Orders (CCO).

Chemlinked, 21 October 2019

<http://chemlinked.com/en/news>

AMERICA

Chemical plants may get options for monitoring hazardous air emissions

2019-11-01

Chemical plants and refineries could pick between two alternatives to track their emissions of hazardous air pollutants, under a 21 October proposal from the United States Environmental Protection Agency. They could beef up monitoring of equipment for releases of hazardous air pollutants and storage tanks for leaks, or they could instead monitor for hazardous pollutants in the air along the fence lines of their facilities. Those choosing fence-line monitoring would have to conduct root-cause analyses and fix leaks if pollutant concentrations rose beyond levels worked out with the EPA. The agency says it is offering that option because direct measurement of leaks from equipment and storage tanks can be costly and difficult. The proposal would apply to chemical plants and refineries that store and distribute organic liquids other than

Chemical plants and refineries could pick between two alternatives to track their emissions of hazardous air pollutants, under a 21 October proposal from the United States Environmental Protection Agency.

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gasoline. Despite the use of emission-control technology required by another regulation, these facilities collectively release 5,300 metric tons of hazardous air pollutants every year, including benzene, toluene, and vinyl chloride, the agency says.

Chemical & Engineering News, 26 October 2019

<http://pubs.acs.org/cen/news>

Draft Risk Evaluation of Methylene Chloride Will Be Published on October 29; SACC Will Review It in December

2019-11-01

On 29 October 2019, the United States Environmental Protection Agency (EPA) will publish a *Federal Register* notice, announcing the availability of and soliciting public comment on the draft Toxic Substances Control Act (TSCA) risk evaluation of methylene chloride (MC). EPA states that it is also submitting the same document to the TSCA Science Advisory Committee on Chemicals (SACC) for peer review and that SACC will hold an in-person public meeting to consider and review the draft risk evaluation on 3-4 December 2019. Preceding the in-person meeting, there will be a preparatory virtual public meeting on 12 November 2019, for SACC to consider the scope and clarity of the draft charge questions for the peer review. Registration for the preparatory virtual meeting must be completed on or before 12 November 2019, to receive the webcast meeting link and audio teleconference information. Written comments for the preparatory virtual meeting and requests for time to present oral comments are due by 8 November 2019. Written comments on the draft risk evaluation that are submitted to EPA on or before 26 November 2019, will be provided to SACC for review and consideration before the 3-4 December 2019, meeting. Requests to present oral comments at the in-person meeting are due 3 December 2019. Publication of the *Federal Register* notice on 29 October 2019, will begin a 60-day comment period on the draft risk evaluation. The draft risk evaluation is not yet publicly available and is not expected to be until the notice is published on 29 October 2019, and Docket ID EPA-HQ-OPPT-2019-0437 is created at <http://www.regulations.gov>.

National Law Review, 26 October 2019

<http://www.natlawreview.com>

On 29 October 2019, the United States Environmental Protection Agency (EPA) will publish a Federal Register notice, announcing the availability of and soliciting public comment on the draft Toxic Substances Control Act (TSCA) risk evaluation of methylene chloride (MC).

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OSHA Implements New Weighting System for Workplace Inspections

2019-11-01

OSHA inspections are getting a makeover; now, they will consider other factors outside of just a time-weighted basis. The OSHA Weighting System (OWS) will go into effect 1 October 2019, and will replace the current weighting system initiated in FY 2015. A new weighted inspection system comes from the growing concern that the current reliance on the factor of time does not provide a holistic evaluation of a workplace's safety and health. OSHA understands time is not the only factor to assess when considering the potential impact of an inspection. Other factors—like types of hazards inspected and abated and effective targeting—also influence the impact on workplace safety and health. The new system includes enforcement initiatives like Site-Specific Targeting to the weighting system. OSHA's new weighting system will incorporate the three major work elements performed by the field: enforcement activity, essential enforcement support functions (e.g., severe injury reporting and complaint resolution), and compliance assistance efforts. OSHA has been running the new weighting system to confirm data integrity. For more information, read the [OSHA news release](#) on the new system.

Occupational Health & Safety News, 2 October 2019

<http://www.ohsonline.com>

Notice of Proposed Rulemaking Title 27, California Code of Regulations Amendment to Section 25705 Specific Regulatory Levels Posing No Significant Risk: P-Chloro- α,α,α -Trifluorotoluene (PCBTF)

2019-11-01

California's Office of Environmental Health Hazard Assessment (OEHHA) proposes to adopt a Proposition 65 No Significant Risk Level (NSRL) of 23 micrograms per day for *p*-chloro- α,α,α -trifluorotoluene (PCBTF), by amending Title 27, California Code of Regulations, section 25705(b). Any written comments concerning this proposed action must be received by OEHHA 2 December 2019, which is the designated close of the written comment period. All comments received will be posted on the OEHHA website at the close of the public comment period. The public is encouraged to submit written information via e-mail or at <https://oehha.ca.gov/comments>.

OSHA knows many factors impact workplace safety. Starting today, OSHA will put into effect its new weighting system for workplace safety and health inspections.

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Proposition 65 prohibits a person in the course of doing business from knowingly and intentionally exposing any individual to a chemical that has been listed as known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual. The Act also prohibits a business from knowingly discharging a listed chemical into water or onto or into land where such chemical passes or probably will pass into any source of drinking water. For carcinogens, an exemption from the warning requirement is provided by the Act when the exposure for which the person is responsible can be demonstrated to produce no significant risk or when a discharge which otherwise complies with all applicable requirements would not cause any significant amount of the discharged or released chemical to enter any source of drinking water. A determination that a level of exposure poses no significant risk may be made utilising regulations adopted by OEHHA (Sections 25701-25721). Section 25701 describes alternative methods for making such a determination. Section 25703 sets forth the process for determining "no significant risk" levels for purposes of Proposition 65 and Section 25705 establishes those levels for certain listed chemicals. Details on the basis for the proposed NSRL for PCBTF are provided in the Initial Statement of Reasons for this regulatory amendment, which is available on request from Monet Vela and is posted on the OEHHA website at www.oehha.ca.gov. This proposed amendment to Section 25705 would add an NSRL for PCBTF by amending Section 25705(b) as follows:

Chemical	NSRL, in micrograms per day
<i>p</i> -chloro- α,α,α -trifluorotoluene	23

To develop the proposed NSRL for PCBTF, OEHHA relied on the National Toxicology Program (NTP) report entitled "Toxicology and Carcinogenesis Studies of *p*-Chloro- α,α,α -trifluorotoluene in Sprague Dawley Rats (Hsd:Sprague Dawley SD) and B6C3F₁/N Mice (Inhalation Studies)". The NTP report summarised the available data from rodent carcinogenicity studies, as well as other information relevant to the carcinogenic activity of PCBTF. The NSRL for PCBTF is based upon the results of the most sensitive scientific study deemed to be of sufficient quality.

Anticipated Benefits of the Proposed Regulation

Some businesses may not be able to afford the expense of establishing an NSRL and therefore may be vulnerable to litigation for a failure to warn or for a prohibited discharge of the listed chemical. By providing an NSRL, this regulatory proposal spares businesses the expense of calculating

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their own NSRL and may enable them to reduce or avoid litigation costs. In addition, the NSRL does not require, but may encourage, businesses to lower the amount of the listed chemical in their product to a level that does not cause a significant exposure, thereby providing a public health benefit to Californians. This in turn may reduce exposure to PCBTF and reduce resident, worker and environmental exposures to chemicals that cause cancer.

No Inconsistency or Incompatibility with Existing Regulations

After conducting an evaluation on any related regulations in this area, OEHHA has found that these are the only regulations dealing with Proposition 65 No Significant Risk Levels for this specific chemical. Therefore, OEHHA has determined that the proposed regulation is neither inconsistent nor incompatible with existing state regulations. The proposed regulation does not impose any mandatory requirements on businesses, state or local agencies and does not address compliance with any other law or regulation.

Impact on the Creation, Elimination, or Expansion of Jobs/Businesses in California

This regulatory proposal will not affect the creation or elimination of jobs within the State of California. Proposition 65 requires businesses with ten or more employees to provide warnings when they expose people to chemicals that are known to cause cancer. The law also prohibits the discharge of listed chemicals into sources of drinking water. PCBTF is listed under Proposition 65; therefore, businesses that manufacture, distribute or sell products with PCBTF in the state must provide a warning if their product or activity exposes the public or employees to significant amount of this chemical. Businesses are also prohibited from discharging significant amounts of this chemical into sources of drinking water. The regulatory proposal does not create additional compliance requirements, but instead provides a "safe harbor" value that aids businesses in determining whether a warning is required for a given exposure or a discharge is prohibited. Because the proposed NSRL provides compliance assistance to businesses subject to the Act, but does not impose any mandatory requirements on those businesses, OEHHA has determined that the proposed regulatory action will not have any impact on the creation or elimination of jobs, the creation of new businesses or the elimination of existing businesses, or the expansion of businesses currently doing business within the State of California. Benefits of this regulation include sparing businesses the expense of

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calculating their own NSRL and possibly enabling them to reduce or avoid litigation costs. By providing an NSRL, it may encourage businesses to lower the amount of the listed chemical in their product to a level that does not cause a significant exposure, thereby providing a public health benefit to Californians. This in turn may reduce exposure to PCBTF and reduce resident, worker and environmental exposures to chemicals that cause cancer. This notice and the Initial Statement of Reasons are being provided to the OEHHA Science Advisory Board's Carcinogen Identification Committee for review and comment. Because the proposed regulatory level provides compliance assistance to businesses subject to Proposition 65, but do not impose any mandatory requirements on those businesses, OEHHA has made an initial determination that the adoption of the regulation will not have a significant state-wide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states. The proposed NSRL was developed to provide compliance assistance for these businesses in determining whether a warning is required or a discharge is prohibited. The NSRL provides a level of exposure at or below which a warning is not required and a discharge is not prohibited. Use of the NSRL is not mandatory. The implementing regulations allow a business to calculate its own level and provide guidance in order to assist businesses in doing so. However, conducting such a process can be expensive and time consuming, and the resulting levels may not be defensible in an enforcement action. OEHHA is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action.

EFFECT ON SMALL BUSINESSES

OEHHA has determined that the proposed regulation will not impose any mandatory requirements on small business. Rather, the proposed NSRL will provide compliance assistance for small businesses subject to Proposition 65 because it will help them determine whether an exposure for which they are responsible is subject to the warning requirement or discharge prohibition of Proposition 65.

CONSIDERATION OF ALTERNATIVES

Government Code section 11346(a)(13) requires that OEHHA must determine that no reasonable alternative considered by the OEHHA or that has otherwise been identified and brought to the attention of the OEHHA would be more effective in carrying out the purpose for which the action is proposed, would be as effective and less burdensome to affected

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private persons than the proposed action, or would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provision of law than the proposal described in this Notice.

AVAILABILITY OF STATEMENT OF REASONS AND TEXT OF PROPOSED REGULATIONS

OEHHA has prepared and has available for public review an Initial Statement of Reasons for the regulation, all the information upon which the regulation is based and the text of the regulation. A copy of the Initial Statement of Reasons, the text of the regulation and the documents relied on to develop the proposed regulation are available upon request from OEHHA at the address and telephone number indicated above. These documents are also posted on OEHHA's website at www.oehha.ca.gov.

OEHHA, 18 October 2019

<http://www.oehha.ca.gov>

Executive Orders Seek to Limit the Bite of Agency Guidance

2019-11-01

On 9 October 2019, President Trump issued two executive orders regarding agency guidance – one focused on the development of new guidance and the other on the appropriate use of guidance in enforcement actions. And EPA is not wasting any time taking action. EPA Administrator Andrew Wheeler issued a memorandum on 21 October 2019 announcing the creation of two working groups to interpret and apply the executive orders. While he did not establish a time frame for completion of the working groups' review processes, Administrator Wheeler indicated that the working groups would provide the agency with further instructions in the "coming weeks." One of the executive orders seeks to ensure that agencies cannot use guidance documents to enforce standards that are not otherwise contained in a statute or regulation. "When an agency uses a guidance document to state the legal applicability of a statute or regulation that document can do no more, with respect to prohibition of conduct, than articulate the agency's understanding of how a statute or regulation applies to particular circumstances." If an agency relies on a document or decision to assert a new or expanded claim of jurisdiction, the document or decision must be published in the Federal Register before the conduct

On 9 October 2019, President Trump issued two executive orders regarding agency guidance – one focused on the development of new guidance and the other on the appropriate use of guidance in enforcement actions.

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over which jurisdiction is sought occurs. The order also requires that regulated parties have an opportunity to contest an agency's legal and factual determinations before the agency issues that party a no action letter, notice of noncompliance, or other similar document. The other executive order sets forth more stringent procedures for the development and publication of agency guidance. Within a specified timeframe, all agency guidance must be available on the agency's website in a single, searchable database. Under the order, agencies are also required review their guidance documents and rescind any that should no longer be in effect. The order also requires agencies to develop (or amend) regulations establishing procedures for issuing guidance documents. At a minimum, these regulations must contain the following provisions:

- A requirement that guidance documents clearly state that they do not bind the public, except as authorized by law or as incorporated into a contract;
- Procedures for the public to petition for withdrawal or modification of a particular guidance document; and
- A more stringent review process, including a public notice and comment period, for "significant" guidance documents.

Each agency will be responsible for addressing these executive orders, but it is clear that EPA has already begun that process. We will stay tuned to see how EPA will incorporate these executive orders into its daily compliance and enforcement activities.

National Law Review, 22 October 2019

<http://www.natlawreview.com>

EUROPE

EU gives Ireland the green light to introduce microbead ban

2019-11-01

The European Union (EU) has cleared the way for the Irish Government to introduce laws which ban microbeads. Minister Eoghan Murphy announced the European Commission's clearance for the restrictions on microbeads contained in the Microbeads (Prohibition) Bill 2019. The minister welcomed the green light from the European Commission for his proposals. This will now facilitate further consideration of the bill at committee stage in the Dáil. The bill will provide for a ban on the

The European Commission has given clearance for the bill.

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manufacture, import, export or sale of products containing intentionally added plastic microbeads, to include “rinse-off” personal care products, detergents, and domestic and industrial abrasive cleaning products and scouring agents. Murphy said: “Now that the standstill period has been concluded, I look forward to working with my Oireachtas colleagues at Committee Stage at the earliest opportunity so that we can have this bill in force as soon as possible. “While several States legislated to prohibit personal care products containing plastic microbeads Ireland will be the first EU Member State to extend such prohibition to detergents, abrasive scouring agents and other cleaning products.” Murphy added that plastic microbeads represent only one element of the microplastics in our oceans. It is estimated that many billions are being washed down the drain and into the world’s rivers, lakes and seas each year. Once in our rivers and seas, they can last for centuries without breaking down. Aquatic animals may ingest them and they cannot be removed once they are in the marine environment. Murphy added: “I am increasingly concerned about the potential risk posed to our aquatic ecosystems by microplastic litter, including plastic microbeads. I know this concern is shared widely, across all parties in the Oireachtas and throughout broader society. “While this is an important step, it is only one of many measures we will have to introduce over the coming years to reduce the level of litter and plastic pollution entering our seas and oceans.”

The Journal, 24 October 2019

<https://www.thejournal.ie>

The Revised Brexit Withdrawal Agreement and Political Declaration and Their Impact on UK Environmental Standards

2019-11-01

UK Prime Minister Boris Johnson recently secured amendments to the draft Withdrawal Agreement to govern the UK’s exit from the European Union (i.e., ‘Brexit’) and the accompanying draft Political Declaration on the UK/EU future relationship. The Withdrawal Agreement is the proposed treaty to govern the terms of the UK’s exit from the EU, while the Political Declaration, which will be non-binding, sets out the framework for the negotiations on the future relationship between the EU and the UK post-Brexit. While neither the amended Withdrawal Agreement nor the amended Political Declaration has yet been approved by the UK Parliament (nor has either been formally approved by the necessary EU

UK Prime Minister Boris Johnson recently secured amendments to the draft Withdrawal Agreement to govern the UK’s exit from the European Union (i.e., ‘Brexit’) and the accompanying draft Political Declaration on the UK/ EU future relationship.

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institutions), there are indications that there may be a majority in favour of both amongst UK parliamentarians who have previously – on three occasions – rejected the previous Withdrawal Agreement negotiated by Mr Johnson’s predecessor, Theresa May. The Brexit situation remains very fluid – at the time of writing the EU has just agreed (but has not yet formally approved) an extension of the UK’s exit date, from 31 October 2019 to 31 January 2020, with an option for the UK to leave earlier if the Withdrawal Agreement is ratified. A UK general election could take place before then – but it is worth considering the potential implications of the amended Withdrawal Agreement and Political Declaration on UK environmental standards should both eventually be approved by the UK and the EU. An important difference between Mr Johnson’s Withdrawal Agreement and Mrs May’s Withdrawal Agreement is that provisions relating to environmental protections have been removed and are now to be found in the amended Political Declaration. While the Withdrawal Agreement, once ratified, would be a legally binding treaty between the UK and the EU, the Political Declaration would be, as noted above, non-binding, at least under international law. Therefore, under Mr Johnson’s proposal, the provisions relating to environmental standards would not be binding on the UK. There are also substantive differences in the environmental provisions. There is no longer a commitment by the UK and EU to build on the environmental standards guaranteed in Mrs May’s Withdrawal Agreement (i.e., the so-called ‘level playing field’ arrangements) and instead, the UK and the EU commit to upholding the environmental standards applicable at the end of the period in which the UK will be required to follow EU rules post-Brexit (which would, under current proposals, end on 31 December 2020). Therefore, and rather than the ‘dynamic alignment’ approach in Mrs May’s Withdrawal Agreement (i.e., with the UK effectively matching the EU’s environmental standards), the new proposed approach is one of ‘non-regression’ (i.e., the UK will not lower its environmental standards, but it will not be required to sign up to future environmental standards adopted by the EU). This suggests that the UK’s future relationship with the EU will be much looser than what was previously contemplated – a free trade agreement as opposed to a full customs union, and relatively free access to the EU’s single market. While the Political Declaration is technically non-binding, the proposed UK legislation to implement the Withdrawal Agreement – which is currently stalled in the UK parliament – requires that the terms of the UK/EU future relationship be consistent with the Political Declaration. Therefore, while non-binding between the UK and the EU under international law, the Political Declaration would be binding on the UK under UK law (although there would be nothing to stop a future UK government from amending

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this, assuming it has a sufficient majority in parliament to do so). The UK's new approach is significant since it potentially creates a situation whereby the UK could seek to diverge from EU environmental standards – subject to the non-regression requirement – as a way of obtaining a competitive advantage over the EU as a place to do business. Indeed, recent news reports suggest that the UK is open to '*significant divergence*' (FT link requires registration) from the EU post-Brexit. Environmental protection is a significant focus of EU regulatory development, and both the EU and the heads of state of EU member states have expressed concern that future lower standards in the UK vis-à-vis the EU would give UK-based business a competitive advantage or could create pressure in the EU for it to lower its standards. Environmental protection is also an area where the UK has found itself – even while it is a full member of the EU – before the European Court of Justice. Of course, the UK's level of access to the EU market post-Brexit will be conditional on the environmental standards adopted by the UK, since many of those standards go beyond regulating activities solely undertaken in the UK, and could extend to, for example, the substances allowed in products and the treatment of foodstuffs for export to the EU. The EU will be unwilling to allow its consumers to be exposed to UK products and foodstuffs where there is any risk resulting from a laxation in UK standards. The post-Brexit extraterritorial effects of the EU's various environmental regimes – the EU, along with the United States, is often described as a 'regulatory superpower' – on the UK are therefore likely to be significant, irrespective of whether or not the UK is formally obliged to follow or directly participate in them. It is open to question whether the UK would be willing to risk materially curtailing access to the EU market – the UK's single biggest export market and likely to remain so for many years post-Brexit – by lowering its environmental standards to obtain a competitive advantage or to secure trade deals with non-EU countries (although the UK is likely to be under pressure to do so). Further, the UK government has faced a backlash from representatives of key industries – aerospace, automotive, chemicals, food and drink, and pharmaceuticals – who, in a joint letter, stated it '*is important [that] regulatory alignment should continue after Brexit as a critical element of the UK's future relationship with the EU*'. Many businesses in the UK are heavily invested in the various EU regulatory regimes and, while such regimes can undoubtedly be onerous and can impose significant costs, they are 'known quantities', and compliance with them is already standard practice. Given the continued uncertainty around Brexit, businesses should continue to

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closely monitor developments and seek to identify how they, or their UK- and EU-based operations, may be impacted by changing circumstances.

National Law Review, 29 October 2019

<http://www.natlawreview.com>

Call launch: supporting the food safety systems of the future

2019-11-01

The European Commission has launched a call today to develop a research and innovation platform on food safety. It will make it easier for national food safety authorities, EU agencies, policy-makers, the scientific community and civil society to coordinate research efforts. The deadline for applications is 22 January 2020. "Identifying food safety research priorities is something that is crucial for EFSA and we are committed to contributing actively. Our recent report on Food Safety Regulatory Research Needs 2030, sets out research priorities over the next 10 years," said EFSA chief scientist Marta Hugas. The EFSA publication looks at how research can stimulate innovation, how science can be communicated effectively to society and how to provide safe food for a growing world population. Major outcomes of the Commission's project will be trans-national research programs, the alignment of national and EU research agendas, and the creation of a Food Safety Strategic Research and Innovation Agenda (SRIA) to address consumers' expectations, emerging technologies and policy priorities. The platform will include information on food safety research and improve coherence between national and EU funding in food safety research. It will also facilitate new approaches to communication on food safety.

EFSA, 15 October 2019

<http://www.efsa.europa.eu>

The European Commission has launched a call today to develop a research and innovation platform on food safety.

REACH Update

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ECHA Submission portal updated to include system-to-system service

2019-10-31

An updated version of the European Chemicals Agency's (ECHA) Submission portal has been released. It introduces improvements for those submitting information to the EU poison centres. The most important updates are:

- System-to-system service, which allows companies who have decided to prepare their notifications in their own IT-systems to automate their submission to the Member State bodies through the portal.
- Upgrade of the PCN format to include, for example, new EU Hazard statements.
- New features in the dossier preparation tool.

More information is available on the poison centres website: [Poison centres news](#)

ECHA News, 30 October 2019

<http://echa.europa.eu>

Biocides Day material online

2019-10-31

The European Chemicals Agency (ECHA) has published the presentation material from its recent Biocides Day, held on 29 October 2019. The Biocides Day presented an update on the current priorities for biocides in the EU. The presentations and a video recording are available.

[Event material](#)

ECHA News, 30 October 2019

<http://echa.europa.eu>

New IUCLID introduces fields for reporting nanomaterials

2019-10-31

Upgrade of IUCLID (6.4) is now available. It includes new data fields for reporting the characteristics of nanoforms and sets of nanoforms, which registrants who intend to submit registrations for substances in nanoform must use as of 30 October 2019. It also features updated modules to

An updated version of the European Chemicals Agency's (ECHA) Submission portal has been released.

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validate the new reporting formats and check how the data will be published. Join our [webinar on 12 November 2019](#) to learn about the data requirements for the characterisation of nanoforms and practical examples on how to use the new IUCLID fields for reporting them. The release also introduces an improved web interface.

ECHA News, 30 October 2019

<http://echa.europa.eu>

Public consultation on harmonised classification and labelling

2019-10-31

The European Chemicals Agency (ECHA) is looking for comments on the harmonised classification and labelling proposals for [bentazone \(ISO\)](#); [3-isopropyl-2,1,3-benzothiadiazine-4-one-2,2-dioxide](#) (EC 246-585-8, CAS 25057-89-0). The deadline for comments is 10 January 2020. To submit a comment, go to: [Give comments](#)

ECHA News, 30 October 2019

<http://echa.europa.eu>

New proposals and intentions to harmonise classification and labelling

2019-10-31

Three intentions to harmonise the classification and labelling have been received for:

- [Ethyl acrylate](#) (EC 205-438-8, CAS 140-88-5);
- [Methyl acrylate](#) (EC 202-500-6, CAS 96-33-3); and
- [Allyl methacrylate](#) (EC 202-473-0, CAS 96-05-9).

A proposal has been submitted for [1-phenylethan-1-one](#), (1-phenylethylidene)hydrazone (EC 211-979-0, CAS 729-43-1).

Further information is available at: [Registry of CLH intentions](#)

ECHA News, 30 October 2019

<http://echa.europa.eu>

The European Chemicals Agency (ECHA) is looking for comments on the harmonised classification and labelling proposals for bentazone (ISO); 3-isopropyl-2,1,3-benzothiadiazine-4-one-2,2-dioxide (EC 246-585-8, CAS 25057-89-0).

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IUCLID 6.4 is available

2019-10-31

A new version of IUCLID is available to all users. It includes an extended and more complete web interface, as well as an update to the format. The web user interface, which is meant to become in the future the only user interface for IUCLID, has been improved. This version includes, for example, direct navigation to referenced documents in dossiers, advanced dossier creation, export and printing options including document selection, and a slightly more compact view for documents. As in every major update of IUCLID, this version comes with an update of the format to take into account:

the latest evolutions of the REACH (for example, new nanoforms requirements) and CLP regulations (latest ATPs); the future SCIP database notification format for substance of very high concern in articles as mentioned in the waste framework directive; and the needs of several regulatory organisations including the European Food Safety Authority (EFSA), and the organisations managing chemicals in Australia and New Zealand. In relation to the update of the IUCLID format for nanomaterials, this new version of IUCLID also includes new validation assistant rules to verify how these substance forms are reported in REACH registration dossiers. This new version of IUCLID can read all IUCLID files generated since version 5.6. It can also export files compatible with version, 6.3, published last year. Users of IUCLID 6.2 or older versions should update their software to minimise the risk of not being able to process the most recent IUCLID files. IUCLID 6.4 will be presented in more detail in a webinar that will take place on the 8th of November. You can register by clicking the link below. The users of the ECHA Cloud services will have their IUCLID instances automatically upgraded. Note that the IUCLID end-user license agreement has been updated to cover IUCLID-related tools, to explicitly encompass other regulations besides REACH and CLP, as well as to align with local Finnish law. Further information is available at:

- [Download IUCLID 6.4](#)
- [Release notes](#)
- [Format](#)
- [REACH requirements for nanomaterials](#)
- [IUCLID 6.4 webinar](#)

IUCLID, 30 October 2019

<https://iuclid6.echa.europa.eu>

A new version of IUCLID is available to all users.

REACH Update

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Committees' opinions on application for authorisation available

2019-10-31

The consolidated opinions of the Committees for Risk Assessment and Socio-economic Analysis for two uses of 4-(1,1,3,3-tetramethylbutyl) phenol, ethoxylated (EC -, CAS -; better known as Triton X-100 or 4-tert-octylphenol, ethoxylated) by Ortho-Clinical Diagnostics are available on ECHA's website at: [Opinions](#)

ECHA News, 30 October 2019

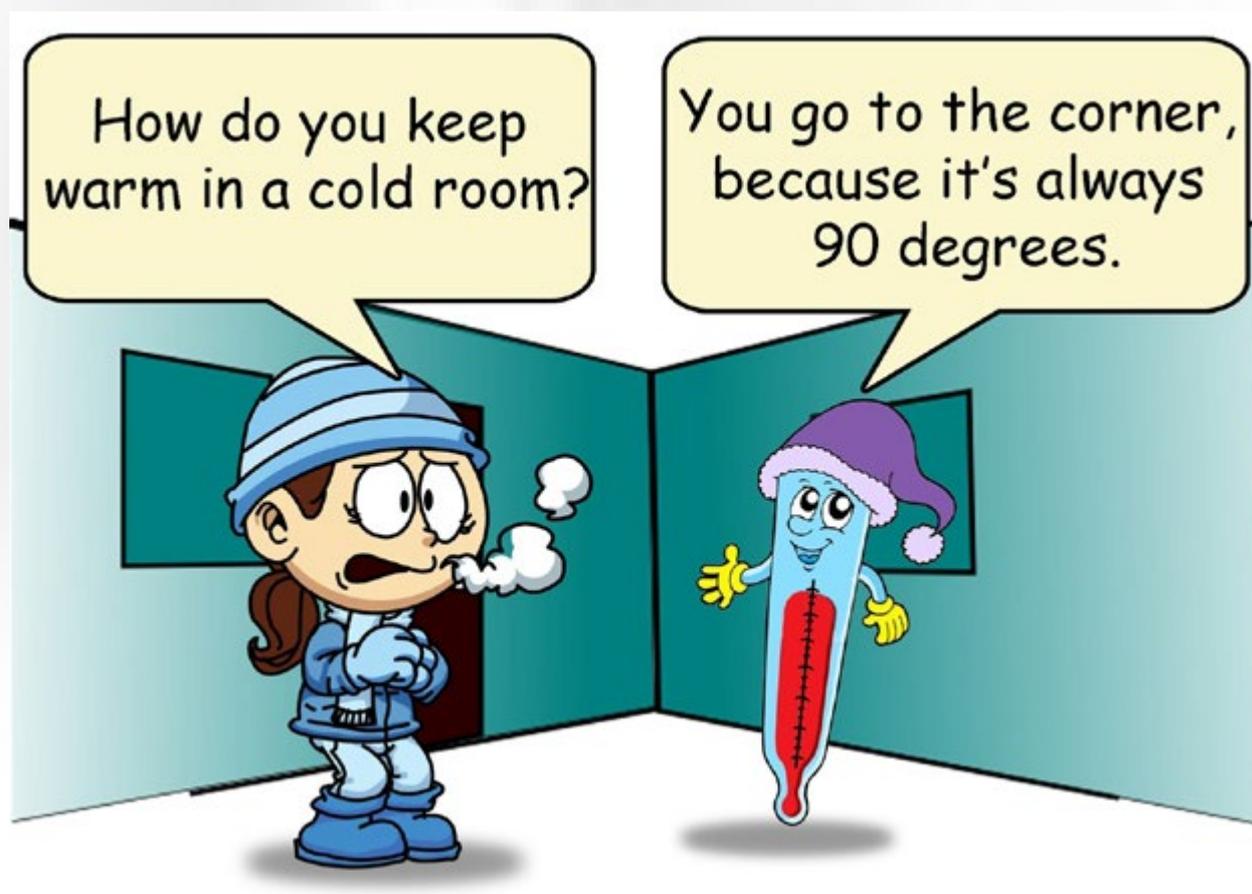
<http://echa.europa.eu>

Janet's Corner

CHEMWATCH

Cold Room

2019-10-27



<http://naughtyfunz.blogspot.com/2015/09/funny-environmental-jokes.html>

Hazard Alert

CHEMWATCH

Chlorine Trifluoride

2019-10-20

Chlorine trifluoride is an interhalogen compound with the formula ClF_3 . This colourless, poisonous, corrosive and very reactive gas condenses to a pale-greenish yellow liquid, the form in which it is most often sold (pressurised at room temperature). [1]

USES [1]

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

EXPOSURE SOURCES [2]

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

HEALTH HAZARD INFORMATION [2]

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

However, based on animal studies:

Hazard Alert

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

Signs and Symptoms of Exposure

- Acute exposure: No signs or symptoms of acute exposure to chlorine trifluoride have been reported in humans.
- Chronic exposure: No signs or symptoms of chronic exposure to chlorine trifluoride have been reported in humans.

SAFETY

First Aid Measures [3]

- Inhalation: Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.
- Skin/eye contact: In case of skin contact, wearing rubber gloves rub 2.5% calcium gluconate gel continuously into the affected area for 1.5 hours or until further medical care is available. May cause severe chemical burns to skin and cornea. Suitable first-aid treatment should be immediately available. Seek medical advice before using product. Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contaminated clothing. Drench affected area with water for at least 15 minutes. Obtain medical assistance

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- Ingestion: Ingestion is not considered a potential route of exposure.

Personal Protective Equipment

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

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

Storage [3]

Chlorine trifluoride should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labelled in accordance with OSHA's Hazard Communication Standard [29 CFR 1910.1200]. Containers of

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chlorine trifluoride should be protected from physical damage and should be stored separately from most combustible materials, water, ice, or silicon-containing compounds (sand, glass, and asbestos), oil, grease, reducing agents, organic compounds, fuels and combustibles, and many metals and metal oxides.

REGULATION

United States [5]

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

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

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

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

Australia [6]

Safe Work Australia has set a time weighted average (TWA) concentration for chlorine trifluoride of 0.1 ppm peak limitation and 0.38mg/mg³ peak limitation for a 40-hour work week.

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Gossip

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Atomic-level imaging could offer roadmap to metals with new properties

2019-10-23

High-entropy alloys, which are made from nearly equal parts of several primary metals, could hold great potential for creating materials with superior mechanical properties. But with a practically unlimited number of possible combinations, one challenge for metallurgists is figuring out where to focus their research efforts in a vast, unexplored world of metallic mixtures. A team of researchers at the Georgia Institute of Technology has developed a new process that could help guide such efforts. Their approach involves building an atomic resolution chemical map to help gain new insights into individual high-entropy alloys and help characterise their properties. In a study published 9 October in the journal *Nature*, the researchers described using energy-dispersive X-ray spectroscopy to create maps of individual metals in two high-entropy alloys. This spectroscopy technique, used in conjunction with transmission electron microscopy, detects X-rays emitted from a sample during bombardment by an electron beam to characterise the elemental composition of an analysed sample. The maps show how individual atoms arrange themselves within the alloy, allowing researchers to look for patterns that could help them design alloys emphasising individual properties. For example, the maps could give researchers clues to understand why substituting one metal for another could make an alloy stronger or weaker, or why one metal outperforms others in extremely cold environments. "Most alloys used in engineering applications have only one primary metal, such as iron in steel or nickel in nickel-based super alloys, with relatively small amounts of other metals," said Ting Zhu, a professor in the George W. Woodruff School of Mechanical Engineering at Georgia Tech. "These new alloys that have relatively high concentrations of five or more metals open up the possibility of unconventional alloys that may have unprecedented properties. But this is a new compositional space that has not been explored, and we still have a very limited understanding of this class of materials." The name "high entropy" refers to the lack of uniformity in the mixture of metals as well as how many different and somewhat random ways the atoms from the metals can be arranged as they are combined. The new maps could help researchers determine whether there are any unconventional atomic structures that such alloys take that could be leveraged for engineering applications, and how much control researchers could have over the mixtures in order to "tune" them for specific traits, Zhu said. To test the new imaging approach, the research team compared two high-entropy alloys containing five metals.

A team of researchers at the Georgia Institute of Technology has developed a new process that could help gain new insights into high-entropy alloys and help characterise their properties.

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One was a mixture of chromium, iron, cobalt, nickel, and manganese, a combination commonly referred to as a “Cantor” alloy. The other was similar but substituted palladium for the manganese. That one substitution resulted in much different behaviour in how the atoms arranged themselves in the mixture. “In the Cantor alloy, the distribution of all five elements is consistently random,” Zhu said. “But with the new alloy containing palladium, the elements show significant aggregations due to the much different atomic size of palladium atoms as well as their difference in electronegativity compared to the other elements.” In the new alloy with palladium, the mapping showed that palladium tended to form large clusters while cobalt seemed to collect in places where iron was in low concentrations. Those aggregations, with their sizes and spacings in the range of a few nanometres, provide strong deformation resistance and could explain the differences in mechanical properties from one high-entropy alloy to another. In straining tests, the alloy with palladium showed higher yield strength while keeping similar strain hardening and tensile ductility as the Cantor alloy. “The atomic scale modulation of element distribution produces the fluctuation of lattice resistance, which strongly tunes dislocation behaviours,” said Qian Yu, a co-author of the paper and a professor in Zhejiang University. “Such modulation occurs at a scale that is finer than precipitation hardening and is larger than that of traditional solid solution strengthening. And it provides understanding for the intrinsic character of high-entropy alloys.” The findings could enable researchers to custom design alloys in the future, leveraging one property or another. The team also included researchers from the University of Tennessee, Knoxville; Tsinghua University; and the Chinese Academy of Sciences.

Science Daily, 9 October 2019

<http://www.sciencedaily.com>

Electronic solid could reduce carbon emissions in fridges and air conditioners

2019-10-22

A promising replacement for the toxic and flammable greenhouse gases that are used in most refrigerators and air conditioners has been identified by researchers from the University of Cambridge. The device is based on layers of a material composed of oxygen and three metallic elements known as PST, and it displays the largest electrocaloric effects—changes in temperature when an electric field is applied—yet observed in a body large enough for cooling applications. The results, reported in the journal

A promising replacement for the toxic and flammable greenhouse gases that are used in most refrigerators and air conditioners has been identified by researchers from the University of Cambridge.

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Nature, could be used in the development of highly-efficient solid-state refrigerators and air conditioners, without the need for bulky and expensive magnets. "When facing a challenge as big as climate change and reducing carbon emissions to net zero, we tend to focus on how we generate energy—and rightly so—but it's critical that we're also looking at the consumption of energy," said co-author Dr. Xavier Moya from Cambridge's Department of Materials Science & Metallurgy. Refrigeration and air conditioning currently consume a fifth of all energy produced worldwide, and as global temperatures continue to rise, demand is only going to keep going up. In addition, the gases currently used in the vast majority of refrigerators and air conditioners are toxic, highly flammable greenhouse gases that only add to the problem of global warming when they leak into the air. Researchers have been trying to improve cooling technology by replacing these gases with solid magnetic materials, such as gadolinium. However, the performance of prototype devices has been limited to date, as the thermal changes are driven by limited magnetic fields from permanent magnets. In research published earlier this year, the same Cambridge-led team identified an inexpensive, widely available solid that might compete with conventional coolants when put under pressure. However, developing this material for cooling applications will involve a lot of new design work, which the Cambridge team are pursuing. In the current work, the thermal changes are instead driven by voltage. "Using voltage instead of pressure to drive cooling is simpler from an engineering standpoint, and allows existing design principles to be repurposed without the need for magnets," said Moya. The Cambridge researchers, working with colleagues in Costa Rica and Japan, used high-quality layers of PST with metallic electrodes sandwiched in between. This made the PST able to withstand much larger voltages, and produce much better cooling over a much larger range of temperatures. "Replacing the heart of prototype magnetic fridges with a material that performs better, and does not require permanent magnets, could represent a game-changer for those currently trying to improve cooling technology," said co-author Professor Neil Mathur. In future, the team will use high-resolution microscopy to examine the PST microstructure, and optimise it further in order to apply even larger voltages.

Phys.org, 9 October 2019

<http://phys.org>

A new strategy for the synthesis of complex natural products

2019-10-23

Chemists from the University of Basel have succeeded in synthesising two complex natural products from the group of dithiodiketopiperazines (DTPs). For this, they employed a new strategy based on "C-H bond activation," resulting in a short and high yielding route. In the most recent edition of the *Journal of the American Chemical Society*, the researchers describe their new concept for the total synthesis of Epicoccin G and Rostratin A. Certain microorganisms, such as fungi, are a rich source of secondary metabolites, which have great potential in medicinal applications. Of particular interest among these secondary metabolites are the dithiodiketopiperazines (DTPs), as they possess a variety of interesting biological activities that could be used in the development of new drugs for malaria or cancer. However, despite extensive efforts over the past decade, relatively few total syntheses of these molecules have been completed and obtaining the necessary quantities for further investigation remains a challenging target. Professor Olivier Baudoin and first author Pierre Thesmar from the Department of Chemistry at the University of Basel have now succeeded in the development of an efficient and scalable synthesis of two of these structurally challenging natural products.

C-H bond activation as a new synthetic strategy

The synthesis route used by the Basel team employed a new strategy for the ring system construction involving a method known as "C-H bond activation," which in recent years has become a valuable synthetic tool. In this key step, two rings are simultaneously formed by a twofold reaction in which a carbon-hydrogen bond (C-H bond) is cleaved and a carbon-carbon bond (C-C bond) formed. This route allows efficient access to a common intermediate on multigram quantities from inexpensive, commercially available starting materials. This intermediate was then converted to the first natural DTP, Epicoccin G, in seven additional steps. Compared with the previous single total synthesis of the same molecule, the current synthesis displays 14 steps instead of 17, and a much higher overall yield of 19.6 percent rather than 1.5 percent.

Next challenge: Rostratin A

Following the successful synthesis of Epicoccin G, the research team ventured to synthesise Rostratin A, a related natural DTP, for the first time and on a larger scale. This molecule displays a number of daunting

Chemists from the University of Basel have succeeded in synthesising two complex natural products from the group of dithiodiketopiperazines (DTPs).

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structural elements that necessitated a significant adaptation of the synthesis end-game. After much experimentation, optimisation of each step and validation on multigram quantities, Rostratin A was synthesised on a 500 mg scale. Overall, this total synthesis was completed in 17 steps and with a high overall yield of 12.7 percent. The new strategy reveals the high potential of the C–H bond activation method in the field of natural product synthesis. In a next step, the researchers aim to synthesise other natural DTPs and their analogues in order to conduct more advanced studies and further evaluate the medicinal potential.

Phys.org, 9 October 2019

<http://phys.org>

Controlling superconducting regions within an exotic metal

2019-10-23

Superconductivity has fascinated scientists for many years since it offers the potential to revolutionise current technologies. Materials only become superconductors - meaning that electrons can travel in them with no resistance - at very low temperatures. These days, this unique zero resistance superconductivity is commonly found in a number of technologies, such as magnetic resonance imaging (MRI). Future technologies, however, will harness the total synchrony of electronic behaviour in superconductors - a property called the phase. There is currently a race to build the world's first quantum computer, which will use these phases to perform calculations. Conventional superconductors are very robust and hard to influence, and the challenge is to find new materials in which the superconducting state can be easily manipulated in a device. EPFL's Laboratory of Quantum Materials (QMAT), headed by Philip Moll, has been working on a specific group of unconventional superconductors known as heavy fermion materials. The QMAT scientists, as part of a broad international collaboration between EPFL, the Max Planck Institute for Chemical Physics of Solids, the Los Alamos National Laboratory and Cornell University, made a surprising discovery about one of these materials, CeIrIn5. CeIrIn5 is a metal that superconducts at a very low temperature, only 0.4°C above absolute zero (around -273°C). The QMAT scientists, together with Katja C. Nowack from Cornell University, have now shown that this material could be produced with superconducting regions coexisting alongside regions in a normal metallic state. Better still, they produced a model that allows researchers to design complex conducting patterns and, by varying the temperature,

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to distribute them within the material in a highly controlled way. Their research has just been published in Science. To achieve this feat, the scientists sliced very thin layers of CeIrIn5 - only around a thousandth of a millimetre thick - that they joined to a sapphire substrate. When cooled, the material contracts significantly whereas the sapphire contracts very little. The resulting interaction puts stress on the material, as if it were being pulled in all directions, thus slightly distorting the atomic bonds in the slice. As the superconductivity in CeIrIn5 is unusually sensitive to the material's exact atomic configuration, engineering a distortion pattern is all it takes to achieve a complex pattern of superconductivity. This new approach allows researchers to "draw" superconducting circuitry on a single crystal bar, a step that paves the way for new quantum technologies. This discovery represents a major step forward in controlling superconductivity in heavy fermion materials. But that's not the end of the story. Following on from this project, a post-doc researcher has just begun exploring possible technological applications. "We could, for example, change the regions of superconductivity by modifying the material's distortion using a microactuator," says Moll. "The ability to isolate and connect superconducting regions on a chip could also create a kind of switch for future quantum technologies, a little like the transistors used in today's computing."

EurekAlert, 10 October 2019

<http://www.eurekalert.org>

Chemical Safety Board says PES refinery explosion 'did not have to happen'

2019-10-23

An outdated piece of pipe that had corroded so much its sides were the width of half a credit card led to the catastrophic explosion and fire at the Philadelphia Energy Solutions refinery in June, according to a new report released by the Chemical Safety and Hazard Investigation Board. The incident released a dangerous chemical, hydrofluoric acid, although no known injuries related to that release occurred. "We are all very fortunate that there were no fatalities or serious injuries as a result of this catastrophic incident," said the Chemical Safety Board's interim executive, Kristen Kulinowski. "But I want to emphasise that we at the CSB are very aware that this event has shaken those that live and work within and around the refinery. Here in Philadelphia, the layoffs and announced closure of the facility means the elimination of about 1,000 jobs as well as an unknown economic impact on the surrounding community."

The report by the Chemical Safety Board shows for the first time that some amount of the dangerous hydrofluoric acid was released to the atmosphere

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This didn't need to happen." Hydrofluoric acid, or HF, is one of the most dangerous industrial chemicals in use. Exposure can lead to serious injury or death. It can also corrode pipes. The Chemical Safety Board report says the faulty pipe that led to the explosion and fire was installed in 1973 and was grandfathered when new standards were put in place in 1995. Swallowing just a small amount of HF or getting small splashes on the skin can be fatal, according to the Centres for Disease Control and Prevention. In a gaseous state, the CDC says, low levels of HF can irritate the eyes, nose and respiratory tract. Breathing it at high levels "can cause death from an irregular heartbeat or fluid build-up in the lungs." About 48 refineries across the country, including two currently operating in the Philadelphia region, use HF as a catalyst to make high-octane gasoline. Kulinowski said pipe corrosion also led to similar incidents at refineries in other parts of the country. "We're concerned that the next time there's a massive explosion and debris is strewn, we've seen this three times, that we're not going to be so lucky. And the major vessel that contains the HF will be compromised." After explosions in California and Utah, Kulinowski said, the Chemical Safety Board recommended that industry inspect all pipes, not just representative sections. But it does not have the power to demand those inspections. The American Petroleum Institute sets the safety standards for how to process and utilise HF. "We need to focus on making sure that this kind of explosion at a refinery doesn't happen anymore. Because it's just a matter of time before the facts are a little bit different, and people die or are critically injured or there's an offsite consequence, Kulinowski said." The CSB is not a regulator — its mandate is to conduct investigations of accidents and provide safety recommendations. Kulinowski said that the investigation at Philadelphia Energy Solutions is ongoing and that recommendations should come as part of its next report, due out in early 2020. "The PES refinery is 150 years old," she said. "The piping component that failed was installed in the 1970s, and although parts of the piping circuit had been inspected as recently as 2018, the specific component that failed has not been inspected for corrosion in the past 45 years." There are "striking similarities" to a 2012 explosion and fire at the Chevron refinery in Richmond, California, she said. In the CSB's Chevron report, the agency recommended that California regulators require "damage mechanism hazard reviews," which examine risks associated with corrosion. California has a state agency that oversees worker safety, while Pennsylvania relies on the federal Occupational Safety and Health Administration. "The board remains concerned that the next time there is a major explosion at a refinery that uses HF for alkylation, workers and those living nearby will not be so lucky," Kulinowski said. PES chief executive officer Mark Smith said the company is "committed

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to working with the CSB to make certain that it understands the agency's concerns." But he said the CSB recommendations from the Chevron incident did not apply to the Philadelphia refinery. "PES understood the CSB as noting that it had previously investigated other refinery incidents that resulted from corrosion," Smith said in a statement. "These incidents and resulting CSB recommendations, however, were tied to specific types of corrosion or damage mechanisms. For this reason, previous CSB recommendations are not directly relevant to this incident. As noted by the CSB, inspection data for representative monitoring locations on the relevant piping segment did not indicate a problem."

Hurling tanks

Workers and residents of the neighbourhood surrounding the PES refinery also avoided potential catastrophes from flying debris. Three explosions occurred after leaked propane caught fire. The largest explosion sent a 38,000-pound vessel — about the same weight as a fire truck — nearly half a mile through the air across the Schuylkill River, where it landed on the waterway's banks, near the company's tank farm. Two other large pieces, one 23,000 pounds and another 15,500 pounds, landed in the refinery. Kulinowski said it was lucky those pieces did not hit any parts of the operation that could have caused even further damage. A fourth piece has still not been recovered because it lies in an area that remains inaccessible. PES estimates that the incident released 676,000 pounds of hydrocarbons, most of it — about 608,000 pounds — burned in the fire and explosions. The CSB report says an estimated 3,271 pounds of hydrofluoric acid was released into the atmosphere, while the refinery's water spray system contained about 1,968 pounds of HF, which was detected by the refinery's own air monitors. City officials had previously reported they did not detect any HF escaping. Kulinowski would not comment on issues surrounding the reliability of the city's air monitors. She said the refinery's own system — known as 'Rapid Acid Deinventory' — that evacuated the bulk of the toxic HF did work and prevented further injuries. "I'm impressed that industry had its act together, that it has a RAD system, and that they activated it in a timely fashion," said Ron Koopman, a physicist and expert in chemical safety. "That's new turf for industry taking responsibility. Because as far as I know ... this is the best response that I'm aware of." As a senior scientist at the Lawrence Livermore National Laboratory, where he worked for 36 years, Koopman conducted the definitive experiment on the release of hydrogen fluoride back in 1986. He said the HF that was released at PES was likely dispersed by the intense explosion. "The explosion is nasty — it could kill people, but it's not the principal hazard," he said. "It's

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the toxic gas [HF] that could continue to be toxic downwind. Sometimes, the explosion and the fire is your friend." Koopman's experiment in 1986 released 1,000 gallons of HF at a Nevada test site. The results shocked him. A video of the experiment shows white billowing clouds of poisonous gas expanding and traveling rapidly across the desert. Highly toxic levels of HF were detected miles away. Refineries typically have water spray mechanisms to contain HF, which were also activated at PES. Koopman said fast action is critical because once the HF is airborne, it can kill people at high concentrations. "The [workers] are my heroes in this process," he said.

What started the explosion

The June incident at PES began when a 90-degree piece of pipe known as an "elbow" ruptured, releasing fluid containing hydrocarbons and HF. The pipes in the refinery's alkylation unit are monitored at specific spots — known as "condition monitoring locations," or CMLs — to measure for thickness. The ruptured elbow, however, was not a CML, and thus its thickness had not been monitored. PES had a policy that any pipe thinner than 0.18 inch would be replaced. The Chemical Safety Board's investigation found that the ruptured pipe was only 0.012-inch-thick — less than a tenth of the thickness that would have triggered a replacement. John Jechura, professor of practice at the Colorado School of Mines, said deciding where to test for corrosion is always a probability issue. "You can't check every square inch of pipe," he said. As a rule of thumb, he said, the area's most vulnerable to corrosion — and thus potential cracks and leaks — are places in the pipe where there is a change in the flow direction: T's, Y's, and elbows. Given that he was not involved with the PES plant, Jechura said he couldn't say why the ruptured elbow was not an area that was monitored more closely. CSB supervisory investigator Lauren Grim, who led the PES inspection, disputed Jechura's statement that not every piece of pipe could be inspected. "Actually, California has updated its safety regulations to require these damage mechanism reviews," she said. "And some CSB leadership is actually talking to California regulators about that this week". Grim said the requirement to conduct 100% inspections could be focused. "This kind of variable corrosion rate isn't an issue in all parts of the refinery," she said. Another issue was the pipe material. The pipes in the alkylation unit were installed in 1973, when industry standards did not specify how much nickel or copper they should contain. In 1995, however, those standards were updated, specifying that pipes should be no more than 0.4% each nickel and copper. The ruptured pipe contained 1.74% nickel and 0.84% copper. Petrochemical-industry

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standards are largely self-directed, and so any pipes installed before the regulations were updated in 1995 were grandfathered in, despite the fact that the American Petroleum Institute's own recommended practice for "Safe Operation of Hydrofluoric Acid Alkylation Unit," last updated in May 2013, states: "HF corrosion has been found to be strongly affected by steel composition and localised corrosion rates can be subtly affected by local chemistry differences." Mike Wilson, national director for occupational and environmental health at the BlueGreen Alliance, said that lack of oversight has meant refineries are not sufficiently required to invest in maintaining and improving safety. "This is certainly the case with the federal standard for refinery safety, which is 27 years old and far outdated," Wilson said. "It requires very little by refiners to actually fix process-safety hazards, such as corroded piping systems." Hydrofluoric acid is regulated by both the Environmental Protection Agency and the Occupational Safety and Health Administration.

OSHA does so under the Process Safety Management of Highly Hazardous Chemicals. The EPA's Risk Management Plan Rule governs public disclosures surrounding the use and accidental release of toxic chemicals, as well as emergency response. The CSB sent a letter to the EPA earlier this year urging it to require safer alternatives. Kulinowski said the agency has not replied. The Obama administration toughened risk management rules, but Trump's EPA says it wants to roll back some of the new provisions, including the requirement that industry assesses the use of safer alternatives. However, other standards — like pipe maintenance and composition — are set by industry groups, and refineries generally police themselves. According to the EPA, between 2007 and 2017, there were 1,517 reportable accidents at facilities using hazardous chemicals — nearly 150 incidents a year over 10 years. Nearly 500 of those accidents affected residents in surrounding communities. "We don't hear about them, but they're significant enough to threaten people's safety, if not their long-term health," Wilson said. He noted that in the explosion at Chevron's Richmond, California, refinery, engineers had recommended on six different occasions that the company replace pipes that were out of date, but Chevron management decided not to replace them. "The CSB continually points out that the most obvious causes of a major incident, such as a corroded pipe, are not what actually caused the incident," Wilson said. "Major industrial failures like this are nearly always the consequence of management decision-making and the way safety is prioritised or not." Wilson noted that until the CSB report is complete, he couldn't say whether Philadelphia Energy Solutions faced a similar issue with regard to safety culture. Koopman, the physicist and chemical-safety expert, agreed

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that self-regulation may not be the best way to ensure that industry employs the best practices to keep workers and nearby residents safe. "Luck has saved a lot of people in this business," he said. "You would hope that we could do better than luck. But when it comes down to it, luck is a good thing."

State Impact, 16 October 2019

<https://stateimpact.npr.org>

Creepy human-like skin makes your phone ticklish and pinchable

2019-10-23

Forget protective covers – there are now skin-like phone cases that respond to being pinched and tickled. Marc Teyssier at Telecom Paris in France and his colleagues have devised an artificial skin for interactive devices that responds to touch. The skin is able to detect a variety of gestures, including sliding, stretching and rotation. "I wanted to pinch my phone," says Teyssier as the reason for designing the skin. The skin also responds to different gestures that mimic human emotional communication. The artificial skin is programmed to associate different gestures with certain emotions. Sudden hard pressure on the skin is associated with anger and tapping is a means of seeking attention, while sustained contact and stroking are associated with providing comfort. The team developed two prototypes: one with a creepily realistic textured layer that resembles human skin and another with a more uniform surface. The artificial skin is made of three layers, consisting of a layer of stretchable copper wire sandwiched between two layers of silicone. Pressure on the skin changes the electric charge of the system. Developing the sensor was a challenge, says Teyssier. "The constraint was to develop something that was stretchable and that can also detect touch," he says. The team created a phone case, computer touch pad and smart watch to demonstrate how the artificial skin works. The work is being presented this week at the ACM Symposium on User Interface Software and Technology in New Orleans, US. The next step is to make the skin more realistic, including with embedded hair and temperature features. Previously, Teyssier designed a robotic finger which enables smartphones to crawl across a table.

New Scientist, 19 October 2019

<http://www.newscientist.com/>

Forget protective covers – there are now skin-like phone cases that respond to being pinched and tickled.

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Technology's future isn't gleaming, it's dirty and biological

2019-10-23

There is a long-standing myth that nature is the opposite of technology. Yet now we know that our industrial machines didn't conquer the wilderness; instead, they caused a climate change catastrophe that might one day wipe us out. Knowing this will dramatically change the way our future technologies look, as well as how we interact with them. Consider the plant tattoo. Last year, a group at Iowa State University revealed flexible water sensors made of graphene that could be taped onto plants. When attached to the undersides of leaves, the devices look like tattoos. They are used to measure how healthy and hydrated crops are, but they could also be adapted for environmental monitoring. Corn fields could become drought prediction systems. At Northumbria University, UK, researchers at the Hub for Biotechnology in the Built Environment are taking this idea further. Earlier this year, they received a grant of £8 million to incorporate sustainable, biological materials into buildings. They will be exploring the idea of walls made from living, self-repairing cells and plumbing systems seeded with microbes that convert waste into fuel. The ventilation systems in these buildings might even include plants with graphene tattoos that monitor air quality. Meanwhile, in medicine, people are using light to manipulate the behaviour of cells in the burgeoning field of optogenetics. Carefully aimed beams of light can activate medicines circulating in the body, or change the behaviour of synapses in the brain. As we cope with environmental and health needs, the realm of nature is becoming nearly indistinguishable from the realm of technology: plants are sensors; light is a form of medicine. Our future won't be anything like the Apple Store version of tomorrow, with its clean white lines and antiseptic designs. Instead, it will be dirty and full of bacteria. And that will be cutting edge. How do we prepare ourselves for a future where advanced machines look like a sunny day on the farm? I think we need better stories about what is really coming next. That is why I sometimes write science fiction instead of reporting the facts. In my new novel, *The Future of Another Timeline*, a cast of heroic geologists struggles to understand a piece of technology that is so advanced that it looks exactly like slabs of rock. You see, they have discovered that time machines are embedded in ancient shield rock formations that were part of Earth's crust more than half a billion years ago. Of course, my characters know they weren't the first to stumble across these wormholes that open when you pound rock against rock in five locations across the planet. People have been smacking rocks together for a long time, so it is pretty likely that

How do we prepare ourselves for a future where advanced machines look like a sunny day on the farm?

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Palaeolithic people were jumping into the time machines long before science was invented. And then there are the written records from classical antiquity about magical portals that can be opened by drumming on the ground. It is only in the age of science that my geologists finally figure out that humans have been mucking around with the timeline forever, by banging on an ancient machine interface that opens wormholes to the past. For these geologists, time travel is like metallurgy. There is a long history of people making iron, but a relatively short history of people understanding why iron comes from heating and blending different kinds of shiny nuggets they mined from rocks. At last, science has progressed far enough for the geologists to comprehend how advanced the time machines are. They are a part of nature, built into Earth by someone or something that left them behind for reasons we can only hope to understand one day. Cosmologist Sean Carroll has assured me that time travel will never exist, which is kind of a bummer. Science fiction is fiction, after all. But it is also a way for us to imagine a radically different future. Nature won't be erased by machines. Instead, it will absorb them.

New Scientist, 16 October 2019

<http://www.newscientist.com/>

Atmospheric pressure impacts greenhouse gas emissions from leaky oil and gas wells

2019-10-23

Fluctuations in atmospheric pressure can heavily influence how much natural gas leaks from wells below the ground surface at oil and gas sites, according to new University of British Columbia research. However, current monitoring strategies do not take this phenomenon into account, and therefore may be under- or over-estimating the true magnitude of gas emissions. The unintentional leakage of natural gas from oil and gas wells into the surrounding subsurface - known as fugitive gas migration - is a major environmental concern that can lead to groundwater contamination and the emission of greenhouse gases into the atmosphere. "Currently, subsurface gas migration is monitored using infrequent or short-term location-restrictive measurements," said Olenka Forde, a geological sciences PhD student at UBC and lead author of the study published in *Scientific Reports*. "Our study shows that the magnitude of gas emissions to the atmosphere can depend on atmospheric pressure before and during the time of monitoring, so short-term, one-time measurements may not be representative of average emissions." Variations in atmospheric pressure tend to compress or expand soil gas, with the most significant

Fluctuations in atmospheric pressure can heavily influence how much natural gas leaks from wells below the ground surface at oil and gas sites, according to new University of British Columbia research.

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impact at sites with deep water tables, explains Forde. During a high-pressure system, soil gas is compressed and pushes leaked natural gas deeper underground, where it will likely not be detected at the surface. When atmospheric pressure declines, natural gas trapped below the surface during the previous high-pressure conditions can escape to the atmosphere, contributing to greenhouse gas emissions. To evaluate this effect, the team ran a field experiment in an area of significant historic and ongoing oil and gas development near Hudson's Hope, in northern B.C. Over a period of five days, 30 cubic metres of natural gas (98.3 per cent methane) was continuously injected 12 metres below the ground surface. Atmospheric pressure and methane emissions were then continuously measured for 24 days during and after gas injection. The researchers controlled for depth and rate of well leakage, which are key factors that influence fugitive gas migration. "We found that the magnitude and duration of atmospheric pressure changes directly influenced the amount of natural gas coming out the ground and being emitted into the atmosphere," said Forde. "Under high pressure conditions, methane emissions decreased, sometimes even below the detection limit. But when atmospheric pressure decreased, methane emissions increased rapidly - at times more than 20-fold in less than 24 hours." As a result, continuous monitoring over a longer period of time is key. "This will help to more accurately detect and evaluate gas migrations and emissions and thus, the risks posed by leaking oil and gas wells," said Forde. There are over four million onshore hydrocarbon wells around the world, a portion of which are known to suffer loss of structural integrity, which can lead to this type of subsurface leakage and resulting greenhouse gas emissions. "The results of our study allow us to move towards refining and improving regulations and monitoring methods," said co-author Aaron Cahill, co-director of the Energy and Environment Research Initiative at UBC. "This will help determine which leaky wells should be prioritized for remedial action to limit the most substantial greenhouse gas emissions."

EurekAlert, 18 October 2019

<http://www.eurekalert.org>

Electric cloth

2019-10-23

Evening gowns with interwoven LEDs may look extravagant, but the light sources need a constant power supply from devices that are as well wearable, durable, and lightweight. Chinese scientists have manufactured fibrous electrodes for wearable devices that are flexible and excel by

Flexible, wearable supercapacitors based on porous nanocarbon nanocomposites

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their high energy density. A microfluidic technology was key for the preparation of the electrode material was a microfluidic technology, as shown in the journal *Angewandte Chemie*. Dresses sparkling light from hundreds of small LEDs may create eye-catching effects in ballrooms or on fashion shows. But wearable electronics can also mean sensors integrated in functional textiles to monitor, for example, water evaporation or temperature changes. Energy storage systems powering such wearable devices must combine deformability with high capacity and durability. However, deformable electrodes often fail in long-term operation, and their capacity lags behind that of other state-of-the-art energy storage devices. Electrode materials usually benefit from a fine balance of porosity, conductivity, and electrochemical activity. Material scientists Su Chen, Guan Wu, and their teams from the Nanjing Tech University, China, have looked deeper into the material demands for flexible electrodes and developed a porous hybrid material synthesized from two carbon nanomaterials and a metal-organic framework. The nanocarbons provided the large surface area and excellent electrical conductivity, and the metal-organic framework gave the porous structure and the electrochemical activity. To make the electrode materials flexible for wearable applications, the micro-mesoporous carbon frameworks were spun into fibres with a thermoplastic resin by using an innovative blow-spinning machine. The resulting fibres were pressed into cloths and assembled into supercapacitors, although it turned out that another round of coating with the micro-mesoporous carbon frameworks further improved the electrode performances. The supercapacitors made from these electrodes were not only deformable, but they could also harbor higher energy densities and larger specific capacitances than comparable devices. They were stable and endured more than 10,000 charge-discharge cycles. The scientists also tested them in practical applications such as smart colour switching of LEDs in dresses and solar-cell-controlled powering of electronic devices integrated in functional clothing. The authors pointed out that the microfluidic droplet-based synthesis was key to improving the performance of the electrode materials for wearable electronics. It was all about adjusting the perfect porous nanostructure, they argued.

EurekAlert, 18 October 2019

<http://www.eurekalert.org>

A molecule that protects plants from overexposure to harmful sunlight thanks to its flamenco-style twist could form the basis for a new longer-lasting sunscreen, chemists have found.

'Flamenco dancing' molecule could lead to better-protecting sunscreen

2019-10-23

A molecule that protects plants from overexposure to harmful sunlight thanks to its flamenco-style twist could form the basis for a new longer-lasting sunscreen, chemists at the University of Warwick have found, in collaboration with colleagues in France and Spain. Research on the green molecule by the scientists has revealed that it absorbs ultraviolet light and then disperses it in a 'flamenco-style' dance, making it ideal for use as a UV filter in sunscreens. The team of scientists report today, Friday 18th October 2019, in the journal *Nature Communications* that, as well as being plant-inspired, this molecule is also among a small number of suitable substances that are effective in absorbing light in the Ultraviolet A (UVA) region of wavelengths. It opens up the possibility of developing a naturally-derived and eco-friendly sunscreen that protects against the full range of harmful wavelengths of light from the sun. The UV filters in a sunscreen are the ingredients that predominantly provide the protection from the sun's rays. In addition to UV filters, sunscreens will typically also include:

- Emollients, used for moisturising and lubricating the skin
- Thickening agents
- Emulsifiers to bind all the ingredients
- Water
- Other components that improve aesthetics, water resistance, etc.

The researchers tested a molecule called diethyl sinapate, a close mimic to a molecule that is commonly found in the leaves of plants, which is responsible for protecting them from overexposure to UV light while they absorb visible light for photosynthesis. They first exposed the molecule to a number of different solvents to determine whether that had any impact on its (principally) light absorbing behaviour. They then deposited a sample of the molecule on an industry standard human skin mimic (VITRO-CORNEUM®) where it was irradiated with different wavelengths of UV light. They used the state-of-the-art laser facilities within the Warwick Centre for Ultrafast Spectroscopy to take images of the molecule at extremely high speeds, to observe what happens to the light's energy when it's absorbed in the molecule in the very early stages (millionths of millionths of a second). Other techniques were also used to establish longer term (many hours) properties of diethyl sinapate, such as endocrine disruption activity and antioxidant potential. Professor Vasilios Stavros

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from the University of Warwick, Department of Chemistry, who was part of the research team, explains: "A really good sunscreen absorbs light and converts it to harmless heat. A bad sunscreen is one that absorbs light and then, for example, breaks down potentially inducing other chemistry that you don't want. Diethyl sinapate generates lots of heat, and that's really crucial." When irradiated the molecule absorbs light and goes into an excited state but that energy then has to be disposed of somehow. The team of researchers observed that it does a kind of molecular 'dance' a mere 10 picoseconds (ten millionths of a millionth of a second) long: a twist in a similar fashion to the filigranas and floreos hand movements of flamenco dancers. That causes it to come back to its original ground state and convert that energy into vibrational energy, or heat. It is this 'flamenco dance' that gives the molecule its long-lasting qualities. When the scientists bombarded the molecule with UVA light, they found that it degraded only 3% over two hours, compared to the industry requirement of 30%. Dr Michael Horbury, who was a Postgraduate Research Fellow at The University Warwick when he undertook this research (and now at the University of Leeds) adds: "We have shown that by studying the molecular dance on such a short time-scale, the information that you gain can have tremendous repercussions on how you design future sunscreens. Emily Holt, a PhD student in the Department of Chemistry at the University of Warwick who was part of the research team, said: "The next step would be to test it on human skin, then to mix it with other ingredients that you find in a sunscreen to see how those affect its characteristics." Professor Florent Allais and Dr Louis Mouterde, URD Agro-Biotechnologies Industrielles at AgroParisTech (Pomacle, France) commented: "What we have developed together is a molecule based upon a UV photoprotective molecule found in the surface of leaves on a plant and refunctionalised it using greener synthetic procedures. Indeed, this molecule has excellent long-term properties while exhibiting low endocrine disruption and valuable antioxidant properties." Professor Laurent Blasco, Global Technical Manager (Skin Essentials) at Lubrizol and Honorary Professor at the University of Warwick commented: "In sunscreen formulations at the moment there is a lack of broad-spectrum protection from a single UV filter. Our collaboration has gone some way towards developing a next generation broad-spectrum UV filter inspired by nature. Our collaboration has also highlighted the importance of academia and industry working together towards a common goal." Professor Vasilios Stavros added, "Amidst escalating concerns about their impact on human toxicity (e.g. endocrine disruption) and ecotoxicity (e.g. coral bleaching), developing new UV filters is essential. We have demonstrated that a highly attractive

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avenue is 'nature-inspired' UV filters, which provide a front-line defence against skin cancer and premature skin aging."

Science Daily, 18 October 2019

<http://www.sciencedaily.com>

Airborne chemicals instantly identified using new technology

2019-10-23

Scientists at Nanyang Technological University, Singapore (NTU Singapore) have developed a device that can identify a wide range of airborne gases and chemicals instantly. The new prototype device is portable and suitable for rapid deployment by agencies to identify airborne hazards, such as from tiny gas molecules like sulphur dioxide. It can also identify larger compound molecules such as benzene, known to be harmful to human health. It can provide real-time monitoring of air quality such as during haze outbreaks, and assist in the detection of gas leaks and industrial air pollution. Developed by a research team led by Associate Professor Ling Xing Yi at the School of Physical and Mathematical Sciences, the new technology was reported last month in science journal ACS Nano. Current methods of identifying gases in the air use a laboratory technique called Gas Chromatography -- Mass Spectrometry (GC-MS), which is reliable but requires tedious sample collection and takes between a few hours and a few days to obtain results from air samples. Emergency scenarios require a fast and ongoing analysis of potential air contamination, such as following a natural disaster, chemical spill or illegal dumping of toxic waste, so that emergency responders can take appropriate action.

How the new device works

The new device uses a small patch made of a special porous and metallic nanomaterial to first trap gas molecules. When a laser is shone on it from a few metres away, the light interacts with the gas molecules, causing light of a lower energy to be emitted. When analysed, it gives a spectroscopic readout in the format of a graph chart. The spectroscopic readout acts like a "chemical fingerprint" corresponding to various chemicals present on the patch. The whole process takes about 10 seconds to complete. These chemical fingerprints from the sample are referenced against a digital library of fingerprints to quickly determine what chemicals have been detected. Known as Raman spectroscopy, this is a long-established technique for identifying chemical substances. Typically, it has been

Scientists have developed a device that can identify a wide range of airborne gases and chemicals instantly.

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used only on solid and liquid samples, since gaseous chemicals are too dilute for the laser and detector to pick up. To overcome this limitation, Assoc Prof Ling and her PhD student Mr Phan Quang Gia Chuong developed a special nanostructure made from a highly porous synthetic material known as a metal-organic framework, which actively absorbs and traps molecules from the air into a 'cage'. This nanostructure also contains metal nanoparticles, which boost the intensity of the light surrounding the molecules. The result is a million-fold enhancement in the Raman spectroscopy signals, which allows for the identification of the trapped molecules. Assoc Prof Ling said the genesis of the invention was sparked by an incident in Singapore, where there were reports of a strong gas-like odour over certain parts of the island in 2017. The cause was only determined a few days later, and was traced to volatile organic compounds released by factories outside of Singapore. Together with her husband, Dr Phang In-Yee, a project leader and scientist at the Institute of Materials Research and Engineering (IMRE), they conceptualised the idea of identifying gases instantly from a distance. "Our device can work remotely, so the operation of the laser camera and analysis of chemicals can be done safely at a distance. This is especially useful when it is not known if the gases are hazardous to human health," explains Assoc Prof Ling, Head of the Division of Chemistry & Biological Chemistry at NTU. The laser was tested in experiments to work up to 10 metres away and can be engineered to reach further distances. Another possible method is to use the chip to capture gases, which is subsequently analysed with a laser.

Ultra-sensitive and accurate result

In experiments, the team showed that the device can identify airborne molecules such as polyaromatic hydrocarbons (PAH), including naphthalene and derivatives of benzene, a family of colourless industrial air pollutants known to be highly carcinogenic. It can detect PAHs at parts-per-billion (ppb) concentrations in the atmosphere as well as performing continuous monitoring of the concentration of the different types of gases like carbon dioxide (CO₂) in the atmosphere, which could be a useful application in many industrial settings. The laser used in the device has an energy intensity of 50 miliwatts, more than seven times weaker than in other applications of Raman spectroscopy. This makes the system safer to operate and more energy efficient. Through NTUitive, NTU's innovation and enterprise company, the team has filed for a patent and is now

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commercialising the technology for use in pollution monitoring, chemical disaster response, as well as other industrial applications.

Science Daily, 18 October 2019

<http://www.sciencedaily.com>

Calcium batteries: New electrolytes, enhanced properties

2019-10-23

Calcium-based batteries promise to reach a high energy density at low manufacturing costs. This lab-scale technology has the potential for replacing lithium-ion technology in future energy storage systems. Using the electrolytes available, however, it has been impossible so far to charge calcium batteries at room temperature. In the Energy & Environmental Science journal, researchers of Karlsruhe Institute of Technology (KIT) now present a promising electrolyte class, with which this will be possible. Efficient, large, and low-cost energy storage systems will facilitate nationwide transition to zero-emission mobility and power supply. Today's predominant lithium-ion technology, however, cannot fulfil this task on a global scale, says Professor Maximilian Fichtner of KIT, Director of the research platform CELEST (Centre for Electrochemical Energy Storage Ulm & Karlsruhe). Here, calcium batteries and other storage technologies are studied. "In the medium term, lithium-ion batteries will reach their limits in terms of performance and some of the resources used for their manufacture. This will prevent their future use wherever that would be reasonable for the energy transition. Availability of resources needed for manufacture, such as cobalt, nickel, and lithium, is limited." At the Helmholtz Institute Ulm (HIU) established by KIT in cooperation with Ulm University, Fichtner and his team focus on alternative battery technologies instead. These technologies are based on more abundant resources. Calcium is a promising candidate, because it can release and accept two electrons per atom contrary to lithium and because it supplies a voltage similar to that of lithium: "Calcium is the fifth most abundant element in the Earth's crust. It is distributed homogeneously on Earth and it is safe, non-toxic, and inexpensive."

Search for a Suitable Electrolyte

Still, there has been a big obstacle in calcium battery development so far: In contrast to the established lithium-ion technology or more recent sodium or magnesium technologies, practicable electrolytes

Calcium-based batteries promise to reach a high energy density at low manufacturing costs. This lab-scale technology has the potential for replacing lithium-ion technology in future energy storage systems.

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to produce rechargeable calcium batteries have been lacking so far. "For a few years now, experimental electrolytes and, hence, prototypes of the calcium battery have been available," say Dr. Zhenyou Li, first author of the study, and Dr. Zhirong Zhao-Karger, who heads the project. Both are working in the POLiS (Post Lithium Storage) Cluster of Excellence of KIT that is embedded in CELEST. "But these electrolytes enable charging at temperatures beyond 75 degrees Celsius only and additionally they are susceptible to undesired side reactions." The researchers have now succeeded in synthesising a class of new electrolytes based on special organic calcium salts. These electrolytes enable charging at room temperature. Using the new electrolyte calcium tetrakis[hexafluoroisopropoxy]borate, the researchers demonstrated feasibility of calcium batteries of high energy density, storage capacity, and quick-charging capability. Their results are reported in the journal Energy & Environmental Science.

Calcium Batteries as Sustainable Energy Storage Systems

The new class of electrolytes is an important basis for transferring calcium batteries from the laboratory to application. In electric vehicles, mobile electronic devices, and stationary storage systems, they might replace the presently predominating lithium-ion battery one day. But this may take a while: "The new electrolytes are a first important step," Fichtner emphasises. "There still is a far way to go to the mature calcium battery."

Science Daily, 15 October 2019

<http://www.sciencedaily.com>

Transforming sulphur dioxide from harmful to useful

2019-10-23

A unique new material developed by an international collaboration of scientists has proved that it can help reduce sulphur dioxide (SO₂) emissions in the environment by selectively catching the molecules in minutely engineered cages. The captured toxic gas can then be safely released for conversion into useful industrial products and processes. Around 87% of sulphur dioxide emissions are the result of human activity, typically produced by power plants, other industrial facilities, trains, ships, and heavy equipment, and can be harmful to human health and the environment. The international team developed porous, cage-like, stable copper-containing molecules known as molecular organic frameworks (MOFs) that are designed to separate sulphur dioxide (SO₂) gas from other gases more efficiently than existing systems. Professor

Scientists have created molecular cages within a polymer to trap harmful sulphur dioxide pollution in order to transform it into useful compounds and reduce waste and emissions.

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Martin Schröder, Vice-President and Dean of the Faculty of Science and Engineering at the University of Manchester, and Dr. Sihai Yang, a Senior Lecturer in Department of Chemistry at the University of Manchester, led an international research team from UK and U.S. on this work. The researchers exposed the MOFs to simulated exhaust gases and found that they efficiently separated out SO₂ from the gas mixture at elevated temperatures even in the presence of water. The research, led by The University of Manchester and published in journal Nature Materials, showed a vast improvement in efficiency compared to current SO₂ capture systems, which can produce a lot of solid and liquid waste and may only remove up to 95 percent of the toxic gas, researchers noted. Conducting state-of-the-art structural, dynamic and modelling studies at international facilities such as ISIS and the Diamond Light Source to conduct neutron and X-ray scattering experiments, and the Advanced Light Source in Berkeley U.S. to conduct single crystal diffraction work, they have been able to determine precise measurements of SO₂ within MOFs at a molecular level. Lead author of the research paper Gemma Smith said the new material shows an adsorption of SO₂ higher than any other porous material known to date. This work is unprecedented as the new material is remarkably stable to SO₂ exposure, even in the presence of water, and the adsorption is fully reversible at room temperature. "Our material has been shown to be extremely stable to corrosive SO₂ and can effectively separate it from humid waste gas streams. Importantly, the regeneration step is very energy-efficient compared to those reported in other studies; the captured SO₂ can be released at room temperature for conversion to useful products, whilst the metal-organic framework can be reused for many more separation cycles."

Phys.org, 19 October 2019

<http://phys.org>

New stable form of plutonium discovered

2019-10-23

An international team of scientists, led by the Helmholtz Zentrum Dresden-Rossendorf (HZDR), have found a new compound of plutonium with an unexpected, pentavalent oxidation state, using the ESRF, the European Synchrotron, Grenoble, France. This new phase of plutonium is solid and stable, and may be a transient phase in radioactive waste repositories. The results are published in Angewandte Chemie as a Very Important Paper (VIP). Countries across the globe are making efforts to improve the safety of the nuclear waste storage in order to prevent release

An international team of scientists, led by the Helmholtz Zentrum Dresden-Rossendorf (HZDR), have found a new compound of plutonium with an unexpected, pentavalent oxidation state, using the ESRF, the European Synchrotron, Grenoble, France.

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of radioactive nuclides to the environment. Plutonium, has been shown to be transported by groundwaters from contaminated sites for kilometres in the form of colloids, which are formed by interaction with clay, iron oxides or natural organic matter. A team of scientists lead by HZDR studies the chemistry of actinides under environmentally relevant conditions, by synthesising such compounds, and then studying their electronic and structural behaviour both with advanced synchrotron X-ray methods experimentally as well as theoretically. The latest paper of the international team shows how an experiment seemingly gone wrong leads to a breakthrough: the discovery of a new stable form of plutonium. It all started when Kristina Kvashnina, physicist from HZDR and based at the ROBL beamline at the European Synchrotron—ESRF (a beamline owned and operated by the HZDR), and her team were trying to create plutonium dioxide nanoparticles using different precursors to be studied at ROBL. When they used the Pu (VI) precursor, they realised that a strange reaction took place during the formation of the plutonium dioxide nanoparticles. “Every time we create nanoparticles from the other precursors Pu(III), (IV) or (V) the reaction is very quick, but here we observed a weird phenomenon half way,” explains Kvashnina. She figured that it must be Pu (V), pentavalent plutonium, a never-observed-before form of the element, after doing a high-energy resolution fluorescence detection (HERFD) experiment at the Pu L3 edge at ROBL. “A stable phase of Pu(V)! - no, it is impossible, it doesn’t exist, the synthesis must have gone wrong,” said the team of chemists, from the Moscow State University when they looked at the data. “Chemists were in complete disbelief, but the results were quite clear,” Kvashnina adds. The only way to be certain of the existence of this pentavalent compound would be to confirm it using HERFD at the Pu M4 edge. Kvashnina explains: “Our choice of beamline was straightforward: the ESRF-ID26 beamline, as it is the best place, regarding the intensity and energy resolution, where such high-energy resolution X-ray absorption spectroscopy studies at low energies can be done. In fact, the Pu M4 edge HERFD experiment was done at ID26 for the first time. To the best of our knowledge, HERFD data at the Pu M4 edge have never been reported in the literature and never been exploited.” The experiments confirmed the initial assumption, and a repetition three months later even demonstrated the long-term stability of the phase. At the same time, theoreticians in Sweden were busy coming up with predictions of the Pu M4 edge spectral features, and theoreticians from ROBL identified the species of that new phase. In the end it all came together and the new Pu (V) phase was confirmed. Many scientists work on prediction of what happens to nuclear waste in million years. “It is a difficult task and only theoretical predictions are possible, but the existence of this new Pu(V) solid phase,

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which is stable, will have to be taken into account from now on. It will change, for sure, the theoretical predictions of plutonium behaviour in the environment over a period of millions of years," concludes Kvashnina.

Phys.org, 18 October 2019

<http://phys.org>

Scientists develop a lithium-ion battery that won't catch fire

2019-10-23

A flexible lithium-ion battery designed by a team of researchers from the Johns Hopkins Applied Physics Laboratory and built to operate under extreme conditions—including cutting, submersion, and simulated ballistic impact—can now add incombustible to its résumé. Current Li-ion batteries are susceptible to catastrophic fire and explosion incidents—most of which arrive without any discernible warning—because they are built with flammable and combustible materials. Samsung Galaxy Note7 phones were banned from airlines as a result of this danger, and the Navy's prohibition of e-cigarettes on ships and submarines is a direct response to the need to reduce the flammability of such devices. With these batteries emerging as the energy storage vehicle of choice for portable electronics, electric vehicles, and grid storage, these safety advancements mark a significant step forward in transforming the way Li-ion batteries are manufactured and used in electronic devices. In research published recently in the journal *Chemical Communications*, the team, led by Konstantinos Gerasopoulos of APL's Research and Exploratory Development Department, details its latest discovery: a new class of "water-in-salt" and "water-in-bisalt" electrolytes—referred to as WiS and WiBS, respectively—that, when incorporated in a polymer matrix, reduces water activity and elevates the battery's energy capabilities and life cycle while ridding it of the flammable, toxic, and highly reactive solvents present in current Li-ion batteries. It's a safe, powerful alternative, the researchers say. "Li-ion batteries are already a constant presence in our daily lives, from our phones to our cars, and continuing to improve their safety is paramount to further advancing energy storage technology," said Gerasopoulos, senior research scientist and principal investigator at APL. "Li-ion battery form factors have not changed much since their commercialisation in the early 1990s; we still use the same cylindrical or prismatic cell types. The liquid electrolyte and required hermetic packaging have a lot to do with that. "Our team's efforts have generally been focused on replacing the flammable liquid with a polymer that

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improves safety and form factor. We are excited about where we are today. Our recent paper shows improved usability and performance of water-based flexible polymer Li-ion batteries that can be built and operated in open air." Additionally, the damage tolerance initially demonstrated with the team's flexible battery in 2017 is further improved in this new approach to creating Li-ion batteries. "The first generation of flexible batteries were not as dimensionally stable as those we are making today," Gerasopoulos said. With this latest benchmark reached, the researchers continue to work on further advancements of this technology. "Our team is continuously improving the safety and performance of flexible Li-ion batteries," said Jeff Maranchi, the program area manager for materials science at APL. "We have already achieved further discoveries building upon this most-recently reported work that we are very excited about. We hope to transition this new research to prototyping within the year."

Phys.org, 18 October 2019

<http://phys.org>

New catalyst helps turn carbon dioxide into fuel

2019-10-23

Imagine grabbing carbon dioxide from car exhaust pipes and other sources and turning this main greenhouse gas into fuels like natural gas or propane: a sustainability dream come true. Several recent studies have shown some success in this conversion, but a novel approach from Stanford University engineers yields four times more ethane, propane and butane than existing methods that use similar processes. While not a climate cure-all, the advance could significantly reduce the near-term impact on global warming. "One can imagine a carbon-neutral cycle that produces fuel from carbon dioxide and then burns it, creating new carbon dioxide that then gets turned back into fuel," said Matteo Cargnello, an assistant professor of chemical engineering at Stanford who led the research, published in *Angewandte Chemie*. Although the process is still just a lab-based prototype, the researchers expect it could be expanded enough to produce usable amounts of fuel. Much work remains, however, before average consumer will be able to purchase products based on such technologies. Next steps include trying to reduce harmful by-products from these reactions, such as the toxic pollutant carbon monoxide. The group is also developing ways to make other beneficial products, not just fuels. One such product is olefins, which can be used in a number of industrial applications and are the main ingredients for plastics.

Imagine grabbing carbon dioxide from car exhaust pipes and other sources and turning this main greenhouse gas into fuels like natural gas or propane: a sustainability dream come true.

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Two steps in one

Previous efforts to convert CO₂ to fuel involved a two-step process. The first step reduces CO₂ to carbon monoxide, then the second combines the CO with hydrogen to make hydrocarbon fuels. The simplest of these fuels is methane, but other fuels that can be produced include ethane, propane and butane. Ethane is a close relative of natural gas and can be used industrially to make ethylene, a precursor of plastics. Propane is commonly used to heat homes and power gas grills. Butane is a common fuel in lighters and camp stoves. Cargnello thought completing both steps in a single reaction would be much more efficient, and set about creating a new catalyst that could simultaneously strip an oxygen molecule off of CO₂ and combine it with hydrogen. (Catalysts induce chemical reactions without being used up in the reaction themselves.) The team succeeded by combining ruthenium and iron oxide nanoparticles into a catalyst. This nugget of ruthenium sits at the core and is encapsulated in an outer sheath of iron," said Aisulu Aitbekova, a doctoral candidate in Cargnello's lab and lead author of the paper. "This structure activates hydrocarbon formation from CO₂. It improves the process start to finish." The team did not set out to create this core-shell structure but discovered it through collaboration with Simon Bare, distinguished staff scientist, and others at the SLAC National Accelerator Laboratory. SLAC's sophisticated X-ray characterisation technologies helped the researchers visualise and examine the structure of their new catalyst. Without this collaboration, Cargnello said they would not have discovered the optimal structure. "That's when we began to engineer this material directly in a core-shell configuration. Then we showed that once we do that, hydrocarbon yields improve tremendously," Cargnello said. "It is something about the structure specifically that helps the reactions along." Cargnello thinks the two catalysts act in tag-team fashion to improve the synthesis. He suspects the ruthenium makes hydrogen chemically ready to bond with the carbon from CO₂. The hydrogen then spills onto the iron shell, which makes the carbon dioxide more reactive. When the group tested their catalyst in the lab, they found that the yield for fuels such as ethane, propane and butane was much higher than their previous catalyst. However, the group still faces a few challenges. They'd like to reduce the use of noble metals such as ruthenium, and optimise the catalyst so that it can selectively make only specific fuels.

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<http://phys.org>

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Nitrogen-embedded polycyclic compound with strong antiaromaticity and stability

2019-10-23

Nitrogen-embedded polycyclic compounds with strong antiaromaticity and stability were synthesised and isolated for the first-time using pyrrole as a key unit. An expedited approach toward stable antiaromatic polycyclic compounds enables not only the revealing of its fundamental properties, but also its application to organic electronic materials. The synthesis and isolation of a nitrogen-embedded polycyclic compound with strong antiaromaticity and stability was achieved for the first time by a research group at Ehime University. This result was published in the Journal of the American Chemical Society. Aromaticity is one of the most important concepts in chemistry, which has the influence on fundamental properties of cyclic conjugated compounds. In general, compounds with $4n+2 \pi$ electrons in the ring are stable due to their aromatic nature, and are widely used around us: from plastics to pharmaceuticals, and from dyes to organic electronics materials. On the other hand, antiaromatic compounds with $4n \pi$ electrons in the ring lack stability, and thus research on the synthesis and characterisation of such compounds remains to be elucidated. In this report, an expedited approach toward a nitrogen-embedded antiaromatic compound with strong antiaromaticity and stability is presented. The new compounds were efficiently synthesised in just three steps from commercially available reagents via a substitution reaction and successive intramolecular Schöll and Vilsmeier-type reactions. Detailed investigation revealed its strong antiaromaticity and stability even in air. Recently, polycyclic compounds have been studied as graphene-like molecules with a discrete structure. But compounds with aromaticity and antiaromaticity have been limited mainly to annulenes and porphyrins. This report presents the first nitrogen-embedded polycyclic compound with antiaromaticity. The easy access to such compounds enables not only the revealing of its fundamental properties but also its application to organic electronic materials.

Phys.org, 18 October 2019

<http://phys.org>

Nitrogen-embedded polycyclic compounds with strong antiaromaticity and stability were synthesised and isolated for the first-time using pyrrole as a key unit.

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California Becomes 1st State to Sell HIV Prevention Drugs Without a Prescription

2019-10-24

California just became the first state to allow people to buy HIV prevention drugs at pharmacies without a prescription, according to recent news reports. Around 1.2 million Americans currently live with AIDS, an incurable disease that develops after an individual is infected with the HIV virus. But in the last couple of decades, new treatments have increasingly allowed people with AIDS to live long and full lives; and new prevention drugs have reduced the number of people being infected with HIV in the first place. On 7 October 2019, California Gov. Gavin Newsom signed a bill that allows people to buy these prevention drugs at pharmacies without a prescription and also prohibits insurance companies from requiring "prior authorisation" before using the insurance to purchase the drugs. One of the pills, called pre-exposure prophylaxis or PrEP, is a daily pill for people who want to prevent HIV infections; the other pill, called post-exposure prophylaxis or PEP, is an emergency pill that people can take after a possible exposure to HIV in order to reduce their chances of infection. PEP must be started within 72 hours of possible exposure to the virus, and continued for 28 days, according to the Centres for Disease Control and Prevention (CDC). That does not always allow enough time for a person to get a prescription from a doctor, Rick Zbur, the executive director of the non-profit LGBTQ civil rights group Equality California, told the Associated Press. PrEP is taken by people who might be at high risk for HIV. When taken daily, it is about 99% effective at preventing infection from sexual activity and 74% effective at preventing infection from the injection of drugs, according to the CDC. Before a person can buy either drug, they are required to be tested for HIV or prove to the pharmacist that they were tested negative for it within the last week, according to NPR. Due to concerns of long-term use without a doctor's review, the bill limits the amount of PrEP people can buy independently to 60 days; after that, they are required to visit a primary care doctor, according to the AP. "Recent breakthroughs in the prevention and treatment of HIV can save lives," Newsom said in a statement. "All Californians deserve access to PrEP and PEP, two treatments that have transformed our fight against HIV and AIDS." About 30,000 people in California currently use PrEP and 6,000 use PEP, according to the California Health Benefits Review Program, the AP reported. "I applaud the Legislature for taking action to expand access to these treatments and getting us closer to ending HIV and AIDS for good," Newsom added. Newsom also signed two other public health bills, one that lowers the cost of prescription drugs by not allowing drug

California became the first state to allow the sale of HIV prevention drugs such as Truvada's PrEP pills without a prescription.

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manufacturers to block the making of cheaper generic drugs and another that requires health care providers caring for pregnant black women to undergo bias training.

Live Science, 10 October 2019

<http://www.livescience.com>

Targeting immune cells may be potential therapy for Alzheimer's

2019-10-24

Targeting microglia may help treat such diseases. Messy tangles of a protein called tau can be found in the brains of people with Alzheimer's disease and some other neurodegenerative diseases. In Alzheimer's, the tangles coalesce just before tissue damage becomes visible in brain scans and people start to become forgetful and confused. Now, a new study has found that brain immune cells called microglia—which are activated as tau tangles accumulate—form the crucial link between protein clumping and brain damage. The research, published 10 October in the *Journal of Experimental Medicine*, shows that eliminating such cells sharply reduces tau-linked brain damage in the mice—and suggests that suppressing such cells might prevent or delay the onset of dementia in people. "Right now, many people are trying to develop new therapies for Alzheimer's disease, because the ones we have are simply not effective," said senior author David Holtzman, MD, the Andrew B. and Gretchen P. Jones Professor and head of the Department of Neurology. "If we could find a drug that specifically deactivates the microglia just at the beginning of the neurodegeneration phase of the disease, it would absolutely be worth evaluating in people." Under ordinary circumstances, tau contributes to the normal, healthy functioning of brain neurons. In some people, though, it collects into toxic tangles that are a hallmark of neurodegenerative diseases such as Alzheimer's and chronic traumatic encephalopathy, a progressive brain disease often diagnosed in football players and boxers who have sustained repeated blows to the head. Holtzman and colleagues previously had shown that microglia limit the development of a harmful form of tau. But the researchers also suspected that microglial cells could be a double-edged sword. Later in the course of the disease, once the tau tangles have formed, the cells' attempts to attack the tangles might harm nearby neurons and contribute to neurodegeneration. To understand the role of microglial cells in tau-driven neurodegeneration, Holtzman, first author and postdoctoral researcher Yang Shi, Ph.D., and colleagues studied genetically modified

A study from Washington University School of Medicine in St. Louis has found that microglia drive neurodegeneration in diseases, including Alzheimer's disease, that are linked to tau protein.

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mice that carry a mutant form of human tau that easily clumps together. Typically, such mice start developing tau tangles at around 6 months of age and exhibiting signs of neurological damage by 9 months. Then, the researchers turned their attention to the gene APOE. Everyone carries some version of APOE, but people who carry the APOE4 variant have up to 12 times the risk of developing Alzheimer's disease compared with those who carry lower-risk variants. The researchers genetically modified the mice to carry the human APOE4 variant or no APOE gene. Holtzman, Shi and colleagues previously had shown that APOE4 amplifies the toxic effects of tau on neurons. For three months, starting when the mice were 6 months of age, the researchers fed some mice a compound to deplete microglia in their brains. Other mice were given a placebo for comparison. The brains of mice with tau tangles and the high-risk genetic variant were severely shrunken and damaged by 9½ months of age—as long as microglia were also present. If microglia had been eliminated by the compound, the mice's brains looked essentially normal and healthy with less evidence of harmful forms of tau despite the presence of the risky form of APOE. Further, mice with microglia and mutant human tau but no APOE also had minimal brain damage and fewer signs of damaging tau tangles. Additional experiments showed that microglia need APOE to become activated. Microglia that have not been activated do not destroy brain tissue or promote the development of harmful forms of tau, the researchers said. "Microglia drive neurodegeneration, probably through inflammation-induced neuronal death," Shi said. "But even if that's the case, if you don't have microglia, or you have microglia but they can't be activated, harmful forms of tau do not progress to an advanced stage, and you don't get neurological damage." The findings indicate that microglia are the linchpin of the neurodegenerative process—and an appealing target of efforts to prevent cognitive decline in Alzheimer's disease, chronic traumatic encephalopathy and other neurodegenerative diseases. The compound Holtzman and Shi used in this study has side effects that make it a poor option for drug development, but it could point the way to other compounds more narrowly tailored to microglia. "If you could target microglia in some specific way and prevent them from causing damage, I think that would be a really important, strategic, novel way to develop a treatment," Holtzman said.

Medical Xpress, 10 October 2019

<http://medicalxpress.com>

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CO2 emissions cause lost labour productivity, research shows

2019-10-24

The planet's warming climate has led to countless changes that are affecting all of us. Droughts, hurricanes, rising sea levels and forest fires—all are now regular events in a world that saw close to 40 billion metric tons of carbon dioxide (CO₂) emissions released into our atmosphere last year. Climate change may also be making outdoor labour more dangerous, according to a new study published in *Scientific Reports*. It was led by Yann Chavaillaz, a former postdoctoral researcher at Concordia and the Ouranos Institute, and Damon Matthews, professor and Concordia Research Chair in Climate Science and Sustainability in the Department of Geography, Planning and Environment. The researchers examine how extreme high temperatures caused by CO₂ emissions could lead to losses in labour productivity. Using calculations based on widely used guidelines regarding rest time recommendations per hour of labour and heat exposure, the authors found that every trillion tonnes of CO₂ emitted could cause global GDP losses of about half a percent. They add that we may already be seeing economic losses of as much as two per cent of global GDP as a result of what we have already emitted. They identify agriculture, mining and quarrying, manufacturing and construction as the economic sectors most vulnerable to heat exposure. These sectors account for 73 per cent of low-income countries' output, according to the authors.

Developing countries are hardest hit

"The thresholds of heat exposure leading to labour productivity loss are likely to be exceeded sooner and more extensively in developing countries in warmer parts of the world," says Matthews. "These countries are also more vulnerable because a higher fraction of their work force is employed in these sectors and because they have less ability to implement infrastructural changes that deal with a changing climate." The research suggests that lower-income countries will experience much stronger economic impacts than higher-income countries. Worst hit are tropical areas of the globe such as Southeast Asia, north-central Africa and northern South America. "The labour productivity loss computed for low- and lower-middle-income countries is approximately nine times higher than the one of high-income countries," reads the report. (The authors are also careful to point out that health recommendations are not obligatory and are often not seriously or consistently applied at real-world work sites. Their estimates of productivity loss are based on the strict adherence to health guidelines regarding labour in extreme heat.)

Climate change may also be making outdoor labour more dangerous, according to a new study published in *Scientific Reports*.

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From emissions to impacts

Matthews and his co-authors based their calculations of historical and future increases of heat exposure using simulations from eight separate Earth Systems Models. While many academic studies have estimated socioeconomic impacts of climate change, he says this paper is novel because it predicts future impacts as a direct function of CO2 emissions. "The relationship between emissions and impact is pretty linear, so we are able to say that this additional quantity of CO2 emissions will lead to this additional increase in impact," he explains. "The impact scales pretty well with the total amount of emissions we produce."

Cost of business

The authors write that their research linking CO2 emissions to loss of labour productivity from heat exposure can help countries adopt mitigating measures. But Matthews says it may also help people change their thinking about the overall consequences of a relentlessly warming planet. "We can see that every additional ton of CO2 emission that we produce will have this additional impact, and we can quantify that increase," he says. "So, this study can help us point to specific countries that are experiencing a quantifiable share of the economic damages that result from the emissions we produce."

Fast Company, 11 October 2019

<http://www.fastcompany.com/>

The world's ecosystems are being fundamentally transformed in the human era

2019-10-24

Brightly coloured corals are supplanted by dark, undulating seaweeds. Familiar fish species vanish — to be replaced by unknown strangers, or nothing at all. Pushed to the brink by warming oceans and human threats, "the places that we used to recognise as coral reefs no longer look the same," said Gabby Ahmadi, director of ocean science at the World Wildlife Fund. It's a metamorphosis unfolding in ecosystems around the globe. A sweeping survey published recently looked at tens of thousands of species counts from the past few decades and found that the world's ecosystems are rapidly reorganising. On average, more than a quarter of all plant and animal species within an ecosystem are being replaced every decade — probably the result of local extinctions, the introduction of invasive species and migrations motivated by climate change. In the midst of a

Brightly coloured corals are supplanted by dark, undulating seaweeds.

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global environmental crisis, when an estimated 1 million species are said to be at risk of extinction, the study offers an important look at biodiversity on the level of individual ecosystems, the authors said. It suggests that for now, at least, human activities have resulted not so much in outright losses as in large-scale reorganisation. But the function of ecosystems — their capacity to filter water and clean air, to sustain the plants and animals we rely on and admire — depends on the activities and health of their inhabitants. And those qualities are at risk. “It’s a little bit like we’re playing musical chairs at the moment,” said macroecologist Maria Azeredo de Dornelas, a co-author on the report. “You have a lot of things moving around, and chances are that some things are going to end up without a chair.” The study, published this week in the journal *Science*, draws on a massive new database called BioTime. The database, which Dornelas helped build, contains more than 8 million measures of abundance on more than 40,000 species in roughly half a million locations on land and in the oceans. This richness, said Sarah Supp, another co-author, allowed the researchers to sift through global biodiversity trends and pinpoint changes happening on a local scale. “This wasn’t really possible before,” said Supp, a Denison University data scientist who specialises in biodiversity studies. “But it’s important because the scale at which our actions take place are often much more pointed toward specific locations, or political boundaries that are not at the scale of the globe.” The researchers were surprised to find that the heightened global extinction rate wasn’t reflected at the ecosystem level. In a few extreme cases, the number of species in a habitat declined by as much as 20 percent per year. But on average, species richness — the head count of species present, in an ecosystem — didn’t appear to change over time. What is changing — with alarming speed — are the kinds of creatures present. “This paper really shows that, more important than just looking at the number of species in an area, we need to look at the identity of those species,” said Kimberly Komatsu, a global change biologist at the Smithsonian Environmental Research Centre who was not involved in the study. “And even moving beyond that, we need to think about what the traits of these species would be and what that means for the functioning of the ecosystem.” Marine ecosystems, such as reefs, are hot spots of transformation, the scientists found. The waters of the western Atlantic and the northwest Australian shelf experienced rates of species turnover much higher than the global average. Tropical regions also seemed to change more than temperate ones, perhaps because these already-warm areas have now been heated to temperatures for which most species are not adapted. There is not enough data from the preindustrial era for scientists to know how much faster turnover is happening because of humans. But evidence from past research suggests

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the current average rate of 28 percent turnover per decade is at least two to three times higher than normal, Dornelas said. To truly understand the consequences of this change, scientists will have to take a closer look at which creatures are vanishing from individual ecosystems — and who is arriving to take their place. Some turnover, such as New England sugar maples showing up in northern Canada, may be a sign of adaptation to a warming world. Other kinds of restructuring, such as the replacement of coral reefs by algae, could have painful consequences. Ahmadia, who was not involved in the new study, has surveyed reefs in the Pacific Ocean and coastal Africa. She said this kind of turnover leads to less-productive reefs. “The composition of the species is going to change. They’re not going to provide the same benefits they used to for local communities,” she said. In an accompanying analysis published by *Science*, ecologists Britas Klemens Eriksson and Helmut Hillebrand pointed out that some of this rapid turnover may lead to homogenisation of ecosystems. Better-adapted species will spread widely, pushing out native creatures. Habitats that once served as home to unique collections of species may all start to look the same, they wrote. The pace and scale of the transformations Dornelas and Supp describe are potentially grim. But the study also points to an opportunity, the scientists said. By understanding biodiversity change at a local scale, conservation scientists can figure out how to focus their efforts. The study argues that regions undergoing rapid transformation should be prioritised for “reactive” conservation measures — interventions that help species adapt to their changing circumstances, rather than attempting to preserve a population the environment can no longer sustain. On the other hand, more stable systems — like temperate forests — are good candidates for “proactive” protections. By insulating these areas from human disturbance, people might be able to preserve the diversity that makes them unique. “Climate change is happening now and we need to be able to accommodate the reorganisation that is taking place, to some extent,” Dornelas said. “There’s no going back in time ... but we can make informed decisions about what kind of future we want to have.”

Washington Post, 18 October 2019

<http://www.washingtonpost.com/>

Before Ikea and H&M can use recycled fabrics, they have to figure out what’s in them. (Answer: lots of poison)

2019-10-24

The fabric in a discarded pair of jeans or shirt could potentially be laden with formaldehyde, dyes linked to cancer, phthalates, or heavy metals.

Ikea and H&M just ran a large study on recyclable fabrics to figure out the kind of chemicals they have—and how they can get rid of them before reuse.

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That's not great for the person who wore the clothing or the people who made it—but it's also a challenge for companies that plan to recycle textiles into new products and don't want those products to include a random and unknown assortment of chemicals. Ikea, which plans to transform into a circular company by 2030—meaning that it will use only recycled and renewable materials and will scale up new business models such as renting furniture—wants to use recycled textiles, but it has its own strict standards for what chemicals it will allow in its products. H&M, likewise, has a 2030 goal of only using recycled or other “sustainably sourced” materials. In a new study, the two companies partnered to run thousands of tests on recycled materials to better understand how they can use them. “The challenge here is when we collect postconsumer textiles, every batch that we collect is new,” says Nils Månsson, the materials and innovation deployment leader at Ikea Range and Supply. “It's also unknown, because we are not talking about Ikea textiles only. We're talking about any textiles that we are able to find in Europe. . . as every batch is new, we need to know that it's also compliant with our strict requirements on chemicals.” In the study, the two companies collected 166 samples of cotton-based textiles, mostly from clothes that had been donated, but also from some preconsumer waste. Then they shredded the samples and spent months running them through chemical analysis in 8,000 tests. The companies found chromium compounds (a carcinogen), heavy metals used in dyeing, in 8.7% of the samples, and alkylphenol ethoxylates (an endocrine disrupter), used in making dyes and pigments, in 19.3% of samples. It's too early to draw conclusions from the early tests, so more studies will follow. “It's only when we get more and more data, as we're talking about something which is unknown, that we can draw the right conclusions and make sure to use the resource of used textiles in the best possible way,” says Månsson. Ikea already uses some of its own preconsumer textile waste to make some products, such as a rug that's woven from fabric left over from making bed linens. But in order to supply the vast amount of material that it needs, it will have to rely on the broader supply of textiles that come from unknown sources. One solution might be turning to new forms of recycling; while traditional textile recycling involves chopping up fibres into smaller pieces, start-ups like Evrnu break down textile waste to the molecular level, removing contaminants and leaving behind essentially pure cellulose. The research that is happening now could help start-ups with new recycling technology make sure that it works for the needs of the market. “We hope that what we do now will also help all those innovation companies that are working with the new

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technologies in chemical recycling know what it is that their technology needs to be able to filter out," Månsson says.

Fast Company, 17 October 2019

<http://www.fastcompany.com/>

Want to put your dog on a raw meat diet? It could be dangerous for both of you

2019-10-24

Few things will get a dog's or cat's sniffer going more quickly than the scent of raw meat. Grounded in the belief that feeding dogs and cats raw meat is more natural than giving them processed foods, pet owners appear to be increasingly seeking out raw meat-based diets. Yet, a new study suggests that could be a risky proposition, as the majority of commercially produced raw foods a research team examined contained high levels of harmful bacteria—including strains that could transmit diseases to pets and their owners alike. Because dogs' and cats' wild ancestors ate raw meat almost exclusively, pet owners often believe their animals will benefit from such a diet, explains the study's lead author, Magdalena Nüesch-Inderbinen, a microbiologist at the University of Zurich's Institute for Food Safety and Hygiene in Switzerland. Although some pet owners prepare their own raw meals with store-bought meat, the pet food industry has jumped wholeheartedly into the market, offering dozens of meal options. These foods usually contain uncooked muscle and organ by-products of animals slaughtered for human consumption. Several cases of bacterial diseases in pets have been linked to such raw meat diets, but few studies have examined how widespread potentially harmful pathogens are in such commercial products. To address that lack of data, Nüesch-Inderbinen and colleagues bought 51 different raw meat pet meals produced by eight different suppliers. (The authors declined to name the specific brands they tested.) The meat—including beef, chicken, horse, or lamb—came from either Switzerland or Germany. The scientists analysed samples from each for the presence of enterobacteria, a family of bacteria that includes such harmful pathogens as Salmonella, Escherichia coli, and Shigella, as well as numerous harmless strains. Nearly three-quarters (72.5%) of the samples had enterobacteria levels that exceeded regulations set by the European Union for pet food safety, the researchers report this week in Royal Society Open Science. Antibiotic-resistant strains of bacteria were identified in 63% of the samples. Salmonella, a highly transmissible pathogen that is one of the most common sources of food poisoning in both humans and pets, was

Few things will get a dog's or cat's sniffer going more quickly than the scent of raw meat.

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found in 4% of the samples. Together, the results suggest raw meat pet foods are far riskier than thought, Nüesch-Inderbinen says. She advises pet owners who buy these products to be extra thorough in washing their hands after handling the food and its packaging, and to be aware of the heightened risk of bacterial disease in their pets. Scott Weese, a microbiologist at the University of Guelph's Ontario Veterinary College in Canada, says the findings about antibiotic-resistant bacteria are especially concerning. "With Salmonella, the expectation is that if you get exposed, you either get sick or don't in a short period of time," he says. "With resistant bacteria that can live in the GI [gastrointestinal] tract for months or more, a pet or person could ... potentially get a disease much later" if an initial course of antibiotics fails to kill the bug. Dana Brooks, president and CEO of the Pet Food Institute, an industry group that represents most of the largest U.S. pet food manufacturers, acknowledged the danger that raw diets may pose to pets and their owners. "These bacteria may present a safety risk to your entire family, especially for vulnerable loved ones, such as children or the elderly," she wrote in a statement to Science. The lack of published scientific evidence for the health benefits of such raw meals seals the deal for Lisa Freeman, a veterinary nutritionist at the Cummings School of Veterinary Medicine at Tufts University in Grafton, Massachusetts. "I strongly recommend against feeding raw meat diets for the health of the pet, the owner, and the greater community."

Science, 16 October 2019

<http://sciencemag.org/>

Man's body brews its own beer after yeast take over his gut microbiome

2019-10-24

A man in the United States has started producing beer in his gut after it accidentally became colonised by high levels of brewer's yeast. The normally healthy 46-year-old began to experience mental fogginess, dizziness and memory loss in 2011 and had to give up his job. He saw multiple doctors, but they couldn't work out what was wrong. A psychiatrist prescribed him antidepressants in 2014, but this didn't help. A few months later, the man was pulled over and arrested for erratic driving. His blood alcohol reading was 200 milligrams per 100 millilitres, about the level that would be expected if he had consumed 20 standard alcoholic drinks. He maintained that he hadn't had anything alcoholic to drink, but the police didn't believe him. On another occasion, the man was hospitalised after falling and hitting his head. Doctors detected a large

In rare cases, someone's gut can make its own alcohol from carbohydrates

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amount of alcohol in his system, but also didn't believe him when he said he hadn't been drinking. Baffled, the man saw a gastroenterologist, who discovered high levels of a fungus called *Saccharomyces cerevisiae* in his stool. This fungus is also known as brewer's yeast, because it is used by beer-makers to convert carbohydrates in grains into alcohol.

Rare condition

Subsequent tests showed that a similar conversion process was happening in the man's gut. Every time he ate carbohydrates, his blood alcohol level shot up, sometimes to as high as 400 milligrams per 100 millilitres. In 2017, the man attended a specialist clinic at Richmond University Medical Centre in New York, where he was diagnosed with auto-brewery syndrome. This is a rare condition that occurs when certain gut microbes become overgrown and convert carbohydrates to alcohol. The man's auto-brewery syndrome was probably triggered by a prolonged course of antibiotics that he took in early 2011 for a thumb injury, says Fahad Malik, one of the doctors at the Richmond University Medical Centre who made the diagnosis. These antibiotics probably disrupted the man's balance of gut microbes, causing abnormal growth of *S. cerevisiae*, which normally exists at low levels in the human gut, says Malik. The abundant yeast then converted any carbohydrates he ate into a beer-like substance. Malik and his colleagues are the first to describe auto-brewery syndrome resulting from antibiotic use. However, it has also been reported in people with gut disorders like Crohn's disease, most commonly due to overabundance of another fungus called *Candida albicans*, which is also known for its role in vaginal thrush. Last month, doctors in China also reported a case of auto-brewery syndrome caused by overgrowth of *Klebsiella pneumoniae* bacteria. Malik treated the man with anti-fungal medication, probiotics, and a strict low-carbohydrate diet to get rid of the excess brewer's yeast in his gut. He has now been symptom-free for almost two years. "He was extremely happy when he started to recover, because for years, no one believed him," says Malik, who will present the case at the annual meeting of the American College of Gastroenterology later this month. "The police, doctors, nurses and even his family told him he wasn't telling the truth, that he must be a closet-drinker," he says. "Now he is off antidepressants, he's back at work and he's finally getting on with his life."

New Scientist, 20 October 2019

<http://www.newscientist.com/>

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Bacterial infections in pregnancy may make schizophrenia more likely

2019-10-24

Children of mothers who had bacterial infections during pregnancy are more likely to develop mental health conditions like schizophrenia and bipolar disorder. We already knew that exposure to viruses in the womb increases a child's risk of developing schizophrenia, but the effects of bacterial infections have been less clear. Younga Lee at Brown University in Rhode Island and her colleagues studied 15,000 US adults whose mothers had regular health checks during pregnancy in the 1950s and 60s. They found that those whose mothers had urinary tract infections, bacterial vaginosis, pneumonia or other bacterial infections during pregnancy were 1.8 times more likely to one day experience psychotic conditions – mental health conditions that can involve hallucinations or delusions – than those whose mothers had not had these infections.

Male susceptibility

The risk was higher for males and more severe infections. Men whose mothers had severe infections like sepsis during pregnancy were five times as likely to develop a condition like schizophrenia. It isn't clear why males seem to be more susceptible, but some evidence suggests that the placentas of female foetuses are better at buffering against environmental pressures than those of male foetuses, says Lee. The findings are consistent with some studies in animals that have found that when pregnant females are infected with bacteria, pieces of the bacterial cell walls can cross the placenta and enter the brain of a foetus, causing structural abnormalities. However, while bacterial infections are common during pregnancy, affecting about one in four pregnant women, conditions involving psychosis are rare, affecting less than 1 in 100 people. Prenatal bacterial infections probably only cause such conditions when there is an underlying genetic susceptibility, says Lee. "Based on this and other research, we think that the best thing we can do is to carefully monitor women whose offspring are at genetic risk for schizophrenia, and to keep their pregnancies as healthy as possible," says Lee. Bacterial infections in these women should be swiftly treated with appropriate antibiotics, she says.

New Scientist, 19 October 2019

<http://www.newscientist.com/>

Children of mothers who had bacterial infections during pregnancy are more likely to develop mental health conditions like schizophrenia and bipolar disorder.

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J&J recalls 33,000 bottles of baby powder as FDA finds asbestos in sample

2019-10-24

Johnson & Johnson said it is recalling around 33,000 bottles of baby powder in the United States after United States health regulators found trace amounts of asbestos in samples taken from a bottle purchased online. J&J shares fell more than 6% to close at \$127.70. The move marks the first time the company has recalled its iconic baby powder for possible asbestos contamination, and the first time U.S. regulators have announced a finding of asbestos in the product. Asbestos is a known carcinogen that has been linked to deadly mesothelioma. The recall is the latest blow to the more than 130-year-old U.S. healthcare conglomerate that is facing thousands of lawsuits over a variety of products, including baby powder, opioids, medical devices and the antipsychotic Risperdal. FDA alerts consumers of J&J baby powder recall, says it stands by tests. Johnson & Johnson says baby powder investigation could take 30 days or more. A jury last week ordered the company to pay \$8 billion to a plaintiff in a case claiming J&J downplayed the risks of Risperdal. That award is not expected to stand, the company and legal experts have said. J&J faces more than 15,000 lawsuits from consumers claiming its talc products, including Johnson's Baby Powder, caused their cancer. On a conference call with reporters on Friday, Dr. Susan Nicholson, head of Women's Health in the company's medical safety organisation, called the asbestos finding "extremely unusual," adding that it was "inconsistent with our testing to date." The voluntary recall announced on Friday is limited to one lot of Johnson's Baby Powder produced and shipped in the United States in 2018, the company said. J&J in a news release said that testing by the U.S. Food and Drug Administration as recently as a month ago found no asbestos in their talc. The FDA said in a statement that the latest sampling took place during its testing for asbestos in talc-containing cosmetics that it began reporting this year. A second Johnson's Baby Powder sample from a different lot tested negative for asbestos, the agency said. The FDA said it stands by the quality of its testing and results and recommended consumers stop using the product if it comes from the affected lot. J&J said on the conference call that it received a report from the FDA on 17 October alerting the company about the asbestos finding. It said it has started an investigation and is reviewing manufacturing records and collecting data on the distribution of the lot to determine where the product was shipped. J&J added that it is working with the FDA to determine the integrity of the tested sample as well as the validity of test results. The type of asbestos discovered by FDA testing has not been

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found in the mine where the company sources its talc, J&J's Nicholson said. She described it as an environmental contaminant most commonly found in building materials and industrial applications. J&J said it was too early to confirm whether cross-contamination of the sample had caused a false positive, whether the sample was taken from a bottle with an intact seal or whether it was prepared in a controlled environment. It added that it could not confirm whether the tested product was authentic or counterfeit. "It is so critical that we perform a thorough investigation of the sample to determine the source of contamination," Nicholson said. Since 2003, talc in Johnson's Baby Powder sold in the United States has come from China through supplier Imerys Talc America, a unit of Paris-based Imerys SA and a co-defendant in much of the talc litigation. Imerys and J&J said the Chinese talc is safe. J&J has known for decades that asbestos lurked in its talc, Reuters reported last year. Internal company records, trial testimony and other evidence show that from at least 1971 to the early 2000s, the company's raw talc and finished powders sometimes tested positive for small amounts of asbestos. Company executives, mine managers, scientists, doctors and lawyers fretted over the problem and how to address it, while failing to disclose it to regulators or the public, Reuters found. J&J has repeatedly said that its talc products are safe, and that decades of studies have shown them to be asbestos-free and that they do not cause cancer. The FDA test indicated the presence of no greater than 0.00002% of chrysotile asbestos in the tested sample, J&J said. The World Health Organization and other authorities recognise no safe level of exposure to asbestos. While most people exposed never develop cancer, for some, even small amounts of asbestos are enough to trigger the disease years later. Thousands of the lawsuits against J&J have been consolidated before a New Jersey federal judge, who is currently weighing company motions to disqualify plaintiffs' expert witnesses, including the head of an asbestos testing lab who has testified in earlier trials that he found the contaminant in J&J powders. Leigh O'Dell, one of the lead plaintiff attorneys, on Friday said the recall "vindicates the position we've been taking for months." Wells Fargo analyst Larry Biegelsen said in a research note that the recall could encourage additional lawsuits and prompt the company to pursue a broader settlement. Jefferies healthcare strategist Jared Holz said J&J has already lost close to \$10 billion in market value due to the talc issue over the past year. He said further downside to J&J stock is likely to be limited because legal concerns over talc are well known and have already taken a toll on the share price. "This is one single bottle within one lot with barely a trace here," he said. J&J said in February that it had received subpoenas from the U.S. Justice Department and the Securities and Exchange Commission for documents

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related to the asbestos contamination allegations. A Bloomberg report, which Reuters has confirmed, said those inquiries include a criminal grand jury investigation into how forthright J&J has been in its statements about the safety of its powders. While talc products make up less than 1% of J&J sales expected by analysts to reach \$82 billion in 2019, the New Jersey-based healthcare-products maker considers its Baby Powder to be an essential facet of a carefully tended image as a caring company.

Reuters Health, 18 October 2019

<http://www.reuters.com/news/health>

Current and ex-smokers may lower lung cancer risk with exercise

2019-10-24

Researchers gave treadmill tests to 2,979 men - 1,602 who were former smokers and 1,377 who were current smokers - to assess their "cardiorespiratory" fitness, or how easily the circulatory and respiratory systems can supply oxygen to muscles during physical exertion. They assessed exercise capacity using a standard measurement known as metabolic equivalents (METs) which reflects how much oxygen is consumed during physical activity. Researchers followed the men for an average of 11.6 years; during this period, 99 participants were diagnosed with lung cancer and 79 of these people died from cancer. Among former smokers, each 1-MET increase during treadmill tests was associated with a 13% lower risk of developing lung cancer. Moderate to high levels of cardiorespiratory fitness were associated with a 51% to 77% lower risk of developing lung malignancies, the study found. And among current smokers who were later diagnosed with lung cancer, each 1-met increase during treadmill tests was associated with an 18% lower risk of dying from cancer. Moderate to high levels of cardiorespiratory fitness were linked to an 84% to 85% lower risk of dying from cancer. "Both former and current smokers can significantly reduce their risk of developing and dying from lung cancer by achieving higher cardiorespiratory fitness," said lead study author Baruch Vainshelboim of the Veterans Affairs Palo Alto Health Care System and Stanford University in Palo Alto, California. "Aerobic exercise at moderate to vigorous intensity such walking, jogging, running, biking, or elliptical for 20 to 30 minutes three to five times a week can improve cardiorespiratory fitness," Vainshelboim said by email. Lung cancer remains the most common cancer worldwide, with more than 2 million new cases and 1.8 million deaths a year, researchers note in the American Journal of Preventive Medicine. Tobacco is the single most important risk factor

Men who are current or former smokers may be less likely to develop or die from lung cancer when they're more physically fit, a recent study suggests.

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for developing and dying from lung cancer, accounting for up to 90% of diagnoses and more than 80% of deaths, researchers note. Eliminating low cardiorespiratory fitness as a risk factor could prevent about 11% of lung cancer diagnoses in former smokers and roughly 22% of cancer deaths in current smokers who develop lung cancer, the study authors estimated. While the study can't prove whether or how improving aerobic fitness might directly reduce the odds of developing or dying from lung cancer, the results still point to one modifiable risk factor that current and former smokers might be able to control to reduce their risk, researchers conclude. It's possible that being more fit helps limit exposure to toxins from cigarettes in the lungs, said Trude Eid Robsahm, a researcher at the Cancer Registry of Norway, Institute of Population-based Cancer Research, who wasn't involved in the study. "In addition, physical activity improves activity in immune cells and produces a cancer-inhibiting environment in the tissue," Robsahm said by email. Getting recommended levels of exercise will help, said Dr. Sudhir Kurl, a researcher at the Institute of Public Health and Clinical Nutrition, University of Eastern Finland in Kuopio. "The consensus public health guideline to perform 150 minutes per week of moderate-intensity physical activity such as brisk walking, jogging will move most of individuals out of the low-fitness category," Karl, who wasn't involved in the study, said by email. "It also may help smokers to quit smoking."

Reuters Health, 18 October 2019

<http://www.reuters.com/news/health>

Early menopause tied to heart problems before 60

2019-10-24

Women who go through menopause earlier in life may be more likely to have a heart attack or stroke before they reach age 60 than their counterparts who go through menopause later on, a recent study suggests. Researchers examined data from 15 observational studies with a total of more than 300,000 women, including almost 13,000 women who survived events like a heart attack or stroke after menopause. Compared with women who went through menopause at age 50 or 51, women who experienced premature menopause, before age 40, were 55% more likely to have events like a heart attack or stroke after menopause. With early menopause, from age 40 to 44, women had a 30% greater risk of cardiovascular events after menopause; with relatively early menopause, from age 45 to 49, the increased risk was 12%. "Heart disease is a leading cause of illness and death for women," said senior study author Gita

Women who go through menopause earlier in life may be more likely to have a heart attack or stroke before they reach age 60 than their counterparts who go through menopause later on, a recent study suggests.

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Mishra of the University of Queensland in Brisbane, Australia. "These findings will help to identify women at most risk of cardiovascular disease for closer monitoring and earlier diagnosis and even prevention of the disease," Mishra said by email. Women go through menopause when they stop menstruating. As the ovaries curb production of the hormone's oestrogen and progesterone, women can experience symptoms ranging from vaginal dryness to mood swings, joint pain and insomnia. Earlier menopause has previously been linked to an increased risk of heart disease, osteoporosis, diabetes and sleep problems. It can also leave women with fewer reproductive years, particularly when it's preceded by premature ovarian failure, when the ovaries stop working before age 40. In the current study, women were 50 years old on average when they went through menopause. Only 1.2% of the women in the study had premature menopause before age 40; and 4.7% experienced early menopause from age 40 to 44. Among women who had events like a heart attack or stroke after menopause, an average of 13.5 years passed between menopause and these cardiovascular events, researchers report in the *Lancet Public Health*. Compared to women who didn't experience events like a heart attack or stroke, women who did were less likely to be educated, and more likely to be obese, and current smokers with a history of high blood pressure. The study wasn't a controlled experiment designed to prove whether or how menopause timing might directly impact cardiovascular health. One limitation of the analysis is that many of the cardiovascular events were self-reported by study participants, not confirmed by medical records. It's also possible that use of hormone therapy after menopause may have impacted the results, the study team notes. Still, the results highlight a need for women to be hypervigilant about heart health if they go through menopause earlier in life, Mishra said. "For women who are experiencing earlier menopause, active management of other risk factors for cardiovascular disease, such as avoiding cigarette smoking and maintaining a healthy body weight are all the more important for reducing their overall risk of cardiovascular disease," Mishra advised. "These women may also consult with health professionals for regular monitoring of their risk of cardiovascular disease."

Reuters Health, 18 October 2019

<http://www.reuters.com/news/health>

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X-rays 'fail to reliably detect' lung disease in stone workers: radiologists

2019-10-24

Chest X-rays on workers exposed to dust from manufactured stone are "failing to reliably detect" serious lung disease, with one study showing X-rays overlooked disease in more than 40 per cent of workers. The Royal College of Radiologists revealed the position in a statement recently and "strongly recommended" CT scanning for the screening of workers at risk of occupational lung disease such as silicosis. Chris Parmangos was about 15 years into his job as a labourer in Sydney when he was diagnosed with lung disease from exposure to silica dust. Silicosis is a potentially deadly group of lung diseases highly prevalent among construction and demolition workers exposed to engineered stone products with high silica dust, such as benchtops and tiles. NSW workers at risk of disease from the harmful dust have access to free and subsidised X-rays through the government's icare NSW screening clinic and the icare Lung Bus, which travels around NSW offering mobile screening. More than 6500 workers have been screened by icare since 2017 under the Dust Diseases scheme, which also tests for other workplace diseases such as mesothelioma and asbestosis. But icare's testing practices will now be reviewed after the college revealed X-rays were "failing to reliably detect disease" in affected workers, while the technology lacked the "sensitivity" and accuracy of CT scans. "Silicosis is much more readily detected in a low-dose CT, a more sensitive test. That's what you would want for your family. You want the best test," college president Lance Lawler said. He said current government screening programs were effective in picking up diseases and used the best of what has been available, "but we could do better", describing CT scanning as "far superior". The college highlighted one study of workers in Queensland in which 43 per cent produced normal chest X-rays, only to have disease show up on a CT scan. Greens MP David Shoebridge said it was concerning that more than 6500 workers had been screened for silicosis using X-rays instead of low-dose CT scans. "We now have the clearest possible evidence that lung screening needs to move immediately from X-rays to low-dose CT scans to ensure not a single case is undiagnosed," he said. Mr Shoebridge is one of eight members of Parliament presiding over an inquiry into the Dust Diseases scheme, focusing on the response to silicosis in the manufactured stone industry and reviewing the compensation scheme available to affected workers. He said the government could no longer delay investment in CT technology on the Lung Bus, calling for a "comprehensive effort to retest the thousands of workers already on the system ... free of charge".

Chest X-rays on workers exposed to dust from manufactured stone are "failing to reliably detect" serious lung disease, with one study showing X-rays overlooked disease in more than 40 per cent of workers.

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A spokeswoman for icare NSW said it would now work with peak bodies and industry regulators SafeWork NSW and SafeWork Australia to consider the findings of the college. "SafeWork Australia is currently reviewing the national guides for health monitoring and we will follow this work closely and adjust practices if there are recommendations from this research." Based on international standards, X-ray screening by icare is coupled with a medical examination, consideration of a person's medical and occupational history and respiratory function testing. The Dust Diseases scheme was formed to provide treatment and financial support to workers who have a disability as a result of a compensable dust disease contracted in a NSW workplace. NSW branch president of the CFMEU Rita Mallia said the worker's union would take the advice of specialists and called on icare to do "whatever is necessary to update technology". Cancer Council Australia says 587,000 Australian workers were exposed to silica dust in the workplace in 2011. The charity estimates that "5758 of these will develop a lung cancer over the course of their life as a result of that exposure". In April, the Morrison government announced the creation of a national dust diseases taskforce under a \$5 million plan to address lung disease.

The Age, 15 October 2019

<http://www.theage.com.au>

This Fungus Mutates. That's Good News if You Like Cheese.

2019-10-23

The legend of Camembert is one of daring escape and dairy espionage. The cheese was invented in 1791 when a priest from Brie (yes, like the cheese), took shelter with a dairymaid, Marie Harel, as he fled France's anticlerical government. He taught her to make cheese with an edible rind, as local lore tells it. But the lesser known character in Ms. Harel's story is a mysterious mould that resided in Normandy. *Penicillium* appears in the wild as a toxic blue fungus, but in Camembert, Brie and other French regional cheeses, it is white and edible. For centuries, cheesemakers didn't know how it evolved from its untamed to its domesticated forms. In a study published recently in *mBio* that could be good news for American cheese lovers, researchers offer the first detailed view of how a fungus transforms into a mould safe for food production in as few as four weeks. "We saw in real time how the fungi could change their metabolism in a way that would be advantageous for cheesemakers," said Benjamin Wolfe, an assistant professor of microbiology at Tufts University and the study's principal investigator. He said the research could ultimately lead

American scientists set out to simulate a fungus's evolution into the edible mould that makes French cheeses like Camembert.

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to “a diverse new approach to making cheese in the United States.” The name Camembert isn’t restricted to cheese produced in Normandy, in contrast to Champagne, which comes from only one region of France. But a special designation is reserved for cheeses produced with unpasteurised milk from French cows. And the specialness of that cheese is derived in part from the fungus that naturally evolves into mould in cheese caves across northern France. Dr. Wolfe wanted to see if he could mimic that evolutionary process. Over the course of a summer, his team planted wild blue penicillium on the surface of freshly rendered cow’s milk cheese curd while simulating the conditions of French cheese caves. After a week, the researchers mixed the fungi together with the cheese and transferred the blend to a new cheese surface. This process was repeated eight times. Each week, they observed changes in the mould’s colour, spore count and toxin levels. By week four, the fungus had evolved to its domesticated form. The mould displayed a number of tell-tale signs of transformation. It turned from greenish-blue to white. Its aroma changed from musty and basement-like to buttery. The rate at which it produced the toxins that made the original fungus inedible was substantially reduced. Dr. Wolfe recalled the excitement in the lab when they first observed its colour change. “It was like, ‘Here come the mutants,’” Dr. Wolfe said. The undergraduates in his lab “fell in love with these fungi, watching them change right before our eyes,” he said. The team’s findings could lead to the development of new kinds of cheese in the United States. Dr. Wolfe has been approached by American cheesemakers who want to know if his team could collect wild blue fungi in their local cheese caves and transform them into edible moulds, creating new regional varieties of cheese. “You could imagine going down different flavour paths,” said Antonis Rokas, a professor of evolutionary biology at Vanderbilt University and a co-author of the study. “You could start enhancing or diminishing the mould flavour of the cheese by directing the evolutionary process.” The researchers did not find any specific mutations that caused the fungus to transform, so they hope to learn more about the genetic mechanisms controlling the mould’s evolution. John Gibbons, an assistant professor of food science at the University of Massachusetts, Amherst, said the study shows how a favourite food item historically evolved and how a fungus used in food production can be manipulated without genetic engineering. “We’ve been producing cheese for thousands of years and alcohol for tens

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of thousands," Dr. Gibbons said. "Now we have a window into history in terms of what early humans wanted out of microbes."

New York Times, 15 October 2019

<http://www.nytimes.com/>

Juul halts all U.S. sales of many flavoured nicotine liquids

2019-10-24

E-cigarette maker Juul Labs Inc said it will completely halt sales in the United States of all flavours except tobacco, mint and menthol, as the company faces heightened scrutiny from regulators, lawmakers and state attorneys general over the appeal of its nicotine products to teenagers. This move, which ends online sales, means Juul's mango, fruit, creme and cucumber nicotine pod flavours will no longer be available for sale anywhere in the United States. The company last year pulled those flavours from retail stores but continued to sell them on its website with what the company said were "strict age-verification controls." Juul's new chief executive, K.C. Crosthwaite, a veteran of Marlboro maker Altria Group Inc, announced the move as the company attempts to repair its relationship with regulators. The U.S. Food and Drug Administration last month warned Juul that it was misleading consumers by marketing its products as safer than cigarettes, and requested additional information on its nicotine blend. Soon after, the Trump administration announced plans to ban all flavoured e-cigarette products, citing alarming growth in teenage use of the products. Soon after, Juul's former CEO, Kevin Burns, stepped down. Crosthwaite said in a statement Thursday that the company needs to "reset the vapor category" by "earning the trust of society," working "cooperatively" with regulators and policymakers. He previously said the company would suspend all advertising in the United States, stop its support of a San Francisco ballot measure that would overturn an e-cigarette ban and refrain from lobbying the Trump administration on the proposed flavour ban. Juul will continue to sell mint, menthol and tobacco flavours online and in stores, though a spokesman said Thursday "we continue to review our policies and practices" in advance of the FDA's proposed flavour ban and "have not made any final

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decisions."The company will "fully support and comply with the final policy when effective."

Reuters Health, 15 October 2019

<http://www.reuters.com/news/health>

Underwater Volcano Could Release Noxious Gas Bubbles Bigger Than The Pyramids

2019-10-24

For a fiery phenomenon we most commonly associate with magma-spewing mountaintops, it's easy to forget that some 70 percent of all Earth's volcanism takes place under the ocean waves. That statistic is a problem for scientists eager to learn more about underwater volcanoes, which, due to their submarine environment, are difficult to study. New research shows a clever workaround, though – as well as revealing an incredible side effect of intense magma eruptions at the bottom of the sea. In a new study, a team led by geophysicist John Lyons from the US Geological Survey's Alaska Volcano Observatory analysed recordings of low-frequency sound in the atmosphere (called infrasound) produced by over 70 explosive eruptions that took place at the underwater Bogoslof volcano off the coast of Alaska between 2016 and 2017. Due to its remote location, Bogoslof is rarely witnessed when it erupts, but historical accounts tell vivid tales of what it looks like when a submerged volcano lets loose. An eyewitness account observed from the steamer Albatross in 1908 describes a "colossal soap bubble" rising out of the ocean, with "gigantic clouds of smoke and steam", while another reports a "gigantic dome-like swelling" of water "as large as the dome of the capital at Washington ... like a huge bubble pushing its way through the water". Analysing the infrasound recordings of Bogoslof's 2016–2017 eruptions – sound waves lower in frequency than human ears can hear – the researchers came up with a model for the probable source mechanism of the volcano's deep rumbles. "The infrasound originates from the oscillation and rupture of magmatic gas bubbles that initially formed from submerged vents, but that grew and burst above sea level," the authors explain in their paper. "We model the low-frequency signals as over-pressurised gas bubbles that grow near the water–air interface, which require bubble radii of 50–220 metres." If the researchers are right in their calculations, these noxious, gassy volcano bubbles could extend up to 440 metres (over 1,400 ft) in diameter. That would make them about the height of Malaysia's Petronas Towers (the tallest buildings in the world until 2004), yielding an immense bubble volume that could easily swallow multiple

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Great Pyramids of Giza. Quite the spectacle to see rising ominously out of the ocean – even before it inevitably bursts. “Imagine the violence of a normal volcanic eruption, but then you add a bunch of water to it,” Lyons told Wired. Pretty crazy stuff, adding to the list of really weird geophysical by-products that we already know about when it comes to underwater volcano eruptions, from vast fields of volcanic glass, to floating pumice rafts, plus fleeting pop-up islands, and the speedy ecosystems they seem to enable. The findings are reported in Nature Geoscience.

Science Alert, 20 October 2019

<http://www.sciencealert.com.au>

For The First Time, Scientists Find Fat Can Clog Lungs And Airways, Not Just Your Heart

2019-10-24

Many of you will be aware of how fatty build-ups in the arteries can increase the chances of developing heart problems, but now scientists have found early evidence the same sort of clogging could happen in the lungs – and it might be linked to asthma. It’s already known that people who are overweight have a higher risk of asthma. Before now it was thought the connection could be caused by extra pressure on the lungs, or additional inflammation in the body. Now there’s evidence fatty deposits may play a part, too. Using material collected from an earlier study, the researchers looked at lung tissue samples from 52 deceased people: 15 with no reported asthma, 21 with reported asthma but who died of something else, and 16 who died of asthma itself. With the help of dyes to highlight the airway structures, almost 1,400 samples were analysed. What they found was surprising - accumulated fat (adipose cells) in the airway walls. What’s more, the level of fatty tissue correlated with the body mass index (or BMI) of the individual – more weight meant more fat. “We’ve found that excess fat accumulates in the airway walls where it takes up space and seems to increase inflammation within the lungs,” says physiologist Peter Noble, from the University of Western Australia. “We think this is causing a thickening of the airways that limits the flow of air in and out of the lungs, and that could at least partly explain an increase in asthma symptoms.” It’s the first-time fatty deposits have been spotted in the lungs, although they do appear in other organs besides the heart, including the liver. And while this doesn’t rule out previous hypotheses about how additional weight makes asthma more likely, it could be another factor to consider. It appears the fat actually alters the structure of the airways and increases inflammation, which is again linked to asthma.

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The exact mechanism that's causing the fat to appear in the airways isn't clear at the moment – that's something that's going to have to wait for the next batch of research. It's also going to be important to run tests on a greater number of people than the 52 involved here. Another question is whether the effects might be reversed with weight loss – whether with regular exercise and a healthy diet, the fat levels inside the lungs would start to decrease as a person's overall weight was lowered. What's certain is that we need a better understanding of obesity and its effects, as well as better ways to tackle it, and fast – by 2025 it's estimated that 18 percent of men and 21 percent of women around the world will be classed as obese. One recent study has compared obesity to an infectious disease, in the way that we might 'catch' unhealthy behaviours from those people around us. What the latest study does is suggest another reason why maintaining a healthy weight is so important to the proper functioning of the human body – and the more we know about that, the better we can aim towards it. "This is an important finding on the relationship between body weight and respiratory disease because it shows how being overweight or obese might be making symptoms worse for people with asthma," says Thierry Troosters, president of the European Respiratory Society, who wasn't involved in the study. "This goes beyond the simple observation that patients with obesity need to breathe more with activity and exercise. The observation points at true airway changes that are associated with obesity." The research has been published in the European Respiratory Journal.

Science Alert, 19 October 2019

<http://www.sciencealert.com.au>

Antarctica's "Sudden Stratospheric Warming" Has Started Impacting Australia

2019-10-24

Record warm temperatures above Antarctica over the coming weeks are likely to bring above-average spring temperatures and below-average rainfall across large parts of New South Wales and southern Queensland. The warming began in the last week of August, when temperatures in the stratosphere high above the South Pole began rapidly heating in a phenomenon called "sudden stratospheric warming". In the coming weeks the warming is forecast to intensify, and its effects will extend downward to Earth's surface, affecting much of eastern Australia over the coming months. The Bureau of Meteorology is predicting the strongest Antarctic

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warming on record, likely to exceed the previous record of September 2002.

What's going on?

Every winter, westerly winds – often up to 200 kilometre per hour (120 miles per hour) – develop in the stratosphere high above the South Pole and circle the polar region. The winds develop as a result of the difference in temperature over the pole (where there is no sunlight) and the Southern Ocean (where the sun still shines). As the sun shifts southward during spring, the polar region starts to warm. This warming causes the stratospheric vortex and associated westerly winds to gradually weaken over the period of a few months. However, in some years this breakdown can happen faster than usual. Waves of air from the lower atmosphere (from large weather systems or flow over mountains) warm the stratosphere above the South Pole, and weaken or “mix” the high-speed westerly winds. Very rarely, if the waves are strong enough, they can rapidly break down the polar vortex, actually reversing the direction of the winds so they become easterly. This is the technical definition of “sudden stratospheric warming.” Although we have seen plenty of weak or moderate variations in the polar vortex over the past 60 years, the only other true sudden stratospheric warming event in the Southern Hemisphere was in September 2002. In contrast, their northern counterpart occurs every other year or so during late winter of the Northern Hemisphere because of stronger and more variable tropospheric wave activity.

What can Australia expect?

Impacts from this stratospheric warming are likely to reach Earth's surface in the next month and possibly extend through to January. Apart from warming the Antarctic region, the most notable effect will be a shift of the Southern Ocean westerly winds towards the Equator. For regions directly in the path of the strongest westerlies, which includes western Tasmania, New Zealand's South Island, and Patagonia in South America, this generally results in more storminess and rainfall, and colder temperatures. But for subtropical Australia, which largely sits north of the main belt of westerlies, the shift results in reduced rainfall, clearer skies, and warmer temperatures. Past stratospheric warming events and associated wind changes have had their strongest effects in NSW and southern Queensland, where springtime temperatures increased, rainfall decreased and heatwaves and fire risk rose. The influence of the stratospheric warming has been captured by the Bureau's climate outlooks, along with

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the influence of other major climate drivers such as the current positive Indian Ocean Dipole, leading to a hot and dry outlook for spring.

Effects on the ozone hole and Antarctic sea ice

One positive note of sudden stratospheric warming is the reduction - or even absence altogether - of the spring Antarctic ozone hole. This is for two reasons. First, the rapid rise of temperatures in the upper atmosphere means the super cold polar stratospheric ice clouds, which are vital for the chemical process that destroys ozone, may not even form. Secondly, the disrupted winds carry more ozone-rich air from the tropics to the polar region, helping repair the ozone hole. We also expect an enhanced decline in Antarctic sea ice between October and January, particularly in the eastern Ross Sea and western Amundsen Sea, as more warm water moves towards the poles due to the weaker westerly winds. Thanks to improvements in modelling and the Bureau's new supercomputer, these types of events can be forecast better than ever before. Compared to 2002, when we didn't know much about the event until after it had happened, this time we've had almost three weeks' notice that a very strong warming event was coming. We also know much more about the process that has been set in train, that will affect our weather over the next one to four months.

Science Alert, 18 October 2019

<http://www.sciencealert.com.au>

What Is Activated Charcoal?

2019-10-24

Activated charcoal can be found almost everywhere: in toothpaste, skin care products, baked goods, beverages and water filtration systems. Here's what you need to know about this seemingly ubiquitous ingredient.

What makes it activated?

Activated charcoal is created from carbon-rich materials burned at high temperatures, according to the National Capital Poison Centre (Poison Control). For example, carbon-rich materials such as wood, coconut shells or coal, are burned at a high temperature (between 600 and 900 degrees Celsius or 1,110 and 1,650 degrees Fahrenheit) to create a charcoal powder. The charcoal powder is then typically charred with some additional material, such as chloride salts, to help create the porous structure, according David O. Cooney's book "Activated Charcoal: Antidote, Remedy and Health Aid" (TEACH Services, Inc., 2016). The excess material

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is then washed away with a dilute acid solution to leave the pure carbon. The charcoal can further be treated to create a finer network of pores, and therefore additional surface area, by exposing it to an oxidising gas, such as steam or carbon dioxide. So much additional surface area is created during the activation process that 50 grams of activated charcoal (which is about the weight of 20 U.S. pennies) has 17.5 times more surface area than a full-size football field, according to a 2016 study in the British Journal of Clinical Pharmacology.

What is activated charcoal good for?

Health professionals administer activated charcoal to patients who have overdosed with certain drugs or have been poisoned, according to Poison Control. The fine powder is often mixed with water or other liquid and drunk by the patient or given via a feeding tube to clean out the gastrointestinal tract as an alternative to stomach pumping.

The activated charcoal acts like a sponge: Toxin particles bind to the surface of the activated charcoal so that the toxin is less likely to be absorbed into the body. This works best with toxins that contain organic particles (which are compounds that contain carbon and are usually bonded with oxygen, hydrogen or nitrogen). Depending on the type of overdose or toxin, a single dose of activated charcoal can be a very effective treatment if given quickly enough. Poison Control recommends that people don't try to use activated charcoal at home to treat a potential overdose or toxin ingestion. Most activated charcoal available over the counter is not as "activated" as what would be given in the emergency room, and it may not be the best solution for your ailment. There is very little scientific evidence showing that activated charcoal is effective for things like high cholesterol, diarrhoea or constipation, gas or indigestion, or that it prevents hangovers (activated charcoal does not bind with alcohol) or promotes wound healing, according to the U.S. National Library of Medicine. There's no research to suggest that activated charcoal should be consumed as part of a so-called "detox" diet, or that it's healthy to consume activated charcoal at all if you're not poisoned. In fact, it's probably unhealthy to consume it if you don't need it. A 2007 study published in the Journal of Food Quality found that activated charcoal eliminated the healthy vitamins found in apple juice. Activated charcoal is also commonly found in water filtration systems, respiratory masks and air filters. Just as it removes toxins from our body, the activated charcoal attracts and binds to contaminants in water and air including radon, fuels, solvents and many industrial and radioactive chemicals, and protects

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us against breathing or ingesting them, according to the United States Environmental Protection Agency (EPA).

What is activated charcoal not good for?

Activated charcoal can now readily be found in many over-the-counter health and beauty products, including toothpaste. Most charcoal-containing toothpastes are incredibly abrasive to tooth enamel and can lead to highly sensitive teeth, which are yellowed due to stripped enamel and more prone to dental decay, according to Benjamin Schwartz, a doctor of dental surgery and a clinical assistant professor at Touro College of Dental Medicine at New York Medical College. "There are very few clinical studies that outline long-term benefits of charcoal toothpastes. Instead, many of those studies show long-term risks with prolonged use of charcoal toothpaste," Schwartz said. In addition, most activated charcoal toothpastes do not contain fluoride and may even reverse the benefits of fluoride, which is a key ingredient for preventing dental cavities. Activated charcoal can be found in everything from shampoos and conditioners to facial washes and masks, with claims that it can soak up excess oils and other impurities. While activated charcoal may be relatively safe when used topically, there is no clinical evidence to support the claim that activated charcoal does anything to eliminate cosmetic imperfections, according to a 2019 study in the journal *Clinics in Dermatology*. Many companies advertise the presence of activated charcoal in their product and claim that their offering is therefore antiviral, antibacterial or antifungal. But there is scant scientific evidence that these products provide any health benefits, Schwartz said. "The charcoal does absorb other minerals, so theoretically it can absorb and inactivate bacterial or viral cells, but to what extent is anyone's guess," he said. "And what is stopping the charcoal from then inactivating the healthy bacteria that reside in the oral cavity?" If the claims promoting activated charcoal in toothpaste as well as other health and beauty products could somehow magically become substantiated by science, it would be a really big deal, Schwartz said. "If we could use a toothpaste that would selectively attack the microscopic offender, then the fight against dental disease would be much easier to win!"

Live Science, 17 October 2019

<http://www.livescience.com>

Technical Notes

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