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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

Guide to managing risk in construction: prefabricated concrete now available

2019-10-25

Safe Work Australia has developed a guide on the safe use of prefabricated concrete elements in the construction industry. Prefabricated concrete (also known as precast concrete) is a concrete element that is manufactured somewhere other than its final place of installation. This method of construction is becoming more common and involves discrete elements like walls or columns being prefabricated offsite and then erected and incorporated by crane into final position in a building structure. Due to its size and mass, prefabricated concrete elements are vulnerable to collapse which poses a significant safety risk and can cause workers and others to be seriously injured or even killed. Safe design and adequate planning are the best ways to manage the health and safety risks that may arise when working with prefabricated concrete. The *Guide to managing risk in construction: prefabricated concrete* provides national guidance material for duty holders in the building industry. It provides information on managing risks and work health and safety (WHS) duties associated with working with prefabricated concrete. The use of prefabricated, tilt-up and concrete elements in both building and civil construction has become increasingly popular in recent years and it is important to be aware of the WHS risks associated with this type of work. For information on working with prefabricated concrete in your state or territory contact your local work health and safety regulator.

Safe Work Australia, 18 September 2019

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

Update - contamination with N-nitrosodimethylamine

2019-10-25

Ranitidine tablets and oral liquids are now in short supply as a number of commonly-used brands have been recalled from pharmacies, hospitals, wholesalers, and other retail outlets, such as supermarkets and online stores. Additional brands may be recalled as TGA continues testing and discussions with companies that supply ranitidine. Ranitidine, which is marketed in Australia under the brand name Zantac and various generic brands, is used to reduce stomach acid and is commonly used to treat heartburn. It may also be prescribed by a doctor to treat and prevent

Safe Work Australia has developed a guide on the safe use of prefabricated concrete elements in the construction industry.

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heartburn, reflux and ulcers. Ranitidine is available in Australia as a prescription medicine and can also be purchased without a prescription from pharmacies, supermarkets and other retailers.

What is NDMA?

NDMA is a type of *N*-nitroso compound. *N*-nitroso compounds are commonly found in low levels in a variety of foods, particularly smoked and cured meats, as well as in some drinking water and in air pollution. Long-term exposure, over years, can increase an individual's risk of developing cancer. The additional risk posed by NDMA from ranitidine, at the levels identified to date, is considered to be very low. However, such contamination is considered unacceptable for a medicine. The actual health risks depend on dose and will vary from person to person. The risks from short-term use of ranitidine are expected to be extremely low. The TGA has been investigating NDMA and other *N*-nitroso compounds that have been found in 'sartan' blood pressure medicines since 2018.

What should consumers do?

There is no immediate health risk associated with this medication as the risks are associated with long-term use. People who use ranitidine may need to switch to alternative therapies because there is a shortage of ranitidine tablets and oral liquids due to the recalls. There are other medicines available to treat heartburn, ulcers and reflux, including prescription medicines and products that can be purchased without a prescription from pharmacies, supermarkets and other retailers. People who are taking ranitidine without a prescription should speak to their pharmacist about their treatment options. NPS Medicinewise has also published information about managing reflux and heartburn for consumers. For people who have been prescribed ranitidine, the risks of not treating their condition may pose a greater risk to health than the potential contamination with NDMA. These people should speak to their doctor about an alternative treatment.

What should health professionals do?

Doctors who are treating patients with ranitidine may need to consider alternative management, as oral dose forms of ranitidine are in short supply. Alternative management may include another H₂ receptor antagonist, proton pump inhibitors, and/or diet and lifestyle modification. Guidance on the management of gastro-oesophageal reflux disease can be found on the NPS MedicineWise website. The NPS MedicineWise website also provides advice about the treatment of acid reflux and

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bloating as part of the overall management of nausea and vomiting in pregnancy. The risks to the foetus associated with use in pregnancy of ranitidine contaminated with NDMA, at the levels observed to date, are expected to be very low. However, consideration should be given to alternative treatments while the issue is being investigated. Pharmacists who are providing advice to patients accessing ranitidine over the counter should discuss treatment options and review whether ongoing pharmacotherapy is appropriate. Health professionals can reassure patients that the additional risk posed by NDMA from ranitidine at the levels identified to date is very low. However, for patients who are currently taking ranitidine these risks may outweigh the clinical benefits. Acceptable levels of nitrosamines are set in nanograms (ng). They are based on what is considered safe if a patient continues to take the affected medicine every day over a lifetime of 70 years. The levels of NDMA contamination detected in ranitidine to date, if taken over decades, may modestly increase an individual's risk of developing cancer. While acceptable levels have been derived from animal carcinogenicity studies and incorporate a wide margin of safety, it is not possible to provide an accurate number estimate of the magnitude of carcinogenic risk associated with NDMA contamination based on currently available safety data.

What is the TGA doing?

The TGA is working with international regulators and medicine sponsors to investigate this issue. The TGA has undertaken laboratory testing of Australian ranitidine medications to determine if these batches are affected. The TGA has published a detailed testing report. A number of recalls are being undertaken in relation to this issue. The TGA continues to work with sponsors to determine suitable actions on a case-by-case basis. The TGA is also introducing new requirements for ranitidine products to ensure that they do not contain unacceptable levels of NDMA. The internationally agreed limits for NDMA are set so that an individual who takes a product over their life-time (70 years) will not increase their risk of cancer by more than 1 in 100,000, based on animal studies. Additionally, the TGA is considering suspending the registration for products which cannot demonstrate adequate safety and quality. Notifications of shortages of prescription ranitidine products and alternative prescription medicines used to treat the same conditions will be published via the TGA's Medicines Shortage Information Initiative.

Recall actions

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Retail level recalls relating to this issue are being undertaken for various strengths, pack sizes and dosage forms for:

- Sandoz ranitidine (marketed under the brand names "Sandoz Ranitidine" and "Mylanta Ranitidine")
- Aspen ranitidine (marketed under the brand name "Zantac")
- Alphapharm ranitidine (marketed under the brand name "RANI 2")
- Apotex ranitidine (marketed under the brand names "APO", "CHEMMART", "TERRY WHITE CHEMISTS" and "APOHEALTH")
- Symbion ranitidine (marketed under the brand names "Pharmacy Choice Acid and Heartburn Relief" / "Extra Strength")
- Cipla Australia ranitidine (marketed under the brand names "AMCAL" and "Pharmacy Care")
- Generic Health ranitidine (marketed under the brand name "Pharmacy Action").
- Nova Pharmaceuticals Australasia ranitidine (marketed under the brand names "Coles (and) Medix Heartburn & Acid Indigestion").
- Australian Pharmaceutical Industries Ltd t/a Soul Pattinson Manufacturing ranitidine (marketed under the brand names "Pharmacy Health (and) Priceline Pharmacy Reflux Relief Extra Strength Ranitidine" and "Terrywhite Chemmart Heartburn Relief Extra Strength Ranitidine")
- Arrow Pharma ranitidine (marketed under the brand names "AUSRAN Ranitidine", "CHEMIST'S OWN RANITIDINE FORTE" and "CHEMIST'S OWN RANITIDINE").

Note: while ALL batches of the previous nine sponsor's products are being recalled, following TGA testing, only some batches of Arrow Pharma ranitidine are being recalled. Refer to the System for Australian Recall Actions (SARA) database for specific, affected batch numbers and expiry dates. Details of these recall actions will appear in the TGA's SARA database. Search for 'ranitidine' in the field under '2. Select products' and tick the brand names of any products you would like to view. The recall actions being undertaken in Australia are consistent with actions being taken in other countries globally.

Reporting problems

Consumers and health professionals are encouraged to report problems with medicines or vaccines. Your report will contribute to the TGA's monitoring of these products. The TGA cannot give advice about an individual's medical condition. You are strongly encouraged to talk with a

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health professional if you are concerned about a possible adverse event associated with a medicine or vaccine.

TGA, 22 October 2019

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

NICNAS helps protect the Australian people and the environment by assessing the risks of industrial chemicals and providing information to promote their safe use

2019-10-25

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is a statutory scheme administered by the Australian Government's Department of Health. The full costs of administering NICNAS are recovered through fees and charges paid by industrial chemical importers and manufacturers in accordance with the *Australian Government Cost Recovery Guidelines*. The majority of our revenue is generated through chemical registrations and assessments. [View a list of fees](#). Fees for services provided to new industrial chemical notifiers, holders of confidence and other parties are based on 'fee for service' schedules in accordance with the administered regulations.

Cost Recovery Implementation Statements

In accordance with the Australian Government's revised cost recovery framework (effective 1 July 2015), NICNAS has prepared Cost Recovery Implementation Statements for 2019-20, 2018-19, 2017-18, 2016-17 and 2015-16:

[Cost Recovery Implementation Statement 2019-20 \[PDF 405 KB\]](#)

[Cost Recovery Implementation Statement 2018-19](#)

[Cost Recovery Implementation Statement 2017-18](#)

[Cost Recovery Implementation Statement 2016-17](#)

[Cost Recovery Implementation Statement 2015-16](#)

[Our structure](#)

NICNAS Director

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is a statutory scheme administered by the Australian Government's Department of Health.

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The NICNAS Director is a statutory office holder with specific functions and powers, as well as direct responsibilities to the Minister for Health. Dr Brian Richards is the current NICNAS Director. Dr Richards was initially appointed for a 5-year term commencing on 27 September 2012, and he was reappointed to the role on 10 August 2017 for a further 5 years. For more information about the role and responsibilities of the NICNAS Director, see section 90 of the *Industrial Chemicals (Notifications and Assessment) Act 1989*.

Programs

There are 5 program areas at NICNAS with 3 areas focused primarily on scientific assessment.

New Chemicals Program

The New Chemicals Program assesses new industrial chemicals notified to us by importers and/or manufacturers.

Existing Chemicals Program

The Existing Chemicals Program conducts:

- assessments of chemicals on the Australian Inventory of Chemical Substances (AICS) which have not previously been assessed in Australia
- assesses Priority Existing Chemicals (PECs)
- prioritises and assess chemicals using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

Targeted Assessment Program

The Targeted Assessment Program conducts:

- secondary notification risk assessments
- assesses chemicals on behalf of other government agencies
- manages the Australian Inventory of Chemical Substances (AICS).

Regulatory Strategy Program

The Regulatory Strategy Program:

- manages business planning, finance, IT, library services and the website.
- works with other government agencies and key stakeholders
- coordinates national and international engagement activities

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- [oversees NICNAS Reforms.](#)

Registration, Outreach and Reporting Program

The Registration, Outreach and Reporting Program:

- Manages the registration of [introducers](#)
- Undertakes [compliance](#) monitoring and investigate non-compliance
- Administers Australia's obligations under the [Rotterdam Convention](#)

[Our performance](#)

Regulator Performance Framework (RPF)

NICNAS self-assess its performance each year following the RPF. The RPF aims to reduce the cost of unnecessary or inefficient regulation imposed on industry and, by measuring and publicly reporting on performance, will give confidence that regulators effectively and flexibly manage risk.

[View our latest RPF self-assessment reports](#)

[View background information on the RPF](#)

[Annual reports](#)

NICNAS' annual reports outline its operations and outcomes by financial year.

[View the Department of Health Annual Report 2017-18](#)

NICNAS, 22 October 2019

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

China Opens RoHS 2 Public Service Platform

2019-10-25

On 8 October 2019, China Ministry of Industry and Information Technology (MIIT) opened [the public service platform for RoHS 2](#). The platform mainly consists of four functional sections, namely the product conformity query, self-declaration submission, certification submission, and a notice centre. So far, the conformity information of over 1200 products can be searched on the platform. The establishment and operation of the platform is based on the [China RoHS 2: Implementation Arrangements for Conformity Assessment System](#). According to the Implementation Arrangements, Products in [the Qualification Management Catalogue \(First Batch\) for China RoHS 2](#) that are manufactured and imported after 1st November 2019 shall complete the information submission of the conformity assessment

The online platform for publishing China RoHS 2 conformity information was launched on 8 October, including the separate supplier self-declaration submission system and third-part certification submission system.

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on the platform. Specifically, the certification body shall submit the assessment results to the platform within 5 working days after the relevant product obtains the certification. And the self-declaration with support documents must be submitted to the platform within 30 days after the product is put on the market. Then the contents submitted will be reviewed and published by SAMR and MIIT. There are two submission systems on the platform, one is for suppliers to self-declare the conformity of their products, and the other is for the third-party certification bodies to report the certification results of the commissioned products. For the self-declaration, [a guide](#) was published on the platform notice centre to introduce the operation procedures to enterprises. And for the voluntary certification, the most important thing for enterprises is to entrust an authorised certification body. According to the [China official information](#), there are 14 certification bodies authorised for the voluntary certification under RoHS 2. Confirmed product information can be looked upon on the platform through the query function. Recently, MIIT and relevant organisations have held public meetings in several cities to promote the conformity assessment system and the public service platform under RoHS 2 to local stakeholders.

Chemlinked, 23 October 2019

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

China Consults on Catalogue of Hazardous Chemicals Subject to Special Regulation

2019-10-25

On 16 October 2019, the Chinese Ministry of Emergency Management (MEM), along with several other authorities, issued the *Catalogue of Hazardous Chemicals Subject to Special Regulation (1st edition)* to solicit public comments. The public consultation is set to end 18 November this year. In line with the *Comprehensive Action Plan for Security of Hazardous Chemicals*, the Catalogue is devised as a response to security problems associated with a series of accidents, including the [2015 Tianjin explosions](#). Following the release of the *First and Second Batch of List of Hazardous Chemicals under Priority Management* in 2011 and 2013, respectively, it represents one of China's attempts to further focus its regulatory efforts on hazardous chemicals. Hazardous chemicals subject to special regulation in the Catalogue refer to those which have high inherent hazards, great security risks, severe post-accident consequences and large circulation volumes. With a total of 20 entries, the Catalogue involves four categories of hazardous chemicals, including explosive chemicals (4), toxic chemicals

China is proposing enforcement of special regulatory measures against a list of 20 hazardous chemicals.

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(6), flammable gases (5) and flammable liquids (5). Besides information like "Product name", "Alias", "CAS registry number" and "UN number" provided for each entry, it also specifies major hazards of each substance. For example, chlorine is described as "a toxic gas which can result in death in the case of inhalation". The Catalogue also provides special regulatory measures to be imposed against such hazardous chemicals, which majorly include six aspects:

1. To establish an information platform so as to achieve life-cycle traceability and control of information
2. To practice unified packaging management rules
3. To employ rigorous qualification requirements for safe production
4. To strengthen the regulation of transport
5. To implement fixed-location management at warehousing sites of hazardous chemicals
6. Requirements stipulated by other authorities or under other regulatory frameworks

Chemlinked, 22 October 2019

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

AMERICA

US Chemical Safety Board urges better refinery inspections, HF substitutes

2019-10-25

The United States Chemical Safety and Hazard Investigation Board (CSB) has repeated its call for a review of refineries' use of hydrofluoric acid (HF) and urged owners and regulators to conduct intensive inspections of all components. The board made the appeal 16 October as it released an interim report on the cause of an accident at the Philadelphia Energy Solutions (PES) refinery, near downtown Philadelphia. The accident injured five workers. It began in the early-morning hours of 21 June in the alkylation unit, where HF is used to boost the octane of gasoline. It involved three explosions and a fire that burned for 24 hours. The largest explosion was in a vessel holding butylene, isobutane, and butane, which sent a 17,000-kilogram fragment across the nearby Schuylkill River. The board found that a ruptured elbow pipe initiated the event. The elbow was part of a piping system that had been installed in 1973. The elbow had never been inspected, and the CSB found its thickness to be far below

The United States Chemical Safety and Hazard Investigation Board (CSB) has repeated its call for a review of refineries' use of hydrofluoric acid (HF) and urged owners and regulators to conduct intensive inspections of all components.

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acceptable levels and about half that of a credit card. The CSB noted that two other similar accidents were caused by corrosion of high carbon steel when exposed to HF. "Since 2015, the CSB has investigated three major incidents at refineries that utilize HF," CSB interim executive authority Kristen Kulinowski says in a statement. Incidents at a Husky Energy refinery in Superior, Wisconsin, and an ExxonMobil refinery in Torrance, California, did not result in HF release. "That was not the case here in Philadelphia. Though the main tank holding HF was not breached, HF was a component of the process fluid released from the alkylation unit. We are lucky there were no serious injuries or fatalities." HF is used in about one-third of the 150 US refineries. Fears of HF release in a dense, lethal, acidic cloud have led the CSB, communities, and members of Congress to call for better controls or substitution. The CSB has urged the Environmental Protection Agency in particular to review its 25-year-old regulation of HF and begin a search for substitutes. The EPA has not initiated such a review. At PES, some 307,000 kg of hydrocarbons was released, and most was combusted during the accident. Some 2,376 kg of HF was also released. Although some of the HF was captured and sent to a wastewater treatment system, 1,484 kg was released to the atmosphere. Corrosion has frequently been a cause of refinery incidents investigated by the CSB. "In its prior investigation of a 2012 Chevron Refinery fire we determined that corrosion caused the rupture of a piping component," CSB supervisory investigator Lauren Grim says in the statement. "Similarly, the 2009 Silver Eagle refinery fire was also caused by the failure of piping that had thinned due to corrosion." The CSB's final report is expected early next year.

Chemical & Engineering News, 21 October 2019

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

EPA Announces Settlement with Company for Chemical Data Reporting Violations

2019-10-25

On 23 October 2019, the United States Environmental Protection Agency (EPA) announced that it settled with Miles Chemical Company Inc. for failing to report timely chemical substances it imported. Under the settlement, the company will pay a \$45,000 penalty. According to EPA, between 2012 and 2015, Miles Chemical Company failed to submit timely forms to EPA documenting the import of large quantities of two chemicals. EPA notes that under the Toxic Substances Control Act (TSCA), chemical importers and manufacturers are required to submit Chemical Data Reporting (CDR) information to EPA every four years. This reporting

On 23 October 2019, the United States Environmental Protection Agency (EPA) announced that it settled with Miles Chemical Company Inc.

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allows EPA to track the chemicals being imported, assess potential human health and environmental effects of these chemicals, and make the non-confidential business information it receives available to the public. EPA notes that chemical substances listed on the TSCA Inventory that are manufactured or imported at volumes of 25,000 pounds or greater must be reported to EPA, as required by TSCA's CDR rule.

National Law Review, 23 October 2019

<http://www.natlawreview.com>

Public Comment Period and Workshops on the Draft Hot Spots Cancer Inhalation Unit Risk Factors for p Chloro- α,α,α -trifluorotoluene (p-chlorobenzotrifluoride, PCBTF)

2019-10-25

California's Office of Environmental Health Hazard Assessment (OEHHA) is releasing a document for public review that summarises the carcinogenicity and derivation of a cancer inhalation unit risk factor (IUR) for pChloro- α,α,α -trifluorotoluene (p-chlorobenzotrifluoride, PCBTF). Cancer inhalation unit risk factors are used to estimate lifetime cancer risks associated with inhalation exposure to a carcinogen. OEHHA is required to develop guidelines for conducting health risk assessments under the Air Toxics Hot Spots Program (Health and Safety Code Section 44360(b) (2)). In implementing this requirement, OEHHA develops IURs for many air pollutants. The draft PCBTF inhalation cancer unit risk factor was developed using the most recent "Air Toxics Hot Spots Program Technical Support Document for Cancer Potency Factors," finalised by OEHHA in 2009. The draft PCBTF inhalation cancer unit risk factor document is being made available today on the OEHHA website. The posting of the document will commence a 45-day public review period that will end on 2 December 2019. Public workshops will be held in Northern and Southern California. After the close of the public comment period, the document will be revised as appropriate by OEHHA, and peer reviewed by the state's Scientific Review Panel on Toxic Air Contaminants. The public is encouraged to submit written information via OEHHA's website rather than in paper form. Comments may be submitted electronically through the following link: <https://oehha.ca.gov/comments>.

Information about dates and agenda for meetings of the Scientific Review Panel can be obtained from the California Air Resources Board website at <http://www.arb.ca.gov/srp/srp.htm>.

California's Office of Environmental Health Hazard Assessment (OEHHA) is releasing a document for public review that summarises the carcinogenicity and derivation of a cancer inhalation unit risk factor (IUR) for pChloro- α,α,α -trifluorotoluene (p-chlorobenzotrifluoride, PCBTF).

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Further information is available at: [Comment Submissions - Draft Hot Spots Cancer Inhalation Unit Risk Factors for p-Chloro- \$\alpha,\alpha,\alpha\$ -trifluorotoluene \(p-chlorobenzotrifluoride, PCBTF\)](#)

OEHHA, 18 October 2019

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

Maine Accepting Comments on PFOS as a Priority Chemical in Children's Products

2019-10-25

The Maine Department of Environmental Protection (DEP) has proposed a rule designating perfluorooctane sulfonic acid (PFOS) as a priority chemical under the state's Toxic Chemicals in Children's Products Law. DEP's proposal would trigger reporting obligations for manufacturers of certain products that contain PFOS. The following product categories would be in scope, to the extent they are sold for residential use, or in a childcare facility, or school, and if a child under 12 years of age may have direct contact with them:

- Childcare articles
- Clothing
- Footwear
- Sleepwear
- Toys
- Cosmetics and personal care products
- Craft supplies
- Electronic devices
- Household furniture and furnishings
- Cookware, tableware, and reusable food and beverage containers

Public comments are due to DEP by November 4, 2019.

Background

Maine's Toxic Chemicals in Children's Products Law identifies and prioritises chemicals subject to notification requirements. Under the Law, DEP is also authorised to impose use restrictions. The Law establishes a tiered prioritisation scheme for chemicals:

- Chemicals of concern– Maine has identified over 1,300 chemicals as chemicals of concern.

The Maine Department of Environmental Protection (DEP) has proposed a rule designating perfluorooctane sulfonic acid (PFOS) as a priority chemical under the state's Toxic Chemicals in Children's Products Law.

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- Chemicals of high concern– From the list of chemicals of Concern, DEP, in coordination with the Maine Department of Health and Human Services and the Maine Centre for Disease Control and Prevention, has designated 36 compounds as chemicals of high concern.
- Priority chemicals– DEP designates certain chemicals of high concern as priority chemicals.

PFOS is already designated as a chemical of high concern, and the proposal would elevate it to a priority chemical.

Covered Product Categories

Manufacturers or distributors of products falling into the categories listed below and containing intentionally added amounts of PFOS would be required to report to DEP, as described further below. Only products sold for residential use, or in a childcare facility or school, and with which a child under 12 years of age may have direct contact, are in the scope of the law.

- Childcare articles
- Clothing
- Footwear
- Sleepwear
- Toys
- Cosmetics and personal care products
- Craft supplies
- Electronic devices
- Household furniture and furnishings
- Cookware, tableware, and reusable food and beverage containers

There would, however, be exemptions for:

- Used products
- Food and beverage packaging (unless the packaged product is intentionally marketed for use by children under 3 years of age)
- Certain motor vehicles or watercraft (except that detachable car seats are not exempt)

Reporting Obligations

A manufacturer or distributor of a covered product with intentionally-added PFOS above the practical quantification limit would be required to provide a one-time notification to DEP and must pay an associated reporting fee to be determined by DEP. These notifications would be due

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180 days after the effective date of the regulations or within 30 days of the sale of a product within Maine (if the product were not sold until after the 180-day reporting period ends).

The regulations would require the report to include the following information:

- Certain identifying and contact information about the manufacturer or distributor.
- A description of the product(s) containing PFOS, including the size of the product or component containing PFOS and whether the product or PFOS-containing component can be placed in the mouth. (Note: If the reportable item is smaller than 5 centimetres in one dimension, it is considered to be mouthable.)
- The amount of PFOS in each unit of the product.
- The function of PFOS in the product.
- The number of product units sold or distributed in Maine or nationally.
- Any other information the manufacturer or distributor deems relevant to the reporting for DEP's consideration, such as relevant independent scientific study on exposure, information on the availability, cost, feasibility and/or performance of alternatives to PFOS, and the reason PFOS is used in lieu of identified alternatives.

Additionally, DEP can impose use restrictions for certain priority chemicals when used in children's products sold in Maine but has not proposed to do so for PFOS.

Opportunity for Comment

DEP will accept comments on the proposed rule until 4 November 2019. DEP will hold a public hearing if it receives five or more requests for a public hearing before the end of the comment period.

National Law Review, 23 October 2019

<http://www.natlawreview.com>

House Committee Approves Sustainable Chemistry Research and Development Act

2019-10-25

On 17 October 2019, the House Committee on Science, Space, and Technology unanimously approved the Sustainable Chemistry Research and Development Act (H.R. 2051), a companion bill to legislation

On 17 October 2019, the House Committee on Science, Space, and Technology unanimously approved the Sustainable Chemistry Research and Development Act (H.R.

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introduced in the Senate by Senators Chris Coons (D-DE), Susan Collins (R-ME), Amy Klobuchar (D-MN), and Shelley Moore Capito (R-WV). Representative Dan Lipinski (D-IL) introduced the House bill on 3 April 2019. It is co-sponsored by Representative John Moolenaar (R-MI). The bill is intended to improve coordination of federal activities, including research and development of more sustainable chemicals, processes, and systems by establishing a coordinating entity under the National Science and Technology Council within the Office of Science and Technology Policy. The legislation would allow the agencies involved in this entity to work, in consultation with qualified stakeholders, to assess the state of sustainable chemistry in the United States and encourage the validation of tools for assessment of sustainable chemistry processes or products. The agencies would include the U.S. Environmental Protection Agency, the National Institute of Standards and Technology, the National Science Foundation, the Department of Energy, the Department of Agriculture, the Department of Defence, the National Institutes of Health, the Centres for Disease Control and Prevention, the Food and Drug Administration, and other related federal agencies, as appropriate. The bill also supports improved education and training in sustainable chemistry.

National Law Review, 18 October 2019

<http://www.natlawreview.com>

NSC Releases Federal Policy Position on Cannabis Use in Safety Sensitive Jobs

2019-10-25

With the widespread legalisation, decriminalisation, and availability of marijuana across the U.S., many have raised concerns on how the illicit drug will be regulated for employees in the workplace. While state laws on the drug vary for medical and recreational use, the NSC just announced a federal position on the drug in safety sensitive positions. The conversation on cannabis as it relates to the workplace is nothing new. A recent article explains how many health professionals and medical organisations have urged Congress to consider the health and safety implications of lenient laws and regulations against cannabis in the workplace. Because the drug does impact psychomotor skills and cognitive abilities, the federal government has announced that it will not allow cannabis use for employees in safety positions. This is understandable—especially since, unlike alcohol, the body's level of marijuana does not correlate to impairment level. By adopting this position, NSC will be able to increase involvement in the policy discussion about cannabis impairment. It will

In a policy position released recently, the National Safety Council states that no amount of marijuana or other THC products is allowed for employees working in safety sensitive positions.

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be able to provide guidance for employers as they consider changing laws on cannabis for employees. The long-term effects of marijuana are undetermined and still being studied. However, researchers do have notable data on the drug already. Research does indicate that marijuana impacts psychomotor skills and cognitive ability. However, the amount of THC detectable in the body does not directly correlate to a degree of impairment, unlike alcohol. This means that a person can test for a low or high amount of cannabis in his or her system, but that does not indicate a certain level of impairment. Cannabis is the most widely consumed illicit substance worldwide, according to the World Health Organization. In 2015, the World Drug Report estimated over 200 million people between ages 15 and 64 ingested cannabis. However, national reports indicate that cannabis has direct effects on employees in the workplace. According to the National Institute on Drug Abuse, employees who tested positive for cannabis had:

- 55 more industrial incidents
- 85 percent more injuries
- 75 percent greater absenteeism compared to those who tested negative

For those who are not convinced there are routine and identifiable psychological effects of cannabis, the National Institute on Drug Abuse found that those who use cannabis routinely have the following psychological reactions: relaxation, sedation, disorientation, impaired judgement, and lack of concentration. The drug has physical implications as well: fine motor skills, reddening of the eyes, increased appetite, dry mouth, and increased heart rate. These effects all contribute to impaired learning, short-term memory and attention deficits, and delayed decision-making. Still, despite marijuana's widespread use around the country, laws on cannabis differ by state and federal laws. While medical cannabis is legal in 46 states, it is federally illegal. The federal government regulates drugs through the Controlled Substances Act (CSA), which does not differentiate between medical and recreational cannabis use. The CSA considers cannabis as a Schedule 1 drug, meaning that the federal government views cannabis as having no medical value and high abuse potential. Therefore, there are no federally approved prescriptions for cannabis use. Doctors may not "prescribe" cannabis for medical use under federal law; however, they can "recommend" its use under the First Amendment. The federal policy does note that more research is needed to make a consensus on any of the mentioned cannabis-related subjects. Yet, studies continue. There are many anecdotal studies on a variety of

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cannabis-related subjects, including but not limited to assessing and defining the THC relationship to impairment, examining other safety implicates related to driving and vehicle rashes, potential medical uses and benefits, and more. These considerations aside, one conclusion had been made: employees in safety sensitive jobs are not permitted to use marijuana.

Occupational Health & Safety, 22 October 2019

<http://www.ohsonline.com>

EUROPE

Size doesn't matter – not even for chemicals

2019-10-25

The EU Commission has started to investigate if polymers should be registered under the EU chemicals legislation REACH, which means that information on their hazards for human health and the environment needs to be provided. This has turned out to be something of a hot potato since opinions on the matter differ. Some say yes, some say no – others ask how and to what extent. In this drama, there are two main characters – monomers and polymers. Monomers are the building blocks of polymers, and polymers are the main ingredient of a wide range of materials – most notably plastics. Monomers are registered under REACH – unlike polymers – due to the fact that these molecules are both small and extremely reactive. In the human body, for example, these molecules are so eager to interact with their environment that they many times attack the tissue, causing permanent damage to our DNA and increasing the risk of cancer.

“Bigger molecules may be toxicologically relevant”

Even though polymers are made up of monomers, they have long been considered to be too big to have a harmful effect on the human body. It has been said that all molecules with a molecular weight above 1000 Da are risk-free as they are too big to be bio-available. However, there is no real scientific basis for this assumption, bigger molecules may be toxicologically relevant. Fluoropolymers are, for example, known to be bio-available well above sizes of 1000 Da. Regardless of the polymer's size, the material for which they are mainly used is causing huge problems. The rampant consumption of plastics in the world today means that the material piles up in enormous amounts in our ecosystems. It has, for

The EU Commission has started to investigate if polymers should be registered under the EU chemicals legislation REACH, which means that information on their hazards for human health and the environment needs to be provided.

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example, been suggested that there will be more plastics than fish in the ocean by 2050. What happens when polymers eventually degrade in the environment?

“Polymers can break down into microplastics and release harmful substances”

Polymers are extremely persistent. If you bury a plastic bag in the ground and dig it up 50 years later, it will probably look the same as before (although much dirtier). But certain factors can speed up the degradation process substantially. The use of solvents is one such factor, another one is sunlight. Under these conditions polymers can, on the one hand, break down into microplastics – which have been recognised as major pollutants in the environment – and on the other hand, release harmful substances that were previously part of the polymer. In 2007 when REACH was adopted, polymers were considered to be less hazardous than monomers and too complicated to register due to the high number of possible polymer chains. Instead of solving the problem, it was postponed and polymers were exempted from registration. That means that today, we lack a lot of vital information about them. A REACH registration will lead to increased knowledge about how polymers are used, the toxic properties of them, how persistent they are and what happens when they break down. It would give us a much better understanding of the plastics that are being used in the EU today. I think few would argue that this isn't kind of important stuff to know in this age of plastic bonanza. A registration of polymers also means that the legislative treatment of them would be in line with all other chemicals, something that is way overdue in my opinion.

ChemSec, 26 September 2019

<http://www.chemsec.org/>

The Commission Clarifies the Fate of Phase-In Substances

2019-10-25

The REACH Regulation contains several provisions for the transitional registration of phase-in substances, or substances that were already on the EU market when REACH was adopted. Phase-in substances that had been pre-registered under REACH benefitted from phased registration deadlines depending on the volumes of chemicals manufactured or imported. With the last of these registration deadlines having passed on 1 June 2018, the Commission clarifies, with a new Implementing Regulation, how these

The REACH Regulation contains several provisions for the transitional registration of phase-in substances, or substances that were already on the EU market when REACH was adopted.

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provisions will be applied in the future. The Commission's Implementing Regulation on the expiry of the last registration deadline for phase-in substances was adopted on 9 October 2019. It contains the following four measures:

7. The method for calculating quantities per year for phase-in substances continues to apply only until 31 December 2019. After that date, quantities of substances that used to have phase-in status will have to be calculated by calendar year, no longer based on an average of the three preceding years.
8. The less stringent data requirements for the registration of certain low volume phase-in substances will continue to apply in order "to ensure equal treatment." This means that registrations meeting the criteria of Article 12(1)(b) of REACH will continue to benefit from these reduced data requirements even if they concern on-phase-in substances.
9. The Implementing Regulation confirms that data sharing obligations in REACH and the Implementing Regulation 2016/9 on data sharing continue to apply after the last registration deadline. Registrants are encouraged to use informal communication platforms such as the substance information exchange for a (SIEFs) provided by REACH for phase-in substances. The Regulation is silent on the fate of existing SIEFs.
10. Pre-registrations of phase-in substances are only valid until 31 December 2019. Until that date, registrants who (pre-)registered a phase-in substance:
 - a. are not required to follow the inquiry process of Article 26 of REACH; and
 - b. can continue to rely on the data-sharing dispute process for phase-in substances provided in Article 30 of REACH.

The Commission Regulation will enter into force on 30 October 2019 and become directly applicable in the EU as of that date.

Steptoe, 17 October 2019

<https://www.steptoel.com>

ETUC tells Spanish government not to sacrifice workers' health

2019-10-25

The Spanish Government is proposing to reduce the protection for workers against cancer-causing substances, and allegedly boosting the

The Spanish Government is proposing to reduce the protection for workers against cancer-causing substances, and allegedly boosting the competitiveness of companies, on the pretext of transposing the revised EU Directive (2004/37/EC) on carcinogens or mutagens at work.

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competitiveness of companies, on the pretext of transposing the revised EU Directive (2004/37/EC) on carcinogens or mutagens at work. The cancer-causing substances, for which the Spanish caretaker government is proposing to increase the exposure limits, are crystalline silica, acrylamide and bromo-ethylene. The European Trade Union Confederation (ETUC) is urging the Spanish government to withdraw its proposals. "Sacrificing workers' health on the altar of competitiveness is unacceptable", said ETUC Deputy General Secretary Per Hilmersson. "It is unthinkable to subsidise companies by allowing them to increase workers' exposure to cancer-causing substances, and pass the healthcare and others costs to families and society." "EU Directives on occupational health and safety only define minimum standards. Member States should maintain or have higher levels of protection for workers, not reduce standards to the EU minimum." For crystalline silica, the Spanish occupational exposure limit value is 0.05 mg/m^3 . The draft decree to transpose the EU Directive allows for twice as much exposure (0.1 mg/m^3). The scientific literature shows that there is a significant mortality rate at this level, e.g. from silicosis or lung cancer. For acrylamide, which causes pancreatic cancer, the Spanish government intends to triple the maximum exposure level. For bromo-ethylene, which causes liver cancer, the government would allow the exposure threshold to be doubled.

ETUC, 22 October 2019

<https://www.etuc.org>

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Member States to evaluate 74 substances in 2020-2022

2019-10-24

The European Chemicals Agency (ECHA) proposes 74 substances for evaluation by Member States under the Community rolling action plan (CoRAP) for 2020-2022. If you have registered any of these substances, you should coordinate actions with your co-registrants and contact the evaluating competent authority. At present, 14 substances are planned to be evaluated in 2020, while 60 substances are listed for evaluation in 2021 and 2022. Registrants of a listed substance should start coordinating their actions and contact the evaluating Member State authority. Downstream users of a listed substance should review the information they have available and share it with the registrants. In particular, it is important that information on the uses are up to date and exposure scenarios and related exposure estimations are clearly documented within the registrants' chemical safety reports. For the substances planned to be evaluated in 2020, the relevant dossier updates should be made before March 2020. The draft plan has been prepared together with the Member States and includes the (non-confidential) substance names, the EC and CAS numbers, the tentative year of evaluation, the contact details of the proposed evaluating Member State, and an indication of the initial area of concern. The groups of structurally similar substances that could potentially be evaluated together are also marked in the draft plan. Registrants can get an overview of substance-specific activities (including substance evaluation) using the [public activities coordination tool \(PACT\)](#). It offers companies one entry point to information about substances that authorities are working on.

Next steps

ECHA's Member State Committee will discuss the draft CoRAP this week and will prepare an opinion on the draft plan in February 2020. Based on the opinion, ECHA will adopt and publish the CoRAP update for 2020-2022 in March 2020. From the date of publication onwards, the Member States have one year to prepare a draft decision requesting further information from the respective registrants to clarify potential concerns identified during evaluation. Further information is available at:

- [Draft CoRAP 2020-2022](#)
- [Substance evaluation](#)
- [Registrant's guide - how to act in substance evaluation](#)
- [Interaction between the evaluating Member State and the registrants under substance evaluation – Recommendations](#)

The European Chemicals Agency (ECHA) proposes 74 substances for evaluation by Member States under the Community rolling action plan (CoRAP) for 2020-2022.

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- [Public activities coordination tool \(PACT\)](#)

ECHA, 23 October 2019

<http://echa.europa.eu>

Public consultation on occupational exposure limits of two substances launched

2019-10-24

At the request of the Commission, the European Chemicals Agency (ECHA) has evaluated two groups of substances, lead and its compounds and diisocyanates for occupational exposure limits (OELs), and has prepared scientific reports which are subject to a 60-day public consultation. The deadline for comments is 16 December 2019. Further information is available at:

- [Give comments](#)
- [OELs web pages](#)

ECHA News, 23 October 2019

<http://echa.europa.eu>

A new proposal to harmonise classification and labelling

2019-10-24

The European Chemicals Agency (ECHA) has published a proposal that has been submitted to harmonise the classification and labelling for benzyl alcohol (EC 202-859-9, CAS 100-51-6). Further information is available at: [Registry of CLH intentions](#)

ECHA News, 23 October 2019

<http://echa.europa.eu>

Public consultation on derogation to the exclusion criteria for DBNPA

2019-10-24

Active substances that meet the exclusion criteria can only be approved if they meet one or more of the following derogation criteria:

- exposure is negligible;

At the request of the Commission, the European Chemicals Agency (ECHA) has evaluated two groups of substances, lead and its compounds and diisocyanates for occupational exposure limits (OELs), and has prepared scientific reports which are subject to a 60-day public consultation.

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- the active substance is essential to prevent a serious danger to human or animal health or the environment; or
- not approving the substance would have a disproportionate negative impact on society when compared to the risks.

Give your comments on whether the conditions for derogation are met for DBNPA, for product-type 4, by 10 December 2019. Further information is Available at:

- [Give comments](#)
- [BPC opinion](#)

ECHA News, 23 October 2019

<http://echa.europa.eu>

SCIP webpages translated

2019-10-24

The web pages about the upcoming SCIP database on hazardous substances in articles is available in 23 EU languages. Companies supplying articles that contain Candidate List substances will need to submit information to the database as from 5 January 2021. Further information is available at:

[SCIP database](#)

ECHA News, 23 October 2019

<http://echa.europa.eu>

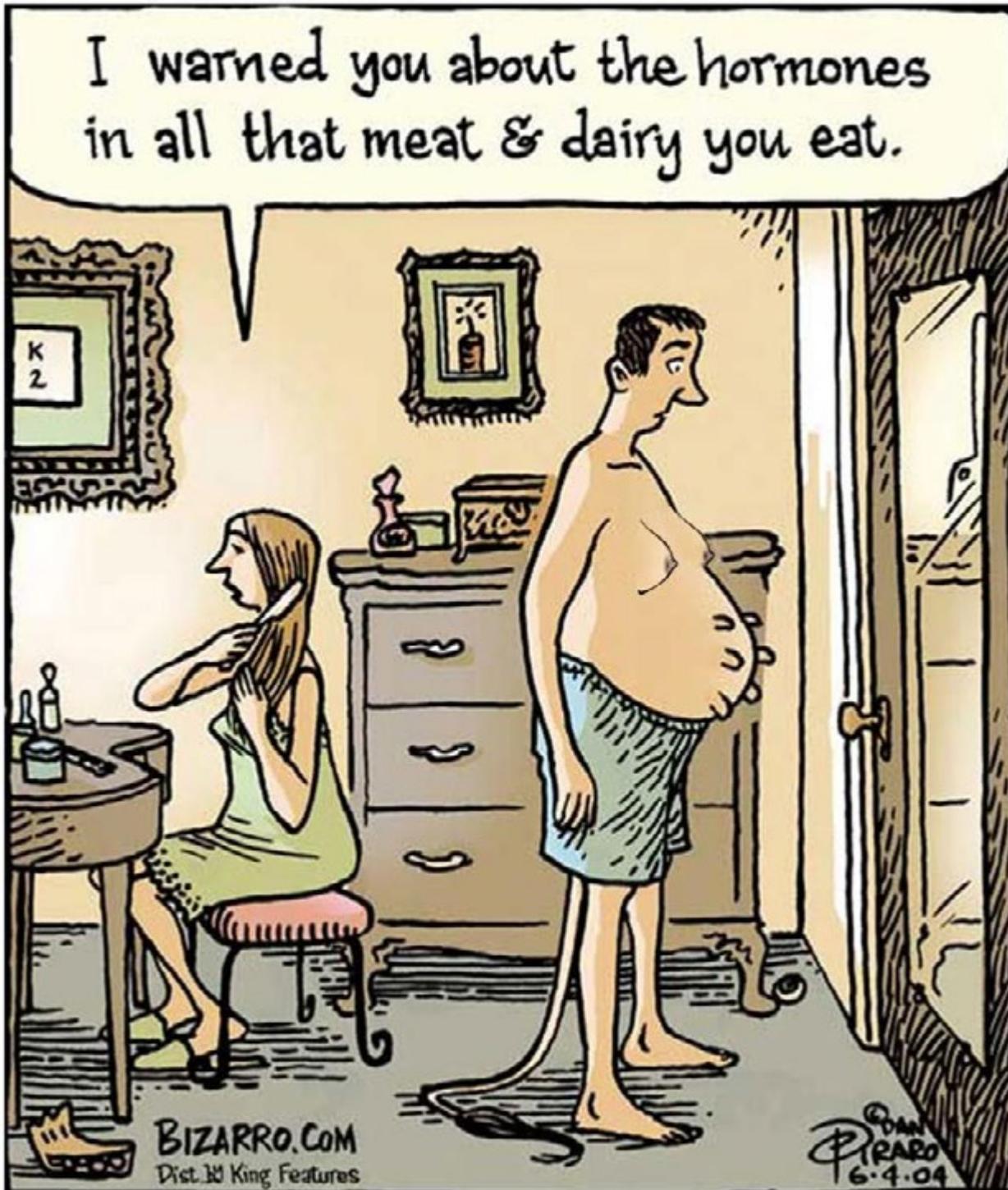
The web pages about the upcoming SCIP database on hazardous substances in articles is available in 23 EU languages.

Janet's Corner

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Meat and Dairy

2019-10-20



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Nitrobenzene

2019-10-13

Nitrobenzene is an organic compound with the chemical formula $C_6H_5NO_2$. It is a pale yellow oil with an almond-like odour. It freezes to give greenish-yellow crystals. [1] The solid crystals melt at 6 degrees celsius and the liquid boils at 211 degrees celsius. Nitrobenzene is flammable. It dissolves only slightly in water, but mixes well with most organic (carbon-containing) solvents. Nitrobenzene is one of a group of substances known as the volatile organic compounds (VOCs). [2]

USES [1,2]

The main use of Nitrobenzene is to make the important industrial chemical Aniline, which is used in the manufacture of plastics and rubbers, dyes, agrochemicals and petrol additives. Furthermore, nitrobenzene is used in shoe and floor polishes, leather dressings, paint solvents, and other materials to mask unpleasant odours. Redistilled, as oil of mirbane, nitrobenzene has been used as an inexpensive perfume for soaps. A significant merchant market for nitrobenzene is its use in the production of the analgesic paracetamol (also known as acetaminophen).

SOURCES & ROUTES OF EXPOSURE [3]

Sources of Exposure

Exposure can occur in the workplace during its manufacture, processing, and use, or in the environment following releases to air, water, land, and groundwater. Exposure can also occur when people use nitrobenzene-containing paints and polishes.

Routes of Exposure

Nitrobenzene enters the body when people breathe air or consume food or water contaminated with nitrobenzene. It can also be absorbed through skin contact. It does not remain in the body due to its breakdown and removal.

HEALTH EFFECTS [4]

Acute Effects

Acute inhalation, oral, and dermal exposure to nitrobenzene in humans produces methemoglobinemia, in which haemoglobin (which carries

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oxygen in the blood) is converted to methemoglobin, resulting in lowering the amount of oxygen released to the tissues of the body. This lowered oxygen capacity is associated with fatigue, weakness, dyspnea, headache, and dizziness. At higher concentrations, depressed respiration, bluish-grey skin, disturbed vision, and coma may occur. Animal studies have reported methemoglobinemia and effects on the liver, kidney, spleen, and central nervous system (CNS) from acute inhalation exposure to nitrobenzene. Tests involving acute exposure of rats have shown nitrobenzene to have moderate acute toxicity from oral exposure.

Chronic Effects

Chronic exposure to nitrobenzene in humans also results in methemoglobinemia. There is also some evidence that the human liver is damaged after chronic inhalation of nitrobenzene. Chronic, inhalation exposure to nitrobenzene in animals results in methemoglobinemia, and effects on the liver and kidney. EPA has calculated (by an alternate method) a provisional Reference Concentration (RfC) of 0.002 milligrams per cubic metre (mg/m³) for nitrobenzene based on haematological, adrenal, renal, and hepatic effects in mice. The Reference Dose (RfD) for nitrobenzene is 0.0005 milligrams per kilogram body weight per day (mg/kg/d) based on haematologic, adrenal, renal, and hepatic lesions in rats and mice.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of nitrobenzene in humans. Developmental effects, such as birth defects or embryotoxic effects, have not been reported in animal studies with inhalation exposure to nitrobenzene. However, reproductive effects, including a decrease in fertility, reduced testicular weights, and decreased sperm production have been noted in inhalation and oral animal studies.

Cancer Risk

EPA has classified nitrobenzene as a Group D, not classifiable as to human carcinogenicity.

ENVIRONMENT EFFECTS [2]

High-level exposure to Nitrobenzene is classed as toxic to wildlife, particularly aquatic life. However, it breaks down quickly in the environment and so only very large releases (resulting from an accidental spill for example) are likely to cause harm. Nitrobenzene is broken down

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quickly in the atmosphere. In soil and water, it is readily broken down by micro-organisms. Nitrobenzene is not accumulated by fish or animals, but some plants can take it up and store it. As a VOC, Nitrobenzene may be involved in the formation of ground level ozone, which can damage crops and materials. It is not considered likely that Nitrobenzene pollution has any effects on the global environment.

SAFETY [5]

First Aid Measures

- **Eye Contact:** Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- **Skin Contact:** After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- **Ingestion:** Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Control & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit

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value. Ensure that eyewash stations and safety showers are proximal to the work station location.

Personal Protective Equipment

It is recommended that the following personal protective equipment be used when handling nitrobenzene:

- Splash goggles;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self contained breathing apparatus should be used to avoid inhalation of the product.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [6,7]

United States

EPA: The Environmental Protection Agency recommends that levels in lakes and streams should be limited to 17 parts of nitrobenzene per million parts of water (17 ppm) to prevent possible health effects from drinking water or eating fish contaminated with nitrobenzene. The EPA requires that discharges, spills, or accidental releases of 1,000 pounds or more of nitrobenzene must be reported to the EPA.

OSHA: The Occupational Safety and Health Administration has set a permissible exposure limit of 5 milligrams nitrobenzene per cubic metre of air (5 mg/m^3) for an 8-hour workday in a 40-hour workweek.

ACGIH & NIOSH: The American Conference of Governmental and Industrial Hygienists and the National Institute for Occupational Safety and

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Health also recommend an occupational exposure limit of 5 mg/m³ for nitrobenzene.

Australia

Safe Work Australia has established a TWA of 5mg/m³ for nitrobenzene for an 8-hour workday.

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Gossip

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High-value chemicals for pharmaceuticals could be made cheaper and greener by new catalysts

2019-10-16

High value chemicals used to make pharmaceuticals could be made much cheaper and quicker thanks to a series of new catalysts made by scientists at the University of Warwick in collaboration with GoldenKeys High-Tech Co., Ltd. in China. The process of making high-value chemicals for uses such as the pharmaceutical or electronics chemical industry requires many years of work and a very high financial investment, with a large amount of side products going to waste. However, in research published in August in the ACS journal Organic Letters, the paper, "Probing the Effects of Heterocyclic Functionality in [(Benzene) Ru (TsDPENR)Cl] Catalysts for Asymmetric Transfer Hydrogenation," shows how scientists are able to tailor conditions in the catalyst to make the molecule required. The research project between the University of Warwick and the GoldenKeys High-Tech Materials Co., Ltd., a Speciality Material Company led by Dr. Yingjian Xu FRSC in China, has resulted in the development of a series of new catalysts for the asymmetric synthesis of alcohols which could be used for high value chemicals such as pharmaceuticals and electronics chemicals, potentially making it faster, cheaper and more environmentally sustainable as less chemicals are required under the catalytic conditions. Researchers were able to make the catalyst by making the molecules' ligands—which act as building blocks, bind to the metal ruthenium. This means that scientists can pick and choose which molecules to bind together to make a catalyst and in turn make the chemical required in a much faster and more sustainable way. In some cases, the ligands are 'bidentate'—meaning they form two bonds to the metal, and in other cases they are 'tridentate'—forming three bonds to the metal. Knowing how each ligand will bind also helps the identification of the optimal active form and the conditions required for the target application. Professor Martin Wills from the Department of Chemistry at the University of Warwick says, "The ability to make high-value chemicals through our new series of catalysts using ruthenium metal means that they can be made much more sustainably." Dr. Yingjian Xu of GoldenKeys High-Tech Materials Co., Ltd. adds, "If this method is used in the pharmaceutical and electronics chemical industries for example then products and intermediates can potentially be made more cheaply and quickly with

High value chemicals used to make pharmaceuticals could be made much cheaper and quicker thanks to a series of new catalysts made by scientists at the University of Warwick in collaboration with GoldenKeys High-Tech Co., Ltd.

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higher purity for consumers and reduce waste as less material is needed to make the catalyst, unlike traditional stoichiometric methods.”

Phys.org, 1 October 2019

<http://phys.org>

Eco-friendly electrochemical catalysts using solar cells to harvest energy from the sun

2019-10-16

A research team from Tokyo Institute of Technology (Tokyo Tech) and Kanazawa University develops an eco-friendly device that uses solar energy to catalyse an electrochemical oxidation reaction with high efficiency. Green energy sources constitute a hot research field globally because of the current environmental crisis and the necessity to avoid non-renewable energy (fossil fuels). Researchers have been seeking ways to harness and harvest solar energy for decades, and photovoltaic devices, which convert light into electricity, are in high demand. The study of these devices has progressed much since their interest last sparked in the 1970s after the economic shocks caused by oil prices. While most advances were made for silicon-based solar cells, scientists have demonstrated that organic photovoltaic devices can also achieve acceptable performance. Using organic materials is advantageous because they are printable and paintable as environmentally friendly processes unlike silicon processes. Organic materials also come in great variety, making it possible to tailor them for each specific application. Organic photovoltaic solar cells consist of an “active layer” sandwiched between two different electrodes (a transparent front electrode and a back electrode). The active layer is where the magic starts; the energy from the photons of the incident light is transferred to the electrons of the material through collisions, exciting them and setting them into motion, leaving behind positively charged pseudo-particles known as “holes.” These do not technically exist, but can be used to approximately describe the electrical behaviour of the material. The importance of the electrodes lies in that each one must collect one type of these charged particles (one gathers holes, and the other electrons) to prevent them from recombining in the active layer. The electrons flow through an external circuit that is connected to both electrodes, creating electricity from light. However, it is challenging to collect large numbers of electrons and holes at the electrodes and convert light into electricity with high efficiency. Some researchers have proposed that it would be beneficial to directly use the generated holes or electrons in chemical reactions near the active layer. Thus motivated,

A research team from Tokyo Institute of Technology (Tokyo Tech) and Kanazawa University develops an eco-friendly device that uses solar energy to catalyse an electrochemical oxidation reaction with high efficiency.

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a research team including Dr. Keiji Nagai from Tokyo Tech and Kanazawa University proposed a simple fabrication procedure for an organic photoelectrochemical device that can harvest solar energy to promote a chemical oxidation reaction. Their approach starts with a conventional organic photovoltaic device, which can be easily fabricated and whose characteristics are well known, and mechanically removing the back electrode where holes are collected. The exposed active layer is coated with ZnPc and submerged in thiol. The holes generated by the incident light are directly used for thiol oxidation, which is catalysed (facilitated) by the ZnPc layer. The excited electrons flow out through the remaining front electrode, generating an electric current. The simplicity and advantages of the fabrication approach and the measured efficiency when harvesting light energy are very promising. "The removal of the back electrode is a promising and repeatable technique for constructing a well-characterised photoelectrochemical cell," explains Dr. Nagai. The researchers also studied the topographic and electrochemical properties of the active layer coated with ZnPc to elucidate the principles of its catalytic activity. "The effects of the ZnPc coating were clearly observed in our analyses and consist of the effective accumulation of photogenerated holes," states Dr. Takahashi of Kanazawa University. Environmentally friendly devices such as the proposed one provide more ways to harvest energy from the sun and get us closer to a greener future.

EurekAlert, 3 October 2019

<http://www.eurekalert.org>

Inventing the world's strongest silver

2019-10-16

A team of scientists has made the strongest silver ever--42 percent stronger than the previous world record. But that's not the important point. "We've discovered a new mechanism at work at the nanoscale that allows us to make metals that are much stronger than anything ever made before--while not losing any electrical conductivity," says Frederic Sansoz, a materials scientist and mechanical engineering professor at the University of Vermont who co-led the new discovery. This fundamental breakthrough promises a new category of materials that can overcome a traditional trade-off in industrial and commercial materials between strength and ability to carry electrical current. The team's results were published on September 23 in the journal Nature Materials.

[Rethinking The Defect](#)

Team creates metal that breaks decades-old theoretical limit, promising new class of super-strong and conducting materials

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All metals have defects. Often these defects lead to undesirable qualities, like brittleness or softening. This has led scientists to create various alloys or heavy mixtures of material to make them stronger. But as they get stronger, they lose electrical conductivity. "We asked ourselves, how can we make a material with defects but overcome the softening while retaining the electroconductivity," said Morris Wang, a lead scientist at Lawrence Livermore National Laboratory and co-author of the new study. By mixing a trace amount of copper into the silver, the team showed it can transform two types of inherent nanoscale defects into a powerful internal structure. "That's because impurities are directly attracted to these defects," explains Sansoz. In other words, the team used a copper impurity--a form of doping or "microalloy" as the scientists style it--to control the behaviour of defects in silver. Like a kind of atomic-scale jiu-jitsu, the scientists flipped the defects to their advantage, using them to both strengthen the metal and maintain its electrical conductivity. To make their discovery, the team--including experts from UVM, Lawrence Livermore National Lab, the Ames Laboratory, Los Alamos National Laboratory and UCLA--started with a foundational idea of materials engineering: as the size of a crystal--or grain--of material gets smaller, it gets stronger. Scientists call this the Hall-Petch relation. This general design principle has allowed scientists and engineers to build stronger alloys and advanced ceramics for over 70 years. It works very well. Until it doesn't. Eventually, when grains of metal reach an infinitesimally tiny size--under tens of nanometres wide--the boundaries between the grains become unstable and begin to move. Therefore, another known approach to strengthening metals like silver uses nanoscale "coherent twin boundaries," which are a special type of grain boundary. These structures of paired atoms--forming a symmetrical mirror-like crystalline interface--are exceedingly strong to deformation. Except that these twin boundaries, too, become soft when their interspacing falls under a critical size of a few nanometres, due to imperfections.

Unprecedented Properties

Very roughly speaking, nanocrystals are like patches of cloth and nanotwins are like strong but tiny threads in the cloth. Except they're at the atomic scale. The new research combines both approaches to make what the scientists call a "nanocrystalline-nanotwinned metal," that has "unprecedented mechanical and physical properties," the team writes. That's because the copper atoms, slightly smaller than the atoms of silver, move into defects in both the grain boundaries and the twin boundaries. This allowed the team--using computer simulations of atoms as a starting

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point and then moving into real metals with advanced instruments at the National Laboratories--to create the new super-strong form of silver. The tiny copper impurities within the silver inhibit the defects from moving, but are such a small amount of metal--less than one percent of the total--that the rich electrical conductivity of silver is retained. "The copper atom impurities go along each interface and not in between," Sansoz explains. "So, they don't disrupt the electrons that are propagating through." Not only does this metal overcome the softening previously observed as grains and twin boundaries get too small--the so-called "Hall-Petch breakdown"--it even exceeds the long-standing theoretical Hall-Petch limit. The team reports an "ideal maximum strength" can be found in metals with twin boundaries that are under seven nanometres apart, just a few atoms. And a heat-treated version of the team's copper-laced silver has a hardness measure above what had been thought to be the theoretical maximum. "We've broken the world record, and the Hall-Petch limit too, not just once but several times in the course of this study, with very controlled experiments," says Sansoz. Sansoz is confident that the team's approach to making super-strong and still-conductive silver can be applied to many other metals. "This is a new class of materials and we're just beginning to understand how they work," he says. And he anticipates that the basic science revealed in the new study can lead to advances in technologies--from more efficient solar cells to lighter airplanes to safer nuclear power plants. "When you can make material stronger, you can use less of it, and it lasts longer," he says, "and being electrically conductive is crucial to many applications."

EurekaAlert, 2 October 2019

<http://www.eurekaalert.org>

Researchers rediscover fast-acting German insecticide lost in the aftermath of WWII

2019-10-16

A new study in the Journal of the American Chemical Society explores the chemistry as well as the complicated and alarming history of DFDT, a fast-acting insecticide. "We set out to study the growth of crystals in a little-known insecticide and uncovered its surprising history, including the impact of World War II on the choice of DDT—and not DFDT—as a primary insecticide in the 20th century," said Bart Kahr, professor of chemistry at New York University and one of the study's senior authors.

[Discovering solid forms of DFDT](#)

A new study in the Journal of the American Chemical Society explores the chemistry as well as the complicated and alarming history of DFDT, a fast-acting insecticide.

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Kahr and fellow NYU chemistry professor Michael Ward study the growth of crystals, which two years ago led them to discover a new crystal form of the notorious insecticide DDT. DDT is known for its detrimental effect on the environment and wildlife. But the new form developed by Kahr and Ward was found to be more effective against insects—and in smaller amounts, potentially minimizing its environmental impact. In continuing to explore the crystal structure of insecticides, the research team began studying fluorinated forms of DDT, swapping out chlorine atoms for fluorine. They prepared two solid forms of the compound—a monofluoro and a difluoro analogue—and tested them on fruit flies and mosquitoes, including mosquito species that carry malaria, yellow fever, Dengue, and Zika. The solid forms of fluorinated DDT killed insects more quickly than did DDT; the difluoro analogue, known as DFDT, killed mosquitoes two to four times faster. “Speed thwarts the development of resistance,” said Ward, a senior author on the study. “Insecticide crystals kill mosquitoes when they are absorbed through the pads of their feet. Effective compounds kill insects quickly, possibly before they are able to reproduce.” The researchers also made a detailed analysis of the relative activities of the solid-state forms of fluorinated DDT, noting that less thermodynamically stable forms—in which the crystals liberate molecules more easily—were more effective at quickly killing insects.

The forgotten history of DFDT

In addition to their chemical analyses, the researchers sought to determine if their creation had a precedent. In doing so, they uncovered a rich and unsettling backstory for DFDT. Through historical documents, they learned that DFDT was created as an insecticide by German scientists during World War II and was used by the German military for insect control in the Soviet Union and North Africa, in parallel with the use of DDT by American armed forces in Europe and the South Pacific. In the post-war chaos, however, DFDT manufacturing came to an abrupt end. Allied military officials who interviewed Third Reich scientists dismissed the Germans’ claims that DFDT was faster and less toxic to mammals than DDT, calling their studies “meagre” and “inadequate” in military intelligence reports. In his 1948 Nobel Prize address for the discovery of the insect-killing capability of DDT, Paul Müller noted that DFDT should be the insecticide of the future, given that it works more quickly than does DDT. Despite this, DFDT has largely been forgotten and was unknown to contemporary entomologists with whom the NYU researchers consulted. “We were surprised to discover that at the outset DDT had a competitor which lost the race because of geopolitical and economic circumstances, not to mention

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its connection to the German military, and not necessarily because of scientific considerations. A faster, less persistent insecticide, as is DFDT, might have changed the course of the 20th century; it forces us to imagine counterfactual science histories," said Kahr.

The need for new insecticides

Mosquito-borne diseases such as malaria—which kills a child every two minutes—are major public health concerns, resulting in 200 million illnesses annually. Newer diseases like Zika may pose growing threats to health in the face of a changing climate. Mosquitoes are increasingly resistant and are failing to respond to the pyrethroid insecticides built into bed nets. Public health officials are concerned and have reconsidered the use of DDT—which has been banned for decades in much of the world with the exception of selective use for malaria control—but its controversial history and environmental impact encourage the need for new insecticides. "While more research is needed to better understand the safety and environmental impact of DFDT, we, along with the World Health Organization, recognize the urgent need for new, fast insecticides. Not only are fast-acting insecticides critical for fighting the development of resistance, but less insecticide can be used, potentially reducing its environmental impact," said Ward.

Phys.org, 11 October 2019

<http://phys.org>

Liquid metals the secret ingredients to clean up environment

2019-10-16

Forget the laboratory, substances that can solve environmental problems by capturing carbon dioxide, decontaminating water and cleaning up pollutants can be easily created in a kitchen, a UNSW Sydney study shows. In a paper published in Nature Communications, UNSW chemical engineers shone a light on the mysterious world of liquid metals and their role as catalysts to speed up chemical processes using low amounts of energy. Professor Kourosch Kalantar-Zadeh of UNSW's School of Chemical Engineering says that "anyone with a shaker and a cooktop at home in their kitchen can make catalysts that can be used for CO₂ conversion, cleaning water and other pollutants. "They can do this by using a combination of liquid metals like gallium, indium, bismuth and tin in alloys that can be melted under 300°C on a cooktop or in an oven." Professor

Forget the laboratory, substances that can solve environmental problems by capturing carbon dioxide, decontaminating water and cleaning up pollutants can be easily created in a kitchen, a UNSW Sydney study shows.

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Kalantar-Zadeh and colleague Dr. Jianbo Tang showed that by heating an alloy of bismuth and tin, the metal melted at a point much lower than if you were to heat each metal individually. Substances that behave like this are said to be eutectic. "Eutectic alloys are the mixes of metals that produce the lowest melting point at a particular combination," says Dr. Tang. "For instance, if we combine bismuth at 57% and tin at 43% they melt at 139°C. But by themselves, both bismuth and tin have melting points above 200°C." Professor Kalantar-Zadeh says the specific mix ratio of eutectic substances produces the maximum natural chaos at the nano-level, which in turn brings the melting point down. The process can also work the other way. Eutectic metal substances already in liquid form can solidify at a single temperature below the usual freezing point of each metal. "This maximum chaos helps, when we solidify the liquid metals, to naturally produce so many defects in the material that the 'catalytic' activity is significantly enhanced," Professor Kalantar-Zadeh says.

How to make a liquid metal catalyst

- Ingredients: a eutectic alloy, water
- Take your eutectic metal alloy and place in a saucepan on a high flame.
- When the metal melts, carefully pour it into a bottle of water and tighten the cap.
- Shake the liquid metal and water together to produce droplets of liquid metal in water. It will be similar to shaking oil and vinegar to produce droplets of oil in the vinegar.
- Let the droplets solidify into a powder. This can now be used as a catalyst for the electrochemical conversion of CO₂.

Liquid metals and the environment

Liquid metal alloys can be used to remove or neutralise pollutants in the environment as well as capturing the carbon in CO₂ emissions. Tin, gallium and bismuth when in liquid form can be used as electrodes to convert carbon dioxide into useful by-products. Another environmental application is that after heating the liquid metals to make oxides, the substances can also be used to absorb energy from light, which enables them to break down contaminants in water. What makes liquid metals an attractive option in solving environmental problems is the fact they can be cheaply produced using low energy and in a low-tech environment. "Metals such as tin and bismuth are accessible to many people around the world," says Professor Kalantar-Zadeh. "People should just consider how easily, cheaply and with so little need for advanced technology that they can be processed and transformed into useful materials such as

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catalysts. "Additionally, playing with liquid metals is fun. While the most famous liquid metal—mercury—is well known to be hazardous, a liquid metal like gallium is completely non-toxic, and meltable at or near room temperature, where we can use it to transform one material to another at very low input energies. Liquid metals could solve lots of problems that we as humans are grappling with these days."

Phys.org, 11 October 2019

<http://phys.org>

New material captures carbon dioxide

2019-10-16

A new material that can selectively capture carbon dioxide (CO₂) molecules and efficiently convert them into useful organic materials has been developed by researchers at Kyoto University, along with colleagues at the University of Tokyo and Jiangsu Normal University in China. They describe the material in the journal *Nature Communications*. Human consumption of fossil fuels has resulted in rising global CO₂ emissions, leading to serious problems associated with global warming and climate change. One possible way to counteract this is to capture and sequester carbon from the atmosphere, but current methods are highly energy intensive. The low reactivity of CO₂ makes it difficult to capture and convert it efficiently. "We have successfully designed a porous material which has a high affinity towards CO₂ molecules and can quickly and effectively convert it into useful organic materials," says Ken-ichi Otake, Kyoto University materials chemist from the Institute for Integrated Cell-Material Sciences (iCeMS). The material is a porous coordination polymer (PCP, also known as MOF; metal-organic framework), a framework consisting of zinc metal ions. The researchers tested their material using X-ray structural analysis and found that it can selectively capture only CO₂ molecules with ten times more efficiency than other PCPs. The material has an organic component with a propeller-like molecular structure, and as CO₂ molecules approach the structure, they rotate and rearrange to permit CO₂ trapping, resulting in slight changes to the molecular channels within the PCP—this allows it to act as molecular sieve that can recognize molecules by size and shape. The PCP is also recyclable; the efficiency of the catalyst did not decrease even after 10 reaction cycles. "One of the greenest approaches to carbon capture is to recycle the carbon dioxide into high-value chemicals, such as cyclic carbonates which can be used in petrochemicals and pharmaceuticals," says Susumu Kitagawa, materials chemist at Kyoto University. After capturing the carbon, the converted

A new porous coordination polymer has propeller-shaped molecular structures that enables selectively capturing CO₂, and efficiently convert the CO₂ into useful carbon materials.

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material can be used to make polyurethane, a material with a wide variety of applications including clothing, domestic appliances and packaging. This work highlights the potential of porous coordination polymers for trapping carbon dioxide and converting into useful materials, opening up an avenue for future research into carbon capture materials.

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<http://phys.org>

Biologically-inspired skin improves robots' sensory abilities

2019-10-16

Sensitive synthetic skin enables robots to sense their own bodies and surroundings—a crucial capability if they are to be in close contact with people. Inspired by human skin, a team at the Technical University of Munich (TUM) has developed a system combining artificial skin with control algorithms and used it to create the first autonomous humanoid robot with full-body artificial skin. The artificial skin developed by Prof. Gordon Cheng and his team consists of hexagonal cells about the size of a two-euro coin (i.e. about one inch in diameter). Each is equipped with a microprocessor and sensors to detect contact, acceleration, proximity and temperature. Such artificial skin enables robots to perceive their surroundings in much greater detail and with more sensitivity. This not only helps them to move safely. It also makes them safer when operating near people and gives them the ability to anticipate and actively avoid accidents. The skin cells themselves were developed around 10 years ago by Gordon Cheng, Professor of Cognitive Systems at TUM. But this invention only revealed its full potential when integrated into a sophisticated system as described in the latest issue of the journal Proceedings of the IEEE.

More computing capacity through event-based approach

The biggest obstacle in developing robot skin has always been computing capacity. Human skin has around 5 million receptors. Efforts to implement continuous processing of data from sensors in artificial skin soon run up against limits. Previous systems were quickly overloaded with data from just a few hundred sensors. To overcome this problem, using a neuro-engineering approach, Gordon Cheng and his team do not monitor the skin cells continuously, but rather with an event-based system. This reduces the processing effort by up to 90 percent. The trick: The individual

Sensitive synthetic skin enables robots to sense their own bodies and surroundings—a crucial capability if they are to be in close contact with people.

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cells transmit information from their sensors only when values are changed. This is similar to the way the human nervous system works. For example, we feel a hat when we first put it on, but we quickly get used to the sensation. There is no need to notice the hat again until the wind blows it off our head. This enables our nervous system to concentrate on new impressions that require a physical response.

Safety even in case of close bodily contact

With the event-based approach, Prof. Cheng and his team have now succeeded in applying artificial skin to a human-size autonomous robot not dependent on any external computation. The H-1 robot is equipped with 1260 cells (with more than 13000 sensors) on its upper body, arms, legs and even the soles of its feet. This gives it a new "bodily sensation". For example, with its sensitive feet, H-1 is able to respond to uneven floor surfaces and even balance on one leg. With its special skin, the H-1 can even give a person a hug safely. That is less trivial than it sounds: Robots can exert forces that would seriously injure a human being. During a hug, two bodies are touching in many different places. The robot must use this complex information to calculate the right movements and exert the correct contact pressures. "This might not be as important in industrial applications, but in areas such as nursing care, robots must be designed for very close contact with people," explains Gordon Cheng.

Versatile and robust

Gordon Cheng's robot skin system is also highly robust and versatile. Because the skin consists of cells, and not a single piece of material, it remains functional even if some cells stop working. "Our system is designed to work trouble-free and quickly with all kinds of robots," says Gordon Cheng. "Now we're working to create smaller skin cells with the potential to be produced in larger numbers."

Tech Xplore, 10 October 2019

<https://techxplore.com/>

Nobel Prize in Chemistry 2019: Lithium-ion batteries

2019-10-16

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2019 to John B. Goodenough, of The University of Texas at Austin, USA, M. Stanley Whittingham, of Binghamton University, State University of New York, USA, and Akira Yoshino of Asahi Kasei Corporation,

The Nobel Prize in Chemistry 2019 is being awarded to John B. Goodenough, M. Stanley Whittingham, and Akira Yoshino "for the development of lithium-ion batteries."

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Tokyo, Japan, and Meijo University, Nagoya, Japan “for the development of lithium-ion batteries.”

They created a rechargeable world

The Nobel Prize in Chemistry 2019 rewards the development of the lithium-ion battery. This lightweight, rechargeable and powerful battery is now used in everything from mobile phones to laptops and electric vehicles. It can also store significant amounts of energy from solar and wind power, making possible a fossil fuel-free society. Lithium-ion batteries are used globally to power the portable electronics that we use to communicate, work, study, listen to music and search for knowledge. Lithium-ion batteries have also enabled the development of long-range electric cars and the storage of energy from renewable sources, such as solar and wind power. The foundation of the lithium-ion battery was laid during the oil crisis in the 1970s. Stanley Whittingham worked on developing methods that could lead to fossil fuel-free energy technologies. He started to research superconductors and discovered an extremely energy-rich material, which he used to create an innovative cathode in a lithium battery. This was made from titanium disulphide which, at a molecular level, has spaces that can house -- intercalate -- lithium ions. The battery's anode was partially made from metallic lithium, which has a strong drive to release electrons. This resulted in a battery that literally had great potential, just over two volts. However, metallic lithium is reactive and the battery was too explosive to be viable. John Goodenough predicted that the cathode would have even greater potential if it was made using a metal oxide instead of a metal sulphide. After a systematic search, in 1980 he demonstrated that cobalt oxide with intercalated lithium ions can produce as much as four volts. This was an important breakthrough and would lead to much more powerful batteries. With Goodenough's cathode as a basis, Akira Yoshino created the first commercially viable lithium-ion battery in 1985. Rather than using reactive lithium in the anode, he used petroleum coke, a carbon material that, like the cathode's cobalt oxide, can intercalate lithium ions. The result was a lightweight, hardwearing battery that could be charged hundreds of times before its performance deteriorated. The advantage of lithium-ion batteries is that they are not based upon chemical reactions that break down the electrodes, but upon lithium ions flowing back and forth between the anode and cathode. Lithium-ion batteries have revolutionised our lives since they first entered the market in 1991. They have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest benefit to humankind. John B. Goodenough, born 1922 in

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Jena, Germany. Ph.D. 1952 from the University of Chicago, USA. Virginia H. Cockrell Chair in Engineering at The University of Texas at Austin, USA. M. Stanley Whittingham, born 1941 in the UK. Ph.D. 1968 from Oxford University, UK. Distinguished Professor at Binghamton University, State University of New York, USA. Akira Yoshino, born 1948 in Suita, Japan. Ph.D. 2005 from Osaka University, Japan. Honorary Fellow at Asahi Kasei Corporation, Tokyo, Japan and professor at Meijo University, Nagoya, Japan. Prize amount: 9 million Swedish kronor, to be shared equally between the Laureates.

Science Daily, 9 October 2019

<http://www.sciencedaily.com>

Electroadhesive' stamp picks up and puts down microscopic structures

2019-10-16

If you were to pry open your smartphone, you would see an array of electronic chips and components laid out across a circuit board, like a miniature city. Each component might contain even smaller "chipllets," some no wider than a human hair. These elements are often assembled with robotic grippers designed to pick up the components and place them down in precise configurations. As circuit boards are packed with ever smaller components, however, robotic grippers' ability to manipulate these objects is approaching a limit. "Electronics manufacturing requires handling and assembling small components in a size similar to or smaller than grains of flour," says Sanha Kim, a former MIT postdoc and research scientist who worked in the lab of mechanical engineering associate professor John Hart. "So, a special pick-and-place solution is needed, rather than simply miniaturising [existing] robotic grippers and vacuum systems." Now Kim, Hart, and others have developed a miniature "electroadhesive" stamp that can pick up and place down objects as small as 20 nanometres wide -- about 1,000 times finer than a human hair. The stamp is made from a sparse forest of ceramic-coated carbon nanotubes arranged like bristles on a tiny brush. When a small voltage is applied to the stamp, the carbon nanotubes become temporarily charged, forming prickles of electrical attraction that can attract a minute particle. By turning the voltage off, the stamp's "stickiness" goes away, enabling it to release the object onto a desired location. Hart says the stamping technique can be scaled up to a manufacturing setting to print micro- and nanoscale features, for instance to pack more elements onto ever smaller computer chips. The technique may also be used to pattern other small, intricate features,

New technique could enable assembly of circuit boards and displays with more minute components

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such as cells for artificial tissues. And, the team envisions macroscale, bioinspired electroadhesive surfaces, such as voltage-activated pads for grasping everyday objects and for gecko-like climbing robots. "Simply by controlling voltage, you can switch the surface from basically having zero adhesion to pulling on something so strongly, on a per unit area basis, that it can act somewhat like a gecko's foot," Hart says. The team has published its results today in the journal *Science Advances*.

Like dry Scotch tape

Existing mechanical grippers are unable to pick up objects smaller than about 50 to 100 microns, mainly because at smaller scales surface forces tend to win over gravity. You may see this when pouring flour from a spoon -- inevitably, some tiny particles stick to the spoon's surface, rather than letting gravity drag them off. "The dominance of surface forces over gravity forces becomes a problem when trying to precisely place smaller things -- which is the foundational process by which electronics are assembled into integrated systems," Hart says. He and his colleagues noted that electroadhesion, the process of adhering materials via an applied voltage, has been used in some industrial settings to pick and place large objects, such as fabrics, textiles, and whole silicon wafers. But this same electroadhesion had never been applied to objects at the microscopic level, because a new material design for controlling electroadhesion at smaller scales was needed. Hart's group has previously worked with carbon nanotubes (CNTs) -- atoms of carbon linked in a lattice pattern and rolled into microscopic tubes. CNTs are known for their exceptional mechanical, electrical, and chemical properties, and they have been widely studied as dry adhesives. "Previous work on CNT-based dry adhesives focused on maximizing the contact area of the nanotubes to essentially create a dry Scotch tape," Hart says. "We took the opposite approach, and said, 'let's design a nanotube surface to minimize the contact area, but use electrostatics to turn on adhesion when we need it.'"

A sticky on/off switch

The team found that if they coated CNTs with a thin dielectric material such as aluminium oxide, when they applied a voltage to the nanotubes, the ceramic layer became polarised, meaning its positive and negative charges became temporarily separated. For instance, the positive charges of the tips of the nanotubes induced an opposite polarisation in any nearby conducting material, such as a microscopic electronic element. As a result, the nanotube-based stamp adhered to the element, picking it up like tiny, electrostatic fingers. When the researchers turned

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the voltage off, the nanotubes and the element depolarised, and the “stickiness” went away, allowing the stamp to detach and place the object onto a given surface. The team explored various formulations of stamp designs, altering the density of carbon nanotubes grown on the stamp, as well as the thickness of the ceramic layer that they used to coat each nanotube. They found that the thinner the ceramic layer and the more sparsely spaced the carbon nanotubes were, the greater the stamp’s on/off ratio, meaning the greater the stamp’s stickiness was when the voltage was on, versus when it was off. In their experiments, the team used the stamp to pick up and place down films of nanowires, each about 1,000 times thinner than a human hair. They also used the technique to pick and place intricate patterns of polymer and metal microparticles, as well as micro-LEDs. Hart says the electroadhesive printing technology could be scaled up to manufacture circuit boards and systems of miniature electronic chips, as well as displays with microscale LED pixels. “With ever-advancing capabilities of semiconductor devices, an important need and opportunity is to integrate smaller and more diverse components, such as microprocessors, sensors, and optical devices,” Hart says. “Often, these are necessarily made separately but must be integrated together to create next-generation electronic systems. Our technology possibly bridges the gap necessary for scalable, cost-effective assembly of these systems.” This research was supported in part by the Toyota Research Institute, the National Science Foundation, and the MIT-Skoltech Next Generation Program.

Science Daily, 11 October 2019

<http://www.sciencedaily.com>

Water + air + electricity = hydrogen peroxide

2019-10-16

The production of hydrogen peroxide can be much safer and simpler through a process developed at Rice University. A reactor developed by Haotian Wang and his colleagues at Rice’s Brown School of Engineering requires only air, water and electricity to make the valuable chemical in the desired concentration and high purity. Their electrosynthesis process, detailed in *Science*, uses an oxidised carbon nanoparticle-based catalyst and could enable point-of-use production of pure hydrogen peroxide solutions, eliminating the need to transport the concentrated chemical, which is hazardous. By using a solid electrolyte instead of traditional liquid electrolyte, it also eliminates the need for product separation or purification used in current processes, so no contaminating ions will be

A reactor produces pure hydrogen peroxide solutions from water, air and energy.

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involved. "If we have electricity from a solar panel, we can literally get hydrogen peroxide from just sunlight, air and water," said Wang. "We don't need to involve organics or fossil fuel consumption. Hydrogen peroxide synthesis by traditional, huge chemical engineering plants generates organic wastes, consumes fossil fuels and emits carbon dioxide. What we're doing is green synthesis." Hydrogen peroxide is widely used as an antiseptic, a detergent, in cosmetics, as a bleaching agent and in water purification, among many other applications. The compound is produced in industrial concentrations of up to 60% solution with water, but in many common uses, the solution is far more diluted. "Industrial hydrogen peroxide has to be transported in high concentrations to maximise the economics," Wang said. "Transportation is hazardous and costly because the concentrated compound is unstable. Hydrogen peroxide also degrades over time, and has to be stored once it gets to its destination. "Our technology delocalises the production of hydrogen peroxide," he said. "As renewable electricity input gets cheaper, air is free and water is also cheap, our product should be competitive in terms of price. "Instead of storing containers of hydrogen peroxide, hospitals that use it as a disinfectant could in the future turn on a spigot and get, for instance, a 3% solution on demand," Wang said. "Instead of storing chemicals to disinfect pool water, homeowners can flick a switch and turn on the reactor to clean their pools." The Rice reactor is somewhat similar to a fuel cell, with electrodes on either side to process hydrogen (or water) and oxygen (from air), feeding them to catalysts on two electrodes sandwiching an ionically conductive porous solid electrolyte. "A fuel cell minimises the production of hydrogen peroxide to produce just water with maximised energy efficiency," said Rice postdoctoral researcher and lead author Chuan Xia. "In our case, we want to maximize hydrogen peroxide instead, and have tuned our catalyst to do so." The low-cost carbon black catalyst, set in a solid electrolyte and oxidised to enhance its reactivity, shifts the oxygen reduction pathway towards the desired chemical at rates and concentrations determined by the applied voltage, air and water feedstock and a steady supply of deionised water. The reaction takes place under ambient temperatures and pressures. Co-lead author Yang Xia, a second-year graduate student in the Wang lab, said the catalyst proved robust enough to synthesize pure solution of 1%-by-weight hydrogen peroxide over 100 continuous hours in the lab with negligible degradation. Wang said the lab plans to engineer both larger reactors and plug-and-play components with an eye toward testing with industrial partners. He sees great promise for industrial-scale applications like municipal water purification systems. The Rice lab has tested low concentrations of its product on campus rainwater and proved its ability to remove organic

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carbon contaminants. "There are so many potential applications," he said. "Before this, electrochemical synthesis of hydrogen peroxide was limited by its product separation or purification process, but we've solved the big barrier to practical applications."

Science Daily, 10 October 2019

<http://www.sciencedaily.com>

Explained: The lifetime of an evaporating liquid drop

2019-10-16

The lifespan of a liquid droplet which is transforming into vapour can now be predicted thanks to a theory developed at the University of Warwick. The new understanding can now be exploited in a myriad of natural and industrial settings where the lifetime of liquid drops governs a process' behaviour and efficiency. Water evaporating into vapour forms part of our daily existence, creating plumes emanating from a boiling kettle and bulging clouds as part of the earth's water cycle. Evaporating liquid drops are also commonly observed, e.g. as the morning dew disappears off a spider's web, and are critical for technologies such as fuel-injection combustion engines and cutting-edge evaporative cooling devices for next generation electronics. Researchers from the Mathematics Institute and School of Engineering at the University of Warwick have had the paper 'Lifetime of a Nanodroplet: Kinetic Effects & Regime Transitions'; published in the journal Physical Review Letters, in which they explore the lifespan of a liquid droplet. Current theories state that the droplet's diameter-squared decreases in proportion to time (classical law); however, this period only accounts for a small portion of the drop's evolution. As the diameter approaches the unobservable micro- and nano-scale, molecular dynamics have to be used as virtual experiments and these show a crossover to a new behaviour, with the diameter now reducing in proportion to time (nano-scale law). Research at Warwick has shown that this behaviour occurs due to complex physics in the vapour flow, which can result in jumps in temperature across just a few molecules as large as 40 degrees! This behaviour is counter-intuitive to our daily experiences (on the macroscale), where we are used to temperatures changing relatively gradually, but must be accounted for to accurately predict the final stages of an evaporating drop's life. Prof Duncan Lockerby from the School of Engineering at the University of Warwick comments: "The main achievement here is the theory's ability to quickly predict the drop's lifetime and create a modelling framework that maintains accuracy from typical engineering scales down to cutting-edge nanoscale applications".

The lifespan of a liquid droplet which is transforming into vapour can now be predicted thanks to a new theory.

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Dr James Sprittles from the Mathematics Institute at the University of Warwick comments: "It is fascinating that intuition based on everyday observations are a hindrance when attempting to understand nanoscale flows, so that, as in this research, one has to lean on theory to enlighten us."

Science Daily, 10 October 2019

<http://www.sciencedaily.com>

Using industrial waste as insulation for buildings

2019-10-16

ETH spinoff FenX transforms industrial waste into a porous foam suitable for building insulation. Unlike other sustainable materials used for the purpose, this type of insulation is non-flammable and inexpensive to produce. No sooner does one of the four young men come up with the idea than they all start blowing up colourful balloons in their lab and tying them to silk threads. They wrap the other end of the thread around a white block that is shaped like a sponge and has the consistency of chalk. "It's as light as a meringue," says Etienne Jeoffroy, taking his hands off the block to show that it's lightweight enough for the balloons to lift it. The block is in fact a sample of insulation material, and the four scientists are the founders of a start-up named FenX that has developed a process for producing this material from industrial waste. Not only is their product lightweight, it is also non-flammable and produced sustainably. In a corner of their lab on ETH's Hönggerberg campus stands a large kitchen blender. "This is how we make the material," says Jeoffroy, CEO of the start-up. Both the production process itself and the equipment they use are relatively simple. Industrial waste is mixed with water and some additives—the "magic ingredients", as Jeoffroy calls their recipe, which is the product of years of research. The result is a porous foam that later solidifies to form the meringue-like insulating material.

Sustainable and inexpensive

Anyone who builds a house faces a dilemma when it comes to selecting the right insulation. Should they choose an artificial insulating material, such as polystyrene or mineral wool? These solutions may be cheap and efficient, but they're not very eco-friendly. Or would it be better to opt for natural alternatives, say wood fibres or flax, which are sustainable but more expensive and often less effective? Something else to consider is that some of today's common insulation materials are highly flammable. FenX is working on a solution to this dilemma. The foam panels that the

ETH spinoff FenX transforms industrial waste into a porous foam suitable for building insulation.

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start-up produces are non-flammable and their production is extremely sustainable. For one thing, the production process is energy efficient because, unlike artificial alternatives, there is no need to apply high temperatures to get the foam to solidify. And, given that the insulation panels installed in walls or roofs are reusable, the whole process is underpinned by recycling. Jeoffroy moreover vows that when the material becomes commercially available, it will be at a competitive price. "We can obtain the industrial waste we use as our raw material cheaply or even free of charge," he explains. The four materials scientists are still exploring which industrial waste products lend themselves to processing for use as insulation foam. In their first pilot tests they used fly ash, but it should also be possible to process other waste, say by-products from the construction, metal or paper industries. "We're currently experimenting with around ten different types of industrial waste," Jeoffroy explains. The idea is that one day, the raw material used for production in a given region will be whichever waste material is readily available locally. This avoids any ecologically and economically pointless transport costs and, in principle, makes production possible anywhere in the world.

Partner required

Against the backdrop of the Paris Agreement on climate change, the construction industry must undertake to become greener, and this new insulation material should bring about some advantages to that effect. Nevertheless, the ETH spin-off still faces a number of challenges, the greatest being the huge increase in production capacity it needs to be viable in the market. After all, even though FenX's production method is simple, a kitchen mixer in the ETH lab is not sufficient to supply the material in the quantities that the construction industry demands. "We need a factory-scale production line, and for that we need a partner," Jeoffroy explains. Their chances of finding one are looking pretty good. According to Jeoffroy, their foam from ETH Zurich has attracted a lot of interest so far, and the team is already involved in a number of pilot projects. The start-up, which is only a few months old, will also have to attract additional financial support if it wants to grow. So far, the young entrepreneurs have financed their business with funds from the ETH Pioneer Fellowship and from Swiss and European grants. A few days ago, FenX also received 150,000 Swiss francs from the Venture Kick funding initiative. "Our goal is to raise funds to the tune of around 1.5 million Swiss francs by April 2020 and to have our foam panels on the market by 2021," says Jeoffroy, outlining his ambitious timetable. "By that point, we want to increase our headcount as well. In particular, we're looking for people with

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expertise in the construction industry, marketing and sales," he explains. The four young entrepreneurs behind FenX—Frenchman Etienne Jeoffroy, Michele Zanini from Ticino, and two Italians, Enrico Scoccimarro and Alessandro Dutto—know each other from their time at the Department of Materials at ETH Zurich. All of them worked on the recipe for the innovative insulation material while still completing their studies or postdocs. They also had the backing of ETH Professor André Studart and of Elena Tervoort, both of whom are now co-founders of the start-up and who continue to provide support in the form of advisors. The fact that the group sets up a company together is down to their unwavering belief in their cause, explains co-founder Zanini: "Bringing this product to market is the only way we can do something to significantly reduce our carbon footprint," he says.

Phys.org, 11 October 2019

<http://phys.org>

Researchers create new glass ceramic material from industrial contaminants

2019-10-16

A new glass ceramic material could become a better alternative to use in construction. Miguel Hernández University (UMH) professor Manuel Jordán has contributed to the creation of a new glass ceramic material from sludge contaminated with toxic chromium. This new material has high resistance to bending compared to others of the same class, and once processed, is nontoxic and environmentally harmless. The new glass ceramic material is 75 percent composed of sludge with high levels of hexavalent chromium Cr (VI), a toxic form of chromium that comes from industrial processes such as the manufacturing of stainless steel or curing leather. This chemical substance is highly soluble and its consumption has been linked to risks of cancer and allergies. The researchers obtained sludge from the industrial area of Tultitlán (Mexico), which is close to urban centres. In order to change its chemical properties, the sludge was mixed with feldspar and distilled coal ashes (coke), and was then cooked in an oven at 1,450 degrees. With this process, the researchers have been able to turn toxic chromium Cr (VI) into a different chemical substance, Cr (III), low quantities of which are essential in our diet. Furthermore, the new compound has been immobilised, which means it does not affect the environment. In addition to being chemically stable, the new material's mechanical resistance to bending (258 mega pascals) is quite high compared to other traditional glass ceramic materials. The results

A new glass ceramic material could become a better alternative to use in construction.

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make it possible to conclude that the glass ceramic process could become a real and useful alternative for the recycling of toxic and dangerous industrial waste, which could be turned into new materials that provide another, potentially better option, for architecture and the construction of buildings and varied public works including pavement, coatings, tiles and roofs. The new material and its mechanical properties are detailed in Material Letters X. The project is based on the preliminary results of the doctoral thesis of Beatriz Rincón, who won the Extraordinary Doctorate Prize in 2018, and which was defended at the UMH under the guidance of professor Jordán.

Phys.org, 11 October 2019

<http://phys.org>

New design strategy can help improve layered superconducting materials

2019-10-16

Scientists from Tokyo Metropolitan University have created a new layered superconducting material with a conducting layer made of bismuth, silver, tin, sulfur and selenium. The conducting layer features four distinct sublayers; by introducing more elements, they were able to achieve unparalleled customizability and a higher “critical temperature” below which superconductivity is observed, a key objective of superconductor research. Their design strategy may be applied to engineer new and improved superconducting materials. Once an academic curiosity, superconductors are now at the cutting edge of real technological innovations. Superconducting magnets are seen in everyday MRI machines, particle accelerators for medical treatments, not to mention the new Chuo Shinkansen maglev train connecting Tokyo to Nagoya currently being built. Recently, a whole new class of “layered” superconducting structures have been studied, consisting of alternate layers of superconducting and insulating two-dimensional crystalline layers. In particular, the customizability of the system has garnered particular interest in light of its potential to create ultra-efficient thermoelectric devices and a whole new class of “high temperature” superconducting materials. A team led by Associate Professor Yoshikazu Mizuguchi from Tokyo Metropolitan University recently created a bismuth sulfide based layered superconductor; their work has already revealed novel thermoelectric properties and an elevated “critical temperature” below which superconductivity is observed. Now, working with a team from the University of Yamanashi, they have taken a multi-layered version

Modified multi-layered bismuth superconductor for higher critical temperatures

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of the system, where the conducting layer consists of four atomic layers, and begun swapping out small proportions of different atomic species to probe how the material changes. Starting with a conducting layer made of bismuth, silver and sulfur, they tried substituting some of the silver for tin. By varying the amount of silver, they were able to raise the critical temperature from 0.5K to above 2.0K. Interestingly, they found that this was accompanied by the disappearance of an anomaly in its resistivity at significantly higher temperatures. Though the reason behind this is not yet understood, it is clear that the addition of tin has significantly modified the electronic structure of the material. Furthermore, they took their best bismuth, silver, sulfur and tin combination and substituted some of the sulfur for selenium, a modification known to improve superconducting properties in their original bismuth sulfide material. Not only did they raise the critical temperature further to 3.0K, they found that the response to magnetic fields showed signatures of "bulk" superconductivity, providing clear proof that they could in fact access both the advantages of reduced dimensionality and bulk materials. By changing the composition and number of layers, the team believe they are on the verge of achieving bottom-up engineering of new, tailored bismuth sulfide based superconducting materials.

EurekaAlert, 12 October 2019

<http://www.eurekaalert.org>

Nanoscale manipulation of light leads to exciting new advancement

2019-10-16

Controlling the interactions between light and matter has been a long-standing ambition for scientists seeking to develop and advance numerous technologies that are fundamental to society. With the boom of nanotechnology in recent years, the nanoscale manipulation of light has become both, a promising pathway to continue this advancement, as well as a unique challenge due to new behaviours that appear when the dimensions of structures become comparable to the wavelength of light. Scientists in the Theoretical Nanophotonics Group at The University of New Mexico's Department of Physics and Astronomy have made an exciting new advancement to this end, in a pioneering research effort titled "Analysis of the Limits of the Near-Field Produced by Nanoparticle Arrays," published recently in the journal, ACS Nano, a top journal in the field of nanotechnology. The group, led by Assistant Professor Alejandro Manjavacas, studied how the optical response of periodic arrays of

UNM researchers find decreasing the density of nanoparticles in ordered arrays produces exceptional field enhancements

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metallic nanostructures can be manipulated to produce strong electric fields in their vicinity. The arrays they studied are composed of silver nanoparticles, tiny spheres of silver that are hundreds of times smaller than the thickness of a human hair, placed in a repeating pattern, though their results apply to nanostructures made of other materials as well. Because of the strong interactions between each of the nanospheres, these systems can be used for different applications, ranging from vivid, high-resolution colour printing to biosensing that could revolutionise healthcare. "This new work will help to advance the many applications of nanostructure arrays by providing fundamental insights into their behaviour," says Manjavacas. "The near-field enhancements we predict could be a game changer for technologies like ultrasensitive biosensing." Manjavacas and his team, composed of Lauren Zundel and Stephen Sanders, both graduate students in the Department of Physics and Astronomy, modelled the optical response of these arrays, finding exciting new results. When periodic arrays of nanostructures are illuminated with light, each of the particles produces a strong response, which, in turn, results in enormous collective behaviours if all of the particles can interact with one another. This happens at certain wavelengths of incident light, which are determined by the interparticle spacing of the array, and can result in electric fields that are thousands, or even tens of thousands, of times that of the light shined on the array. The strength of this field enhancement depends on the geometrical properties of the array, such as the spacing between the nanospheres, as well as the size of the spheres themselves. Completely counterintuitively, Manjavacas and his group found that decreasing the density of nanoparticles in the array, either by increasing the spacing between each of them, or by decreasing their size, produces field enhancements that are not only larger, but extend farther away from the array. "It was really exciting to find out that the key to these huge field enhancements actually lies in making the particles smaller and farther apart," says Zundel of the discovery. "The reason for this is that the interactions between the nanoparticles, and thus the collective response, is strengthened," according to Sanders.

EurekAlert, 11 October 2019

<http://www.eurekalert.org>

The nanoscale radiation detector is a hundred times faster than its predecessors, and can function without interruption

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Radiation detector with the lowest noise in the world boosts quantum work

2019-10-16

Researchers from Aalto University and VTT Technical Research Centre of Finland have built a super-sensitive bolometer, a type of thermal radiation detector. The new radiation detector, made of a gold-palladium mixture makes it easier to measure the strength of electromagnetic radiation in real time. Bolometers are used widely in thermal cameras in the construction industry and in satellites to measure cosmic radiation. The new developments may help bolometers find their way to quantum computers. If the new radiation detector manages to function as well in space as it does in the laboratory, it can also be used to measure cosmic microwave background radiation in space more accurately. 'The new detector is extremely sensitive, and its noise level - how much the signal bounces around the correct value, is only one tenth of the noise of any other bolometer. It is also a hundred times faster than previous low-noise radiation detectors', says Mikko Möttönen, who works as a joint Professor of Quantum Technology at Aalto University and VTT. At first, the research group built a radiation detector out of gold, but it broke in a few weeks, because gold is not compatible with the aluminium which is used as a superconductor in the detector. To overcome this, the group started to use a mixture of gold and palladium, which is very durable but a rare material in bolometers. 'In addition to the material, the secret of the new radiation detector lies in its really small scale. The nanowire running through the middle of the radiation detector is only about a micrometre long, two hundred nanometres wide and a few tens of nanometres thick', says Roope Kokkonen, who studied the bolometer at Aalto University. A bolometer works by measuring the heating effect of radiation. When a bolometer heats up, its electrical characteristics change, and this can be measured with high precision. The smaller the bolometer, the less radiation is required to heat it. 'A small radiation detector has a low heat capacity, so weak radiation provides a stronger signal', Kokkonen explains.

Better protection

'Quantum computers operate in cryostats, extremely cold super-freezers, in which even the smallest amount of excess radiation causes a lot of disturbance. As nanobolometers are very sensitive, they could conveniently measure the level of excess radiation in the cryostat in order to reduce the radiation through better protection', Möttönen says. The bolometer could also be used to read the value of quantum bits, or qubits. However, for this purpose, the bolometer would need to be even faster.

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'In order to read quantum information in superconducting quantum computers several times in a row without it degrading in between, the bolometer would have to be about a hundred times faster', Möttönen says. Microwave amplifiers were also developed in the research. Their task is to strengthen the signal, but they also add noise. The superconducting microwave amplifier developed by VTT succeeded to halve the bolometer noise in comparison to the best commercial amplifier used. The bolometer was developed in the Quantum Computing and Devices research group led by Mikko Möttönen. The article was published in the Communications Physics journal on the 11th of October.

EurekAlert, 11 October 2019

<http://www.eurekalert.org>

New science on cracking leads to self-healing materials

2019-10-16

Cracks in the desert floor appear random to the untrained eye, even beautifully so, but the mathematics governing patterns of dried clay turn out to be predictable -- and useful in designing advanced materials. In a pair of new studies from Princeton University, researchers found that in a large class of common materials, including clay and human skin, individual grains of the material shrink as they dry. The amount and speed of shrinkability varies with the material's physical properties. By harnessing this previously unknown trait, the researchers are able to predict, and even reverse, cracking over time. "The application of materials that spontaneously heal themselves, by leveraging shrinkability, is something I'm very excited about," said Sujit Datta, assistant professor of chemical and biological engineering at Princeton University and lead author on the studies. In the first paper, by balancing conditions just so, the researchers fine-tuned a shrinkable granular material so that it alternately cracked apart in precise clusters, didn't crack at all, or started to crack but closed again. The second paper, due out October 10 in Physical Review Letters, lays out the general physics governing shrinkability -- that is, how each grain changes individually as it interacts with the aggregate, and how this trait impacts the sizes of clusters left after a granular material cracks. Nearly a century of work in this field had assumed all grains retain their size, failing to describe the shrinking of individual grains in such materials. The revelation impacts everything from biomedical treatments to fuel cells to toxic-waste containment. This work was funded in part by the School of Engineering and Applied Science at Princeton University, the Grand Challenges Initiative of the Princeton Environmental Institute, and the

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Princeton Centre for Complex Materials, a Materials Research Science and Engineering Centre supported by NSF grant DMR-1420541.

Science Daily, 10 October 2019

<http://www.sciencedaily.com>

New production technique for high-performance polymer could make for better body armour

2019-10-16

A team of researchers has found a new way to produce a polymer material called PBO, a product known commercially as Zylon that's used in bulletproof vests and other high-performance fabrics. The new approach could be useful in making PBO products that resist degradation, a problem that has plagued PBO-based materials in the past. "We show that using a nanoparticle catalyst, we can produce PBO in more environmentally friendly conditions and without using a chemical that's known to cause these materials to degrade unexpectedly," said Shouheng Sun, a professor of chemistry at Brown University and co-author of a new paper describing the research. "We think this could be a path toward making more robust PBO materials." The research is described in the journal *Matter*. The traditional way to make PBO (its full name is polybenzoxazole) involves the use of polyphosphoric acid (PPA) as both a catalyst for necessary chemical reactions and as a solvent. PPA is a strong, highly corrosive acid and has been pinpointed as the source of PBO degradation. Molecules of the acid become lodged in the polymer chain, leaving the fibres susceptible to degradation when exposed to light and moisture over time. That degradation has led to the recall of PBO-based body armour in the past. Sun's lab at Brown has been working extensively with composite nanoparticle catalysts capable of performing the new reactions required to make PBO, and they do so without using PPA. Catalysing the reactions with nanoparticles would also require less energy and can be performed using renewable formic acid as a hydrogen source. All of that makes the production process greener. Up to now, however, composite nanoparticle catalysts have largely been used to make only small organic molecules. Whether a composite catalyst, which in this case is made from particles of gold and palladium alloys, could be used to catalyse the controlled growth of polymer chains was previously unknown. "The key question we were trying to answer is if we can control the reactions so that we get a good control on the degree of polymerisation," Sun said. "We ultimately showed that we could do that by tuning the composition and size of the alloy nanoparticles in our catalyst." An alloy composition of close to 40 percent

Using a new composite nanoparticle catalyst, researchers have shown they can make degradation-resistant PBO, a polymer used to make body armour and other high-performance fabrics.

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gold and 60 percent palladium was shown to be optimal for controlling the rate of reactions needed to make PBO. Particles around 8-nanometers in size produced a reaction speed that maximized the molecular weight of the PBO polymers. To find out if the PBO was indeed resistant to degradation, the team worked with researchers in Brown's School of Engineering to perform mechanical testing. Those tests showed that the PBO polymers made with the nanoparticle catalyst were more resistant to degradation than commercially available Zylon -- even after being boiled in water and acid for days. The researchers say that future work will focus on generating PBO polymers with higher molecular weights. The polymers generated for this study were significantly lighter than those of the commercial-grade product, which limits their initial mechanical strength. Still, the researchers say, the work is a strong proof-of-concept for the idea that composite nanoparticles can produce degradation-resistant PBO. Jerome Robinson, an assistant professor of chemistry at Brown and a study co-author, noted that the diverse expertise of the Brown research team was critical to the success of this work. "It was really important that we were able to collaborate with engineers and other researchers," Robinson said. "To be able to walk across the street to the School of Engineering and do the mechanical testing was great, and I think we have the right team to carry this research forward."

Science Daily, 9 October 2019

<http://www.sciencedaily.com>

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Aspirin may halve air pollution harms

2019-10-17

A new study is the first to report evidence that nonsteroidal anti-inflammatory drugs (NSAIDs) like aspirin may lessen the adverse effects of air pollution exposure on lung function. The team of researchers from the Columbia Mailman School of Public Health, Harvard Chan School of Public Health, Boston University School of Medicine published their findings in the *American Journal of Respiratory and Critical Care Medicine*. The researchers analysed a subset of data collected from a cohort of 2,280 male veterans from the greater Boston area who were given tests to determine their lung function. The average age of participants was 73 years. The researchers examined the relationship between test results, self-reported NSAID use, and ambient particulate matter (PM) and black carbon in the month preceding the test, while accounting for a variety of factors, including the health status of the subject and whether or not he was a smoker. They found that the use of any NSAID nearly halved of the effect of PM on lung function, with the association consistent across all four weekly air pollution measurements from same-day to 28 days prior to the lung function test. Because most of the people in the study cohort who took NSAIDs used aspirin, the researchers say the modifying effect they observed was mainly from aspirin, but add that effects of non-aspirin NSAIDs are worthy of further exploration. While the mechanism is unknown, the researchers speculate that NSAIDs mitigate inflammation brought about by air pollution. "Our findings suggest that aspirin and other NSAIDs may protect the lungs from short-term spikes in air pollution," says first and corresponding author Xu Gao, PhD, a post-doctoral research scientist in the Department of Environmental Health Sciences at the Columbia Mailman School. "Of course, it is still important to minimise our exposure to air pollution, which is linked to a host of adverse health effects, from cancer to cardiovascular disease." "While environmental policies have made considerable progress toward reducing our overall exposure to air pollution, even in places with low levels of air pollution, short-term spikes are still commonplace," says senior author Andrea Baccarelli, MD, PhD, chair of the Department of Environmental Health Sciences at the Columbia Mailman School. "For this reason, it is important to identify means to minimize those harms." An earlier study by Baccarelli found that B vitamins may also play a role in reducing the health impact of air pollution.

A new study is the first to report evidence that nonsteroidal anti-inflammatory drugs (NSAIDs) like aspirin may lessen the adverse effects of air pollution exposure on lung function.

Science Daily, 2 October 2019

<http://www.sciencedaily.com>

Curiosities

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Environmental toxins impair immune system over multiple generations

2019-10-17

New research shows that maternal exposure to a common and ubiquitous form of industrial pollution can harm the immune system of offspring and that this injury is passed along to subsequent generations, weakening the body's defences against infections such as the influenza virus. The study was led by Paige Lawrence, Ph.D., with the University of Rochester Medical Centre's (URMC) Department of Environmental Medicine and appears in the Cell Press journal *iScience*. The research was conducted in mice, whose immune system function is similar to humans. "The old adage 'you are what you eat' is a touchstone for many aspects of human health," said Lawrence. "But in terms of the body's ability to fight off infections, this study suggests that, to a certain extent, you may also be what your great-grandmother ate." While other studies have shown that environmental exposure to pollutants can have effects on the reproductive, respiratory, and nervous system function across multiple generations, the new research shows for the first time that the immune system is impacted as well. This multigenerational weakening of the immune system could help explain variations that are observed during seasonal and pandemic flu episodes. Annual flu vaccines provide some people more protection than others, and during pandemic flu outbreaks some people get severely ill, while others are able to fight off the infection. While age, virus mutations, and other factors can explain some of this variation, they do not fully account for the diversity of responses to flu infection found in the general population. "When you are infected or receive a flu vaccine, the immune system ramps up production of specific kinds of white blood cells in response," said Lawrence. "The larger the response, the larger the army of white blood cells, enhancing the ability of the body to successfully fight off an infection. Having a smaller size army -- which we see across multiple generations of mice in this study -- means that you're at risk for not fighting the infection as effectively." In the study, researchers exposed pregnant mice to environmentally relevant levels of a chemical called dioxin, which, like polychlorinated biphenyls (PCBs), is a common by-product of industrial production and waste incineration, and is also found in some consumer products. These chemicals find their way into the food system where they are eventually consumed by humans. Dioxins and PCBs bio-accumulate as they move up the food chain and are found in greater concentrations in animal-based food products. The scientists observed the production and function of cytotoxic T cells -- white blood cells that defend the body against foreign pathogens, such as viruses and

New research shows that maternal exposure to a common and ubiquitous form of industrial pollution can harm the immune system of offspring and that this injury is passed along to subsequent generations, weakening the body's defences against infections such as the influenza virus.

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bacteria, and seek out and destroy cells with mutations that could lead to cancer -- was impaired when the mice were infected with influenza A virus. This weakened immune response was observed not only in the offspring of the mice whose mothers were exposed to dioxin, but in the subsequent generations, including as far out as the rodent equivalent of great-grandchildren. The researchers also found that this effect was more pronounced in female mice. The study authors' hypothesis that the exposure to dioxin -- which binds a protein in cells called AHR -- in some fashion alters the transcription of genetic instructions. The exposure itself does not trigger a genetic mutation, rather the cellular machinery by which genes are expressed is altered and this phenomenon is passed onto subsequent generations.

Science Daily, 2 October 2019

<http://www.sciencedaily.com>

No need to cut down red and processed meat for health reasons, controversial findings suggest

2019-10-17

Most people can continue to eat red and processed meat as they do now. A major study led by researchers at McMaster and Dalhousie universities has found cutting back has little impact on health. A panel of international scientists systematically reviewed the evidence and have recommended that most adults should continue to eat their current levels of red and processed meat. The researchers performed four systematic reviews focused on randomised controlled trials and observational studies looking at the impact of red meat and processed meat consumption on cardiometabolic and cancer outcomes. In one review of 12 trials with 54,000 people, the researchers did not find statistically significant or an important association between meat consumption and the risk of heart disease, diabetes or cancer. In three systematic reviews of cohort studies following millions of people, a very small reduction in risk among those who had three fewer servings of red or processed meat a week, but the association was uncertain. The authors also did a fifth systematic review looking at people's attitudes and health-related values around eating red and processed meats. They found people eat meat because they see it as healthy, they like the taste and they are reluctant to change their diet. The five systematic reviews, a recommendation and an editorial on the topic were published in the *Annals of Internal Medicine* today. McMaster professor Gordon Guyatt, chair of the guideline committee, said the research group with a panel of 14 members from seven countries

Contrary to previous advice, five new systematic reviews suggest that most people can continue to eat red and processed meat as they do now. The major studies have found cutting back has little impact on health.

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used a rigorous systematic review methodology, and GRADE methods which rate the certainty of evidence for each outcome, to move from evidence to dietary recommendations to develop their guidelines. "There is a worldwide interest in nutrition and the issue of red meat in particular. People need to be able to make decisions about their own diet based on the best information available," he said. Bradley Johnston, corresponding author on the reviews and guideline, said the research team realises its work is contrary to many current nutritional guidelines. "This is not just another study on red and processed meat, but a series of high-quality systematic reviews resulting in recommendations we think are far more transparent, robust and reliable," said Johnston, who is a part-time associate professor at McMaster and an associate professor of community health and epidemiology at Dalhousie. He added: "We focused exclusively on health outcomes, and did not consider animal welfare or environmental concerns when making our recommendations. "We are however sympathetic to animal welfare and environmental concerns with a number of the guideline panel members having eliminated or reduced their personal red and processed meat intake for these reasons." The accompanying editorial by authors at the Indiana University School of Medicine said: "This is sure to be controversial, but is based on the most comprehensive review of the evidence to date. Because that review is inclusive, those who seek to dispute it will be hard pressed to find appropriate evidence with which to build an argument." Other researchers involved in the work included those from the Netherlands, Poland and Spain, including the Iberoamerican Cochrane and Polish Cochrane centres and the guideline committee included lay people as well as the scientists. Dena Zeraatkar and Mi Ah Han, a visiting professor from South Korea, also had leadership roles on the McMaster team working on the reviews. There were no primary external funding sources.

Science Daily, 30 September 2019

<http://www.sciencedaily.com>

Metabolic discovery may help in fight against heart disease, diabetes

2019-10-17

Researchers at Cornell University have uncovered a key step in how the human body metabolises sugar, which could lead to better treatment and prevention of heart disease, obesity and Type 2 diabetes. Martha S. Field, assistant professor of nutritional sciences, has further characterized the human metabolic pathway by identifying two enzymes that convert

Researchers at Cornell University have uncovered a key step in how the human body metabolises sugar, which could lead to better treatment and prevention of heart disease, obesity and Type 2 diabetes.

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the sugar erythrose into erythritol. This reaction represents the final step in the conversion of glucose to erythritol in human metabolism. "Your normal diet contains fruits, vegetables and beans and you will inevitably ingest sugar alcohols," said Field, who is the senior author on the paper. Knowing how the body makes sugar alcohols opens up an array of new possibilities for treatment and prevention of heart disease and Type 2 diabetes. Previous research had shown that elevated levels of erythritol in blood plasma are associated with future increased fat storage and weight gain, so erythritol serves as a biomarker for weight gain, possible heart disease and diabetes. "That raises the question: Are elevated levels of erythritol in plasma a causal factor in weight gain, and, if so, could this newly discovered metabolism be a path toward intervention in our fight to combat obesity?" she said. The paper, "Unexpected Roles for ADH1 and SORD in Catalyzing the Final Step of Erythritol Biosynthesis," was published in the *Journal of Biological Chemistry*.

Phys.org, 2 October 2019

<http://phys.org>

In the Sea, Not All Plastic Lasts Forever

2019-10-17

A major component of ocean pollution is less devastating and more manageable than usually portrayed, according to a scientific team at the Woods Hole Oceanographic Institution on Cape Cod, Mass., and the Massachusetts Institute of Technology. Previous studies, including one last year by the United Nations Environment Program, have estimated that polystyrene, a ubiquitous plastic found in trash, could take thousands of years to degrade, making it nearly eternal. But in a new paper, five scientists found that sunlight can degrade polystyrene in centuries or even decades. "Policymakers generally assume that polystyrene lasts forever," Collin P. Ward, a marine chemist at Woods Hole and the study's lead author said in a statement on Thursday. "That's part of the justification for writing policy that bans it." A main rationale for his team's study, he added, "was to understand if polystyrene actually does last forever." Polystyrene, one form of which often carries the brand name Styrofoam, is used to manufacture single-use cups, straws, yogurt containers, disposable razors, plastic tableware, packing materials and many other everyday items, which are discarded daily by the ton. Much of it ends up in the ocean. A swirling mass of throwaway junk known as the Great Pacific Garbage Patch, located between Hawaii and California, is estimated to occupy an area roughly twice the size of Texas. Many nations, companies, citizen

Polystyrene, a common ocean pollutant, decomposes in sunlight much faster than thought, a new study finds.

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groups and ocean institutes, as well as United Nations programs, have worked hard to ban single-use items and better regulate their disposal. "We're not calling the concerns or the actions wrong," Christopher M. Reddy, a marine chemist at Woods Hole and another author on the study, said in an interview. "We just have a new thread to add and we think it's significant." The study was published in the journal *Environmental Science and Technology Letters*, a publication of the American Chemical Society, a scientific group based in Washington. The research was funded by the Andrew W. Mellon Foundation, the Frank and Lisina Hoch Endowed Fund at Woods Hole, the Stanley Watson Chair in Oceanography at Woods Hole and a graduate research fellowship from the National Science Foundation, a federal agency. It's common knowledge that sunlight can cause plastics to weather. "Just look at plastic playground toys, park benches, or lawn chairs, which can rapidly become sun-bleached," Dr. Ward noted in the Woods Hole statement. The new study demonstrated that sunlight does even more, breaking down polystyrene into basic chemical units of organic carbon, which dissolves in seawater, and trace amounts of carbon dioxide, at levels far too low to play a role in climate change. By the end of this process the plastic has effectively disappeared from the environment. In the paper, the researchers described the study as "the first direct evidence" of how of sunlight can break down polystyrene in the environment into its basic chemical building blocks. Previous studies focused largely on the degrading effect of microbes. That made sense, Dr. Reddy, said, because microbes can eat many forms of organic carbon. But, he added, the chemical structure of polystyrene — particularly its backbone of large, ringed molecules — made the plastic unappetizing to decomposing bacteria. However, that same molecular backbone turned out to be "the perfect shape and size to catch certain frequencies of sunlight," Dr. Reddy said. And the energy that is absorbed breaks the chemical bonds. In the lab, the researchers tested five different samples of polystyrene to see if sunlight could tear them apart. The team submerged each sample in a sealed glass container of water and exposed it to light from a solar simulator, a special lamp that mimics the frequencies of sunlight. The scientists then studied the water for evidence of breakdown products. With sophisticated tools of detection and analysis, Dr. Ward and his colleagues then traced the origin of the loose materials back to the polystyrene. "We used multiple methods, and they all pointed to the same outcome," he said in the statement: sunlight can turn polystyrene from a solid material back into basic chemical units. The study also found that additives to polystyrene, which can determine its colour, flexibility and other physical features, can slow or speed decomposition. In a joint interview, Dr. Ward and Dr. Reddy said that one remaining puzzle concerns

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the exact nature of the dissolved organic carbon, which is too small in size to form visible particles. "We feel confident we can figure it out," Dr. Reddy said. The research team included Cassia J. Armstrong and Julia H. Jackson of Woods Hole, and Anna N. Walsh of Woods Hole and the Massachusetts Institute of Technology. In the paper, the authors noted that the newly identified means of polystyrene breakdown "should be incorporated into global fate models" for plastics and help frame policy. None of the current inventories "account for degradation," Dr. Ward noted. In the interview, he and Dr. Reddy suggested that the new finding might eventually shed light on one of the outstanding mysteries of ocean pollution: that more than 99 percent of the plastic that should be identifiable is missing. Expeditions that have specifically looked for evidence of the calculated mass of plastic have repeatedly come up with surprisingly low returns. In time, Dr. Ward said, the accelerating search for the breakdown products of polystyrene and other kinds of oceanic pollution may let scientists "balance the books."

New York Times, 11 October 2019

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

California bans hotels from using tiny plastic bottles

2019-10-17

You know how in the song "Hotel California" the Eagles sing how it's such a lovely place? Well, California has just figured out how to make hotel rooms even more lovely. Back in April, members of the state assembly voted to replace small plastic bottles with dispensers or bottles larger than 12 ounces. Now Governor Gavin Newsom announced he has signed the bill banning hotels from putting those tiny plastic bottles of shampoo, conditioner, or soap (aka souvenirs) in hotel rooms. The law takes effect in 2023 for hotels with more than 50 rooms and 2024 for hotels with less than 50 rooms. Violators could be fined \$500 for a first offense and \$2,000 for subsequent violations, the AP reports. While some travellers may want to stock up now, this, of course, does not mean that hotels will stop offering guests shampoo, conditioner, and lotion. It just means that intrepid travellers will have to figure out how to use refillable dispensers that are attached to the wall or tackle larger bottles. (It's just like at home, guys!) While guests who love stocking up on those travel-size bottles of shampoo at hotels will be sad at the loss of the freebie, the sense of helping the planet by cutting down on plastic waste surely makes up for the loss. California's new law follows similar actions by some of the world's largest hotel chains eager to look like they are going green. Marriott International, which owns Hilton, Marriott, and a bazillion other brands,

California bans hotels from using tiny plastic bottles

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plans to stop using small plastic bottles in its hotel rooms by December 2020. IHG, the company behind Holiday Inn, Kimpton, and more, said it will eliminate about 200 million small bottles by 2021. Last year, Disney said it was getting rid of small plastic shampoo bottles at its resorts and on cruise ships. Now hotels don't have a choice in the matter, because California is determined to keep the world a lovely place.

Fast Company, 10 October 2019

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

New EPA Lead Standards Would Slow Replacement of Dangerous Pipes

2019-10-17

The Trump administration recently proposed new regulations on lead and copper in drinking water, updating a nearly 30-year-old rule that may have contributed to the lead-tainted water crisis in Flint, Mich., that began in 2015. The draft plan, announced by the Environmental Protection Agency administrator, Andrew Wheeler, at a news conference in Green Bay, Wis., includes some provisions designed to strengthen oversight of lead in drinking water. But it skips a pricey safety proposal advocated by public health groups and water utilities: the immediate replacement of six million lead pipes that connect homes to main water pipes. The proposed new rule would also more than double the amount of time allotted to replace lead pipes in water systems that contain high levels of lead. Mr. Wheeler framed the new regulations as a major step forward in protecting water supplies. "The water sector has known for years and years that the regulations governing lead and copper in our water need to be improved, but administration after administration has failed to get it done," Mr. Wheeler said, noting that the standards were last updated in 1991. "We are delivering on the president's commitment that all Americans have access to clean and safe drinking water." Although the new proposal would extend the timetable for replacing lead pipes, it would include new requirements that schools and day care centres be tested for lead, and, if elevated lead levels are found, customers would have to be told within 24 hours, not the current standard of 30 days. It would also require water utilities to conduct inventories of their lead service pipes and publicly report their locations. Environmental activists said those moves forward would not make up for the relaxation of standards in other areas. The slower timetable for the replacement of lead pipes is a "huge weakening change that will swallow up the few small improvements in the proposal," wrote Erik D. Olson, an expert in drinking water policy at the Natural

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Resources Defence Council, an advocacy group, in an email. The new rule proposes changing a key element of the current rules, which requires that a water system that is found to contain lead levels higher than 15 parts per billion must replace 7 percent of its lead service lines each year for as long as the lead levels exceed that measurement. The new proposal would instead require water systems with those lead levels to replace 3 percent of lead service lines each year. Mr. Olson's group estimated that the loosening of standards could extend the length of time needed to replace dangerous lead water pipes from 13 years to 33 years. "It means that another generation of American kids will be exposed to dangerous levels of lead from their drinking water," he said. President Trump has made the rollback of environmental regulations a hallmark of his administration, with initiatives to weaken or erase dozens of E.P.A. regulations on climate change, chemical pollution and water quality. At the same time, he has also called attention to the concerns about lead in water that were ignited by the discovery of high levels of lead and other contaminants that poisoned Flint's drinking water for more than a year. He also frequently emphasises his desire to promote "crystal-clear water." During a 2016 campaign stop in Flint, Mr. Trump said: "It used to be, cars were made in Flint and you couldn't drink the water in Mexico. Now, the cars are made in Mexico and you cannot drink the water in Flint." "We shouldn't allow it to happen," he said. Mr. Trump's first EPA administrator, Scott Pruitt, announced that he would prioritise removing lead from water, saying that the agency was declaring "war on lead." Mr. Pruitt stepped down amid a corruption scandal in 2017. A 2018 report from the EPA's Office of Inspector General said management weaknesses had hobbled the agency's response to the Flint crisis and that federal officials should have taken stronger action to correct repeated blunders by state regulators. Mr. Pruitt's successor, Mr. Wheeler, announcing the plan, highlighted it as part of Children's Health Month, which falls in October. But for Flint advocates, it fell well short. "We need urgent action and bold investments to rebuild America's water infrastructure, not weakened policies that fail to protect the health and safety of our citizens," said Representative Dan Kildee, Democrat of Michigan, who was born and raised in Flint and represents it in Congress. "The Flint water crisis should have taught policymakers at all levels of government that we must get serious about removing lead from our water systems. Yet the president's policies have continuously put special corporate interests ahead of public health." The draft plan will

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be open for public comment for 60 days, and Mr. Wheeler said that he expected to complete the final plan next summer.

New York Times, 10 October 2019

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

How Vaping Nicotine Can Affect A Teenage Brain

2019-10-17

The link between vaping and severe lung problems is getting a lot of attention. But scientists say they're also worried about vaping's effect on teenage brains. "Unfortunately, the brain problems and challenges may be things that we see later on down the road," says Nii Addy, associate professor of psychiatry and cellular and molecular physiology at Yale School of Medicine. Potential problems include attention disorders like ADHD, impulse control issues and susceptibility to substance abuse. There's no easy way to study precisely what nicotine is doing in a teenager's brain. But research on young animals shows that nicotine can interfere with processes that are critical to memory, learning, focus, impulse control and brain development. "It's unfortunate that a whole generation of teenagers are basically guinea pigs for the effects of nicotine in the brain," says Frances Leslie, professor of pharmaceutical sciences at the University of California, Irvine. Leslie says the problem is that nicotine mimics acetylcholine, an important chemical messenger in the brain. So, nicotine is able to fool brain cells that have something called a nicotinic receptor. Unfortunately, she says, "those parts of the brain that are actively maturing during adolescence are being actively controlled by nicotinic receptors." Nicotine also acts on the brain's dopamine system, which plays a role in desire, pleasure, reward and impulse control. It's still not clear what tweaking the dopamine system does to the brain of an adolescent human. But in young mice, Leslie says, the result is alarming. "A very brief, low-dose exposure to nicotine in early adolescence increases the rewarding properties of other drugs, including alcohol, cocaine, methamphetamine — and these are long-term changes," she says. Of course, nicotine-vaping products also contain lots of other substances, including flavours like bubblegum and pink lemonade. And Addy wonders whether these flavours might offer a dopamine kick of their own. "If both nicotine and flavours are both acting on this same dopamine system in the brain," he says, "is that somehow facilitating and making it more likely that people will take products that have both flavours and nicotine?" So, Addy and a team of researchers studied rats that drank plain and flavoured liquids containing nicotine. "What we found is that the sweet flavours can

How does nicotine in e-cigarettes affect young brains? Researchers are teasing out answers. Research on young mice and rats shows how nicotine hijacks brain systems involved in learning, memory, impulse control and addiction.

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make the nicotine more palatable in the oral cavity," he says, "but also act in the brain to increase nicotine taking." This effect is especially troubling in a teenage brain, Addy says, which is more sensitive than an adult brain to rewards. Animal research by another Yale University scientist suggests that vaping during adolescence can lead to long-term brain changes, like attention deficit hyperactivity disorder, Addy says. "If there's exposure to nicotine early on, that can influence attentional processes later in life," he says.

So, what might help reduce teen vaping?

One approach is to ban flavoured products, something that was proposed by the Trump administration in September. And if the ban happens, it could reduce the number of new vapers, says Janet Audrain-McGovern, a psychologist at the University of Pennsylvania. Research shows that "if the first e-cigarette that you used was flavoured, then you're more likely to go on and use an e-cigarette again," Audrain-McGovern says. Another promising approach is to make nicotine-vaping products more expensive. When taxes forced up the price of tobacco products, Audrain-McGovern says, the number of young customers declined. Finally, Audrain-McGovern thinks it should be harder for teenagers to buy vaping products online. At the moment, many vaping websites simply ask visitors if they are underage before allowing a sale. "I don't think it's that difficult to click the box that you're 18 or you're 21 and, if you have a credit card, to get those products," Audrain-McGovern says. In August, Juul Labs launched a program that offers incentives to retailers that implement an age-verification system for customers. But some measures that helped discourage smoking probably won't work as well against vaping, Audrain-McGovern says. For example, studies suggest that physically active teens are less likely than their peers to smoke but no less likely to vape. Another challenge is that it's hard for scientists and regulators to keep up with the rapid pace of change in the vaping world. "Teens who maybe four years ago were using predominately vape pens are now using Juul and some of the pod mods," Audrain-McGovern says. And those newer products are designed to deliver higher levels of nicotine to the brain. More nicotine makes the products more addictive.

NPR, 10 October 2019

www.npr.org

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Fast food increases exposure to a ‘forever chemical’ called PFAS

2019-10-17

From the calories to the additives, there are many reasons fast food is unhealthy, but a new study of a toxic chemical called PFAS reveals the packaging that contains it may also be doing harm to our bodies. PFAS, or per- and polyfluoroalkyl substances, refers to a class of chemicals used abundantly in common household items to make objects water or fire resistant. A new study published in the journal *Environmental Health Perspectives* looked at levels of PFAS in people who ate fast food versus those who ate homecooked meals. Using data from the CDC’s National Health and Nutrition Examination Survey (NHNES), a comprehensive and regularly maintained dataset, researchers looked at PFAS in blood samples collected from more than 10,000 people from 2003 to 2014. Five commonly used types of PFAS were found in the blood of around 70 percent of those surveyed. The survey also questioned people on how often they had eaten fast food over the past 24 hours, week, and month. After a 24-hour period, those who had eaten fast food consistently showed an increase in the amount of PFAS in their blood. Unlike other common contaminants, which pass through the human body quickly, PFAS can linger for years, meaning that regular fast food consumption adds more PFAS to the system, scientists say. It’s unclear at what threshold PFAS begins to take a toll on human health. A number of studies have linked the chemical to cancer, thyroid disorders, hormonal changes, and weight gain. Washington state and the city of San Francisco have both passed legislation to limit the use of PFAS in food containers. A 2017 study conducted on 400 fast food wrappers and containers found that more than half of bread and dessert wrappers contained the fluorine compound. It was also present in nearly 40 percent of sandwich and burger wrappers, and 20 percent of paperboard, the stiff containers used to hold french fries. The chemical is commonly added as a barrier to packaging because it resists water and grease, making food more portable. It’s those same tough properties that concern those who study the effects PFAS might have on the body. “We’re still learning about health effects that may occur at lower and lower levels of exposure,” says study author Laurel Schaidler, an environmental engineer and chemist at the Silent Spring Institute. “Food is just one source of exposure,” she says, noting that PFAS is commonly found in paint, carpeting and clothing. “At this point I would say it makes sense for people to try to reduce their exposure, [but] we’re not able to link a certain rate of fast food intake with harmful health effects.” She says the regular ingestion of PFAS may have

Used in fast food packaging, the long-lasting chemicals can seep into food—and build up in our bodies.

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cumulative effects on human health. PFAS is so notorious for its inability to break down that the compounds in it are often referred to as “forever chemicals.” Where other contaminants like bisphenol-A clear from the body in a number of hours, even the weakest PFAS can remain for months.

Why we don't know what we don't know

Demonstrating a measurable health impact from eating five PFAS-contaminated cheeseburgers a week versus just one is difficult because of how ubiquitous the chemicals are. To see the impact a chemical might have, scientists first rely on studies in which lab animals like rats and mice are exposed to varying degrees of a certain toxin. Those animal studies have shown PFAS exposure consistently results in damage to liver, kidneys, and the immune system. Tumours are also common and some strains of PFAS show signs of causing cancer and thyroid disruption. Scientists also look for trends in diseases at the population level. For this, large study groups of thousands of people are needed to control for PFAS alone. It took dozens of population studies to show that early-in-life lead exposure could impact cognitive performance later in life, a finding that helped set stricter regulations on how profusely lead could be used. Scientists have yet to reach a consensus about bisphenol-A (or BPA), a chemical the FDA deems safe that some research indicates could be an endocrine disruptor.

Window of exposure

The amount of exposure an individual has to PFAS can vary widely, says Schaidler, making it difficult for scientists to construct a historical snapshot of when they consumed the contaminate. “There are windows of susceptibility for certain diseases, but it's very difficult when studying adults to go back and recreate their exposures,” she says. Rolf Halden is the director of Arizona State University's Centre for Environmental Health Engineering. He says the study's data show a clear link between fast food and PFAS consumption, but he worries more about the overall abundance of PFAS in consumer goods. “I am less interested in the aspect of popcorn and fast food and more fascinated that we see [that] 70 percent of the U.S. population is getting exposed to chemicals that cannot degrade,” he says. In addition to the unknown health consequences of consuming food contaminated with PFAS, Schaidler says consumers should be concerned about the impact PFAS has on the environment when it's discarded. In unlined landfills, PFAS can leach into groundwater. Earlier this month, a report by the Environmental Working Group found that tap water going to 7.5 million Californians tested positive for the contaminant. In addition to Washington and San Francisco, California, New York, and Rhode Island

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have each proposed restrictions on PFAS. Last month, Denmark was the first country to ban it from food packaging. Of the study results, Halden adds: "It would be naive to think what's here is the complete exposure to PFAS. That [total exposure] is much larger and still growing more complex."

National Geographic, 10 October 2019

www.nationalgeographic.com.au

Here's How Eating 5-Day-Old Pasta or Rice Can Actually Kill You

2019-10-17

If meat is left out on the counter for too long, we all know we need to throw it out. But what about rice or pasta? Although that carby goodness might seem harmless after sitting on the bench for a bit, you'll probably think twice about it once you hear about the bacterium *Bacillus cereus*. It's not a particularly rare germ. *B. cereus* will happily live wherever it can – soil, food, or in the gut. "The known natural habitats of *B. cereus* are wide-ranging, including soil, animals, insects, dust and plants," Anukriti Mathur, a biotechnology researcher at the Australian National University, explained to Science Alert. "The bacteria will reproduce by utilising the nutrients from the food products [...] including rice, dairy products, spices, dried foods and vegetables." Some strains of this bacterium are helpful for probiotics, but others can give you a nasty bout of food poisoning if given the ability to grow and proliferate – such as when you store food in the wrong conditions. The worst scenarios can even bring death. In 2005, one such case was recorded in the *Journal of Clinical Microbiology* – five children in one family got sick from eating four-day-old pasta salad. According to the case study, pasta salad was prepared on a Friday, taken to a picnic on Saturday. After coming back from the picnic, it was stored in the fridge until Monday evening, when the kids were fed it for dinner. That night the children began vomiting, and were taken to hospital. Tragically, the youngest child died; another suffered from liver failure but survived, and the others had less severe food poisoning and could be treated with fluids. "*B. cereus* is a well-known cause of food-borne illness, but infection with this organism is not commonly reported because of its usually mild symptoms," the researchers explain. "A fatal case due to liver failure after the consumption of pasta salad is described and demonstrates the possible severity." While these deaths are mercifully rare, they have been recorded in the literature more than once. Another case published in 2011 tells the story of a 20-year-old student in Belgium who would prep his meals for the week – on that fateful occasion, it was spaghetti

If meat is left out on the counter for too long, we all know we need to throw it out.

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with tomato sauce. He'd cooked the pasta five days earlier and would heat it up together with sauce. That day, he accidentally left his food on the kitchen bench for an unspecified amount of time. After diarrhoea, abdominal pain, and profuse vomiting, he died later that night. A reply to this case study highlighted two more cases of young people who suffered liver failure and died from *B. cereus* - an 11-year-old who died after eating Chinese noodles, and a 17-year-old who died after eating four-day-old spaghetti. Now, before you swear off pasta for life, we need to stress that most people who get sick with *B. cereus* do not end up having liver failure. Usually, it's a pretty mild case of food poisoning. "It is important to note that *B. cereus* can cause severe and deadly conditions, such as sepsis, in immunocompromised people, infants, the elderly, and pregnant women," says Mathur. "[Most] affected individuals get better over time without any treatment. These individuals do not go see a doctor to receive a diagnosis," and therefore they are under reported.

But how can it cause such severe food poisoning, and is there anything we can do? *B. cereus* has a bad habit of secreting dangerous toxins in food. Some of these toxins are really hard to kill with the heat your regular microwave would deliver. For example, one of the toxins which causes vomiting in humans (called an emetic toxin), can withstand 121°C (250°F) for 90 minutes. And that's not the only toxin you'll find in its arsenal. "Our immune system recognises a toxin [haemolysin BL] secreted by *B. cereus*, which leads to an inflammatory response," Mathur explains, talking about a research study on the bacterium she co-authored last year. "Our research study shows that the toxin targets and punches holes in the cell, causing cell death and inflammation." Her team also identified two ways we can help the body neutralise the effect of haemolysin BL, therefore stopping the death march of *B. cereus*. The methods involve either blocking the activity of the toxin, or reducing the inflammation caused by it. Although their approach is still in the early stages of research, the team hopes that these techniques could even be used in other toxin-producing bacteria, such as *E. coli*. But most importantly – keep your food in the fridge and practice good kitchen hygiene. "It is important for people to wash their hands properly and prepare food according to safety guidelines," says Mathur. "Further, heating left-over food properly will destroy most bacteria and their toxins." The research has been published in *Nature Microbiology*.

Science Alert, 12 October 2019

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

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Here's What Would Happen if All The Ice on Earth Melted Overnight

2019-10-17

Ninety-nine per cent of all freshwater ice on Earth is sitting on top of Greenland and Antarctica, and each year, a little more of it melts into the ocean. Normally, it would take hundreds to thousands of years for it all to melt away. But what if something happened that caused a massive global melt overnight? As we slept, sea levels would rise by a whopping 66 meters. Coastal cities like New York, Shanghai, and London would drown in the apocalyptic mass flood, forcing up to 40 percent of the world's population out of their homes. While all this chaos ensues above-ground, something equally sinister is happening below. All that rising saltwater will infiltrate groundwater reserves farther inland, forcing its way into nearby freshwater aquifers. You know, the ones that supply our drinking water, irrigation systems, and power-plant cooling systems? All those aquifers would be destroyed. Not good. On top of that, the ice on Greenland and Antarctica is made of freshwater, so when it melts, that's about 69 percent of the world's freshwater supply that's going straight into the oceans. This will wreak havoc on our ocean currents and weather patterns. Take the Gulf Stream, for example. It's a strong ocean current that brings warm air to northern Europe and relies on dense, salty water from the Arctic in order to function. But a flood of freshwater would dilute the current and could weaken or even stop it altogether. Without that warm air, temperatures in northern Europe would plummet, and that could spawn a mini ice age, according to some experts. That's not even the worst of it. Take a look at what will happen when that last 1 percent of freshwater ice that's not part of Greenland or Antarctica thaws. Some of that 1 percent is sitting in glaciers farther inland. The Himalayan glaciers specifically pose one of the largest threats because of what's trapped inside: toxic chemicals like dichlorodiphenyltrichloroethane, or DDT. Scientists discovered that glaciers like this can store these chemicals for decades. But as they thaw, those glaciers release the chemicals into rivers, lakes, and groundwater reserves, poisoning each one as they go. The rest of that 1 percent is hanging out underground, mostly in the Arctic tundra, as something called permafrost. Permafrost is organic matter that's been frozen in the ground for two-plus years. Now, one of the most immediate problems with thawing permafrost would be mercury poisoning. That's right: There are an estimated 15 million gallons of mercury stored up in the Arctic permafrost. That's almost equal to the amount of mercury everywhere else on Earth. On top of that, the organic matter in permafrost is a tasty meal for microorganisms. After they digest it all, they fart out two of the

Ninety-nine per cent of all freshwater ice on Earth is sitting on top of Greenland and Antarctica, and each year, a little more of it melts into the ocean.

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most potent greenhouse gases out there, carbon dioxide and methane. Scientists estimate this could double the current levels of greenhouse gases in the atmosphere, and potentially cause global temperatures to rise by 3.5 degrees Celsius compared to today. That might not sound like much, but say goodbye to that mini European ice age, and even rivers and lakes around the world. They'd evaporate from the higher temperatures and cause mass droughts and desert-like climates. And all that extra water vapour in the atmosphere would fuel more frequent and stronger storms, floods, and hurricanes. So, all of that newly established coastline on the eastern US would be one of the last places you'd want to live. Instead, there would be mass migrations to Canada, Alaska, the Arctic, and even what's left of the Antarctic. And you're right, this is probably never going to happen. After all, there's enough ice right now to cover the entire continent of North America in a sheet a mile thick. So, the next time you hear about record-breaking heat or ultra-powerful hurricanes, at least you know that it could be worse. But scientists estimate that if we don't take action and global temperatures increase by just 1 degree Celsius, the effects of climate change we already see today will be irreversible. So yes, it could be worse, and it will be if we're not careful.

Science Alert, 12 October 2019

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

Your heartbeat may shape how likely you are to have a car crash

2019-10-17

Drivers may be more likely to crash if an obstacle appears at the same time as a heartbeat. To investigate how the beat of our hearts influences our reaction times, Sarah Garfinkel at the University of Sussex, UK, and her colleagues designed a virtual reality driving game. While participants were driving, obstacles would appear in the road, either in time with a heartbeat or between beats. When objects coincided with heartbeats, drivers' reaction times were slower and they were more likely to crash. Garfinkel presented the results at New Scientist Live in London, where she discussed the possible effect of systoles – the squeezing of the heart ventricles that occurs in the middle of a heartbeat – on driving. "If you're driving and you're in a highly aroused state and your heart is beating strong and fast, you will have more cardiac systoles, and that is going to impair your reaction time and ability to avoid objects," she said. The research adds to a series of studies showing that systoles have an inhibitory effect on the brain's ability to process stimuli. For example, painful stimuli are perceived

Drivers may be more likely to crash if an obstacle appears at the same time as a heartbeat.

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as less painful if they coincide with a heartbeat. Garfinkel previously found an effect on memory, too. If participants are shown words either in time with heartbeats or between beats, they are more likely to forget words that appeared on a beat when tested later. These effects are thought to be mediated by baroreceptors; blood pressure sensors located in the major arteries. These receptors fire in bursts every time the heart contracts, but as well as helping to regulate blood pressure, they appear to have an inhibitory effect on certain cognitive functions. According to this hypothesis, "you activate the baroreceptors and you inhibit the brain activity within the cardiac cycle," says Christopher Ring at the University of Birmingham, UK. Some studies have detected fluctuations in electrical activity in the brain according to the phase of the cardiac cycle. But our heartbeats may also enhance some neural functions. For example, Garfinkel has found that fearful stimuli are perceived to be more frightening if they appear during a heartbeat. "There seem to be 'better' and 'worse' cardiac phases for sensory processing. It's unclear, however, whether that's a bug or a feature," says Michael Gaebler at the Max Planck Institute for Human Cognitive and Brain Sciences in Germany. Noise in the brain may hamper processing of stimuli, or the brain may make use of rhythmic fluctuations in cardiac activity to optimise sensory processing, he says. Sensory processing is just one step in a complex cascade of events while driving, says Gaebler. "My guess would be that while cardiac-related perceptual fluctuations may contribute [to accidents], a lot of other things have to go wrong to lead to an accident."

New Scientist, 12 October 2019

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

Will a ban on snacking on public transport really help combat obesity?

2019-10-17

Eating and drinking while on urban buses, trams and trains should be banned to help address the rising rate of child obesity, according to a report published by the outgoing chief medical officer for England, Sally Davies. It isn't the only recommendation made in the report. There are 49 in total, including less controversial ones, such as a call for more research on why people in the West are growing fatter, on average. But the ban on snacking while travelling has attracted the most attention. Although there would be exceptions for drinking water, for breastfeeding and for anyone with a medical need to eat, it would apply to adults as well as children. There have been complaints on social media that it would

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make things harder for those with busy lives who need to refuel while travelling to work, for instance. So, what is the supporting evidence? In the report, the travel snack ban comes as part of a set of strategies aimed at letting children grow up “free from marketing, signals and incentives to consume unhealthy food and drinks”. The other proposals in this group, such as further restrictions on junk food adverts, at least have some clear logic behind how they would achieve this goal, whether or not you agree with them. But the link between obesity and a habit of eating while travelling is less clear, and Davies doesn’t provide much explanation. Her idea seems to have come out of the blue. It is fair to say that most people eating while on public transport probably aren’t having a lovingly prepared salad – we are more likely to be scoffing a chocolate bar or a packet of crisps. As Davies points out, sweet and savoury snacks are thought to be a particular contributor to obesity. Portion sizes have been rising on the whole, especially in food eaten outside the home. The average size of a family pack of crisps, for instance, has risen by 50 per cent in the past 20 years, from 100 to 150 grams. Other studies have shown that children respond to unhealthy food being advertised on television by eating more of it, and fail to compensate by eating less at subsequent meals. “This will, over time, lead to weight gain,” says Davies. Perhaps the aim of the ban is simply to whittle away at the opportunities we have for cramming in the calories, or maybe it is to stop children seeing the adults around them enjoying these foods. But the report does have the whiff of a move away from gently nudging people into eating less unhealthy food to physically stopping them from doing so. It would chime with other more combative anti-obesity policies coming into vogue, such as banning snack vending machines in hospitals and restricting the number of takeaway shops allowed to operate in any given area. We can’t find out more about the evidence to support the travel snack ban, as Davies has recently stepped down from her position as chief medical officer and the relevant government press office says this means it doesn’t have to answer any questions about it. That isn’t good enough. True, Davies’s recommendations won’t automatically be followed, but the report was commissioned by UK health secretary Matt Hancock earlier this year and has become an official public document that is likely to influence future health policy. The public has the right to know how well supported it is by facts. The rising rate of obesity has been called, with some justification, the biggest public health problem currently faced by Western countries. Other

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anti-obesity initiatives have failed before. It is vital that any further steps we take to combat it are firmly grounded in evidence.

New Scientist, 10 October 2019

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

Healthier diet may help lift depression symptoms

2019-10-17

Young adults who eat poorly and feel blue might be able to perk themselves up by switching to a healthier diet, a small study suggests. In a randomised trial, men and women aged 17-35 in Australia who switched to a healthier diet had fewer depression symptoms after three weeks. And those who kept up the healthy eating for three months continued to feel better than at the start, researchers report in the journal PLoS ONE. "This has 100% reach (since everybody needs to eat), is more cost effective than medications, and is an aspect of treatment that individuals can control themselves," said lead study author Heather Francis of Macquarie University in Sydney, Australia. "This raises the possibility that making changes to diet can act as a therapy to improve depression symptoms," she told Reuters Health by email. Francis and colleagues studied 76 people who scored high on two depression and anxiety scales - indicating moderate or high depression symptoms - and who also scored high on a questionnaire about dietary fat and sugar consumption. Participants were randomly assigned to a diet-change group or a habitual-diet group for three weeks. The diet-change group received instructions from a registered dietician through a 13-minute video, which they could re-watch as needed. The video provided dietary guidance based on the 2003 Australian Guide to Healthy Eating as well as the Mediterranean Diet eating pattern. This included instructions to increase intake of vegetables to five servings per day, fruits to two or three servings per day, whole grains to three servings per day, lean protein to three servings per day, unsweetened dairy to three servings per day and fish to three servings per week. The program also recommended daily consumption of three tablespoons of nuts and seeds, two tablespoons of olive oil, and one teaspoon each of turmeric and cinnamon. Participants were also told to decrease refined carbohydrates, sugars, fatty or processed meats and soft drinks. The diet-change group also received sample meal plans and recipes, as well as a box of food items, including olive oil, natural nut butter, walnuts, almonds, sunflower seeds, cinnamon and turmeric. They were told to keep their shopping receipts to be reimbursed with a \$60 gift card. After three weeks, average depression scores had dropped into

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the normal range in the diet-change group, while remaining elevated or severe in the habitual-diet group - and the improvements were maintained three months later, the research team reports. "Depression is a whole-body disorder, not just a disorder of the brain," Francis said. "Depression is associated with a chronic inflammatory response, but what is the source of this inflammation? (Earlier research has shown) that poor diet both increases systemic inflammation and is also a risk factor for depression." Still, researchers should be careful about suggesting cause-and-effect relationships in studies like these, said Marc Molendijk of Leiden University in The Netherlands, who wasn't involved in the research. Molendijk, who studies dietary habits and mental health and also serves on the PLoS ONE editorial board, cautioned against giving the results too much weight. "There probably are expectancy effects at play, leading to a placebo effect," he said by email. "It's also a bad message to depressed people, as they may attribute the responsibility for their depression to themselves." On the other hand, noted Joseph Firth of the University of Manchester in the UK, "the age-old saying, 'Healthy body, healthy mind' really is true."

Reuters Health, 11 October 2019

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

Why tomato puree might improve male fertility

2019-10-17

Lycopene - a nutrient found in tomatoes - may boost sperm quality, a study has suggested. Healthy men who took the equivalent of two tablespoons of (concentrated) tomato puree a day as a supplement were found to have better quality sperm. Male infertility affects up to half of couples who cannot conceive. Fertility experts said more studies were needed involving men known to have fertility problems. NHS advice for men experiencing fertility problems currently suggests they adopt a healthy lifestyle and wear loose-fitting underwear. It also suggests reducing stress as much as possible and ensuring they have regular sex around the time their partner ovulates to maximise the chances of conception. But the idea that certain nutrients could boost male fertility has been gaining ground for some time. Lycopene, like vitamin E and zinc which have been the focus of previous research, is an antioxidant which means it prevents oxidation in cells, and therefore damage. It has been linked to other health benefits, including reducing the risk of heart disease and some cancers. The Sheffield team say they used a lactycopene supplement because the nutrient in food can be harder for the body

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to absorb and so they could be confident each man received the same amount each day. The men would have needed to eat 2kg of cooked tomatoes each day to get the equivalent dose of lycopene.

'Very encouraging'

In the 12-week trial, which was partly funded by the company which makes the supplement, 60 men were randomly selected to take 14 milligrams of lactolycopene per day or a dummy pill. Their sperm was tested at the start, at six weeks and at the end of the study, and while there was no difference in sperm concentration, the proportion of healthy-shaped sperm and motility - how fast sperm can "swim" - was higher in those taking lycopene. Dr Liz Williams, a specialist in human nutrition at the University of Sheffield, who led the research which was published in the European Journal of Nutrition, said: "At the moment, there is very little advice we can give to men. "We tell them to reduce alcohol consumption and eat a healthy diet - but these are very general messages." She added: "This was a small study and we do need to repeat the work in bigger trials, but the results are very encouraging." The next step is to repeat the exercise in men with fertility problems and see if lycopene can increase sperm quality for those men and whether it helps couples conceive and avoid invasive fertility treatments." Andrew Drakeley, clinical director at Liverpool Women's Hospital's Hewitt Fertility Centre, said: "Optimising the health of the subfertile couple, both male and female can often avoid the need for invasive and expensive fertility treatment." But he said: "Further work in a subfertile population, demonstrating improved fecundity is needed before the treatment can be recommended." Gwenda Burns, of the charity Fertility Network, added: "Although in the very early stages, this study offers hope for improvement of sperm quality and a greater understanding of male fertility in the future."

BBC News, 9 October 2019

<http://news.bbc.co.uk>

Do you really need to stretch and warm up before exercise?

2019-10-17

"Do your stretches and make sure you're warmed up". It was a ritual reinforced by PE teachers and coaches before we swam, ran or took to the football field. Warming up is something many of us take for granted, but when it comes to improving performance or preventing injury, research

We've long taken for granted that stretching and warming up was an important of preparing for exercise. But research suggests otherwise.

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has raised questions about the effectiveness of these pre-exercise routines. Take stretching, for example. Remember all those times you were asked to bend over and touch your toes? Turns out that might not have been doing you much good. So, what does help? Whether you're wondering how to prepare for a weights session or whether you have to warm down after a run, here's the latest. When Gary Cairnduff became a physiotherapist nearly 30 years ago, one of his patients was an experienced competitive cyclist. When this cyclist saw a competitor stretching before a race, he assumed they had an injury. It was a "sign of weakness" — and he made a point to target them. This attitude may seem a little extreme, but he might have been right to be sceptical. Static stretches — like bending over for 10 seconds and trying to touch your toes — have been a mainstay of warm-ups for years. But Mr Cairnduff says they might not actually be useful in improving performance or preventing injuries. One research review published in 2008 concluded there was "moderate-to-strong evidence that routine application of static stretching will not reduce overall injury rates on the basis of the work that has been undertaken". There may be an exception for injuries to tendons and ligaments, which were found to be reduced by static stretching routines in three of the seven studies reviewed, but the research is far from conclusive. But Mr Cairnduff says there is one area where static stretching can help you improve: flexibility. So, if you're involved in a sport like diving or gymnastics, where flexibility is important, these exercises can still be a useful part of your warm-up routine.

What about dynamic stretches?

Dynamic stretches take your body through the full range of a functional movement. An example would be a leg swing, which involves moving your leg forward and backwards while holding onto something for support. The efficacy of dynamic stretches in preventing injury has not been widely studied, but there's some preliminary evidence suggesting they might improve performance in some sports, says James Alexander, a physiotherapist based in Newcastle who has researched injury prevention strategies for runners. "If someone was undertaking a running event, I'd certainly advise a warm-up that involves dynamic stretches," he says. "There has been reported performance benefits to taking an active warm-up, and the evidence for static stretching with regards to performance or reduced injury risk is just not there."

What you need to know about warming up

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While there's not a lot of evidence to suggest warm-ups reduce injury risk, it doesn't mean they're completely unhelpful. Some people find warming up helps them get in the right frame of mind for exercise, others simply enjoy it.

No pain, no gain? Not quite

When it comes to keeping fit, when do you tell yourself to stop griping and keep going — and when should you actually rest? How long you need to warm up — and what you should be doing — depends on the activity and your fitness level, Mr Alexander says. The goal is to gradually build up intensity and prepare your body for what comes next. When he's going for a leisurely jog, Mr Alexander will often run out the door without any warm-up at all. During the first few minutes, he'll gradually increase his pace and intensity. If he was preparing for a time trial, race or interval session, he'd do a warm up involving five to 10 minutes of dynamic stretches like butt kicks and knee raises and some short "run-throughs". "I'm going to finish that warm-up with three efforts, where I'm running at the pace I want to hit over a short distance. It might be my goal 5K pace, or my goal half-marathon pace," he says. If you're doing resistance training, the principles are the same, Mr Alexander says. You might warm up with bodyweight exercises like lunges and squats, working your way up until you reach your desired weight for your first set. As a general rule, you want to warm up until the point of a "light sweat", Mr Alexander says. It's a sign you've got your body moving and are not yet at the point of fatigue. Remember, though, there's not a lot of evidence to suggest your warm-up routine will prevent injuries.

Do we need to warm down after exercise?

While warming up is about preparing our bodies for training or an event, warming down, the accepted wisdom goes, is about recovery. It's about gradually winding down. If you have played a game of football or run five kilometres, it might be a few minutes of walking once you've finished. Warming down can help remove blood lactates, a by-product of exercise that has been associated with fatigue. However, it's still not clear whether this is of any practical benefit. A recent review of research found warming down is unlikely to prevent injuries or improve performance when exercise is repeated on the same day or the following day. The review also found active warm-downs were "generally not effective for reducing delayed-onset muscle soreness following exercise". Given it's unlikely that warming down will have a great impact, there's no need to beat yourself up if you're

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not doing it. On the flip side, if you're getting something out of your warm-downs, there's no reason to stop.

ABC News, 10 October 2019

<http://www.abc.net.au/news/>

Coffee bean extracts alleviate inflammation, insulin resistance in mouse cells

2019-10-17

When coffee beans are processed and roasted the husk and silverskin of the bean are removed and unused, and often are left behind in fields by coffee producers. Food science and human nutrition researchers at the University of Illinois are interested in the potential of inflammation-fighting compounds found in the silverskin and husk of coffee beans, not only for their benefits in alleviating chronic disease, but also in adding value to would-be "waste" products from the coffee processing industry. A recent study, published in *Food and Chemical Toxicology*, shows that when fat cells of mice were treated with water-based extracts from coffee beans skins, two phenolic compounds—protocatechuic acid and gallic acid—in particular reduced fat-induced inflammation in the cells and improved glucose absorption and insulin sensitivity. The findings show promise for these bioactive compounds, when consumed as part of the diet, as a strategy for preventing obesity-related chronic illnesses, such as Type 2 diabetes and cardiovascular disease. "In my lab we have studied bioactive compounds from different foods, and have seen the benefits for the prevention of chronic diseases," says Elvira Gonzalez de Mejia, professor of food science in the College of Agricultural, Consumer and Environmental Sciences at U of I, and co-author of the study. "This material from coffee beans is interesting mainly because of its composition. It's been shown to be non-toxic. And these phenolics have a very high anti-oxidant capacity." For the study, the researchers looked at two types of cells, macrophages (immune response cells) and adipocytes (fat cells), and the effect of the combined compounds from the extracts, as well as the individual pure phenolics, on adipogenesis—the production and metabolism of fat cells in the body—and the related hormones. They also looked at the effect on inflammatory pathways. When obesity-related inflammation is present, the two types of cells work together—stuck in a loop—to increase oxidative stress and interfere with glucose uptake, worsening the situation. In order to block this loop and prevent chronic disease, the researchers' goals are to eliminate or reduce as much inflammation as possible in order to allow glucose uptake to be facilitated, as well as to have healthy cells that will

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produce adequate insulin. Miguel Rebollo-Hernanz, a visiting scholar in de Mejia's lab, and lead author of the study, explains how the results provide insights into the mechanism of action of these extracts and pure compounds, and their potential efficacy for future studies in humans or animals. For the study, the fat cells and immune cells were cultured together to recreate the "real-life" interaction between the two cells. "We evaluated two extracts and five pure phenolics, and we observed that these phenolics, mainly protocatechuic acid and gallic acid, were able to block this fat accumulation in adipocytes mainly by stimulating lipolysis [the breakdown of fats], but also by generating 'brown-like' or 'beige' adipocytes," Rebollo-Hernanz explains. Significantly, these "brown-like" cells are known as fat burners, and they contain more mitochondria, an important organelle in cells that turns nutrients into energy. In the study, the researchers observed that some phenolics were able to stimulate browning of the fat cells, increasing the content of mitochondria in adipocytes, or fat cells. "Macrophages are present in the adipose tissue and when adipose tissue grows excessively, there are interactions that stimulate inflammation and oxidative stress," Rebollo-Hernanz says. "We saw that these phenolics were able to reduce and decrease the secretion of inflammatory factors, but also decrease oxidative stress." When macrophages interact with fat cells, the cells have fewer mitochondria. Having less mitochondria, they lose the capacity of burning lipids. Using these phenolics, the researchers found that this impact of macrophages on the fat cells was completely blocked. The fat cells maintained their function. "The compounds we tested were able to inhibit inflammation in the macrophage. That means inhibiting many markers that produce inflammation to the adipocytes. Those were blocked," de Mejia says. "Coming to the adipocytes themselves, we saw inhibition of different markers related to inflammation as well. Absorption of glucose was improved because the glucose transporters were present. And this went back and forth." Now we know that in the presence of these compounds we can reduce inflammation, reduce adipogenesis, and decrease the 'loop' that helps the two types of cells grow and develop bad compounds that will negatively affect the whole system," she adds. The researchers also stressed the positive impact on the environment of using the coffee bean by-products. During coffee processing, the bean is separated from the husk, the external outer layer of the bean. After the bean is roasted, the silverskin layer is separated. "It's a huge environmental problem because when they separate this husk after processing, it usually stays in the field fermenting, growing mould, and causing problems," de Mejia explains. Worldwide 1,160,000 tons of husk are left in fields per year, potentially causing contamination. Additionally, 43,000 tons of silverskin is produced

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each year, which, de Meija adds, may be easier to utilise because it stays with the bean as it is exported to different countries to be roasted. "Once producers see the value, they will treat these materials as an ingredient instead of a waste," de Meija says. "It will require good collaboration between academic institutions, industry, and the public sector to solve this problem, but the market is there for these products." The paper, "Phenolic compounds from coffee by-products modulate adipogenesis-related inflammation, mitochondrial dysfunction, and insulin resistance in adipocytes, via insulin/PI3K/AKT signalling pathways," is published in *Food and Chemical Toxicology*.

Medical Xpress, 11 October 2019

<http://medicalxpress.com>

Technical Notes

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OCCUPATIONAL RESEARCH

Occupational swine exposure and Hepatitis E virus, Leptospira, Ascaris suum seropositivity and MRSA colonization in Austrian veterinarians, 2017-2018-A cross-sectional study

lncRNA VNN3 mediated benzene-induced hematotoxicity through promoting autophagy and apoptosis

Occupational Exposures Among Hair and Nail Salon Workers: A Scoping Review

Industry Derived Occupational Exposure Limits: A Survey of Professionals on the Dutch System of Exposure Guidelines

PUBLIC HEALTH RESEARCH

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