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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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## Regulatory Update

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### ASIA PACIFIC

#### Call for Information on PentaBDE

2019-05-17

The National Industrial Chemicals Notification & Assessment Scheme (NICNAS) are currently assessing the human health and environmental risks of pentabromodiphenyl ether (pentaBDE) as a Priority Existing Chemical under sections 57 and 60A of the Industrial Chemicals (Notification and Assessment) Act 1989 (the ICNA Act). Under section 58 of the ICNA Act, the Director of NICNAS is seeking to obtain the most up to date information on pentaBDE for the purpose of assessing the chemical. PentaBDE (CAS number: 1163-19-5) was declared a priority existing chemical (PEC) in January 2006, and this declaration remains in force. This call for information should, therefore, be read in conjunction with the declaration notice for this chemical that was published in the January 2006 Chemical Gazette: [Chemical Gazette January 2006 \(page 14\)](#). On 6 March 2007, the then Minister of Health and Ageing prohibited the manufacture and import of pentaBDE (and mixtures containing the chemical) while the chemical remains a PEC. The notice for immediate prohibition can be found in the March 2007 Chemical Gazette: [Chemical Gazette March 2007 \(page 5\)](#).

#### Who does this notice apply to?

The notice is directed to all importers and manufacturers of pentaBDE, or articles or mixtures containing pentaBDE.

#### Information required

NICNAS are issuing the call for information to ascertain whether there are any recent importers or manufacturers of pentaBDE, or articles (products) or mixtures containing pentaBDE. Should you be importing or manufacturing pentaBDE, or articles or mixtures containing pentaBDE, you must provide the information specified below:

- the quantities of pentaBDE which have been or will be imported (as 'pure' pentaBDE or in articles or mixtures) or manufactured by the company between 1 July 2017 and 30 June 2019;
- the quantities of pentaBDE which have been or will be included into articles or mixtures by the company between 1 July 2017 and 30 June 2019, and the concentration of pentaBDE in these articles and mixtures;

**NICNAS is currently assessing the human health and environmental risks of pentabromodiphenyl ether as a Priority Existing Chemical.**

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- the uses of pentaBDE in articles or mixtures containing pentaBDE known to the company;
- contact details of the persons to whom the company has supplied or intends to supply pentaBDE, or articles or mixtures containing pentaBDE. This is an important piece of information that allows us to contact downstream users for information necessary for the assessment.

Any other persons who have relevant information (eg users of pentaBDE, or articles or mixtures containing pentaBDE) are also encouraged to provide the information.

### Exempt information applications

To apply under section 60 of the ICNA Act for some or all of this information to be exempt from publication: [Download Application for Exempt Information \(Form 3\) \[Word 67KB\]](#)

Note that 'basic information', as defined in section 75(2) of the ICNA Act, cannot be exempted from publication.

### Application fee

A fee of \$1,100 for the consideration of an application for exempt information must be paid when you submit your application.

### Due date

If you are a manufacturer or importer of pentaBDE, you must provide the information by close of business 7 June 2019.

### Non-compliance

A person to whom this notice applies must not refuse or fail to comply with the notice. Refusing or failing to comply with the notice without a reasonable excuse is an offence under the ICNA Act.

### Information collected

Information collected by NICNAS may be provided to State, Territory or Commonwealth regulatory agencies for the purposes of monitoring compliance under relevant legislation. For 'Exempt Information' applications that have been granted, information will not be disclosed by NICNAS except in the circumstances set out in sections 76 and 79 of the

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ICNA Act. All information provided to NICNAS will be used only for the purposes for which it was provided under the ICNA Act.

NICNAS Chemical Gazette, 7 May 2019

[http://www.nicnas.gov.au/Publications/Chemical\\_Gazette](http://www.nicnas.gov.au/Publications/Chemical_Gazette)

### Vaccines overview

2019-05-17

The Therapeutic Goods Administration (TGA) is responsible for assessing vaccines and other medicines before they can be used in Australia. TGA only register a vaccine for use in Australia if its benefits are much greater than its risks.

#### What is a vaccine?

Vaccines are medicines that protect you against specific diseases, such as measles, influenza (flu) or whooping cough. Vaccination is the act of receiving a vaccine, which in most cases involves having the vaccine injected with a needle. Vaccines can contain:

- dead viruses or bacteria
- severely weakened forms of viruses or bacteria
- small, purified components of viruses or bacteria.

After receiving a vaccine, your body's immune system can remember the virus or bacterium and fight off an infection much more effectively than if it was encountering the virus or bacterium for the first time.

Vaccines protect you and the people around you from serious and life-threatening diseases. There are some people in the community who cannot be vaccinated because they are too young or too sick. Widespread vaccination helps protect these people by making it more difficult for a disease to spread. Some people experience minor side effects following vaccination, such as mild fever or pain, redness, or swelling at the injection site. Serious side effects, like allergic reactions, are very rare.

#### The TGA assesses vaccines before they can be used in Australia

The TGA rigorously assesses vaccines for safety, quality and efficacy before they can be used in Australia. Vaccines receive the same high level of scrutiny as other prescription medicines and related therapeutic goods. The agency uses the best available scientific evidence to assess the risks and benefits of each vaccine. Evidence requirements are based on international guidelines developed by the European Medicines Agency.

**The Therapeutic Goods Administration (TGA) is responsible for assessing vaccines and other medicines before they can be used in Australia.**

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Clinical trials are a key part of the scientific evidence that we review during the assessment of a new vaccine. A clinical trial is a scientific study where a promising new medicine is given to a group of people to assess its risks and benefits. The results of clinical trials and the way in which the trials were conducted are carefully assessed. Well-designed trials of a sufficient length with a sufficient number of people who represent the people for whom the vaccine is intended are required. The results must demonstrate that the benefits of the vaccine greatly outweigh the risks. In addition, TGA require vaccine manufacturers to meet manufacturing quality standards. As a further check, our laboratories assess the quality of every batch of a vaccine before it can be supplied in Australia.

### TGA decisions are informed by independent advice

The TGA's decision of whether to register a vaccine for use in Australia is informed by the advice of the Advisory Committee on Vaccines (ACV). The ACV is an independent committee appointed by the Australian Government Minister for Health. It is composed of members with expertise in science, medicine and public health. The ACV complements our expertise in the TGA, ensuring that our assessments of vaccines are as robust as possible.

### The TGA monitors vaccines after they are supplied in Australia

The TGA monitors vaccines for safety after they are supplied in Australia. If you experience an adverse event (side effect) from a vaccine, you should seek assistance from a health professional and report the adverse event to the TGA. The agency receives adverse event reports from consumers, health professionals, the companies who supply vaccines, and state and territory health departments. These reports are published in the publicly available Database of Adverse Event Notifications (DAEN). Reporting serious adverse events is mandatory for the companies who supply vaccines in Australia. These companies must also develop and implement risk management plans for their vaccines. TGA laboratories also help monitor vaccine safety. Alongside assessing the quality of all vaccine batches before they are supplied in Australia, our laboratories may also test the quality of selected vaccine batches after they are supplied in Australia. Laboratory testing results are published on TGA's website. If a problem is suspected with a vaccine, an investigation will be launched. In some cases, this could mean suspending the use of a vaccine during the investigation. The community is notified of safety concerns through the publication of alerts on the TGA website.

### Where can I find more information?

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The Australian Government Department of Health immunisation page includes information on getting vaccinated, vaccine safety, the National Immunisation Schedule and other topics. You can also call the National Immunisation Hotline on 1800 671 811. The Australian Government Department of Health 'Get the facts' website includes additional information about vaccinating your children. The NPS Medicinewise website includes information about vaccines and other medicines in the consumer information section. You can also call their Medicines Line on 1300 MEDICINE (1300 633 424). The National Centre for Immunisation Research and Surveillance (NCIRS) website includes a range of vaccine information, including factsheets on vaccine preventable diseases and vaccine safety. The Australian Academy of Science website includes information on the science of immunisation.

TGA, 14 May 2019

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

### Reassessment of methyl bromide

2019-05-17

New Zealand's Environmental Protection Authority (EPA) have produced a timeline to show the progress of an application to reassess methyl bromide. The agency received an application from Stakeholders in Methyl Bromide Reduction Inc (the applicant) to reassess methyl bromide, a hazardous substance used in quarantine and pre-shipment fumigations. Every application under the Hazardous Substances and New Organisms Act 1996 (the HSNO Act) follows a statutory process towards a decision being made. There are several steps to the processing of any application. The EPA have determined that this application will follow a modified reassessment process and will include a public notification process, at which time, the agency will invite public submissions, and include a public hearing if one is requested. This timeline identifies what has happened

**New Zealand's Environmental Protection Authority (EPA) have produced a timeline to show the progress of an application to reassess methyl bromide.**

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to date on the application to reassess methyl bromide, and when it happened, in chronological order.

| Date          | Step   | What happened in this step?   |
|---------------|--|---|
| 15 April 2019 | Further information and consent to waive a timeframe were requested (under sections 52 and 59 of the HSNO Act) | The applicant was asked to provide additional information to further inform their application, and to consent to a waiver on the timeframe for public notification to allow for provision of that information. The applicant consented to the timeframe waiver on 29 April 2019 and advised that the information would be provided by 28 June 2019. This information will form part of the reassessment application, which submitters will have an opportunity to comment on once the application is publicly notified. |
| 12 April 2019 | Decision on pathway determination and consultation method  | The EPA decided to process the reassessment application as a modified reassessment (section 63A(1) of the HSNO Act). The EPA decided that the application will be publicly notified (section 63A(5) of the HSNO Act).   |
| 9 April 2019  | Application formally received  | The application form was checked for mechanical completeness, and payment of the application fee received.  |

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| Date          | Step  | What happened in this step?   |
|---------------|---|---|
| 25 March 2019 | Application to reassess methyl bromide lodged | An application form was provided on Friday 22 March, with the supporting appendices provided on 25 March. |
| 18 April 2018 | Grounds to reassess methyl bromide            | An EPA decision-making committee decided that grounds existed to reassess methyl bromide (APP203465).     |

NZ EPA, 8 May 2019

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

### South Korea Implements Regulations on Hazard Assessment of FMCGs

2019-05-17

On 17 April 2019, South Korea amended and implemented *Regulations on Hazard Assessment of Human Applied Products*. The regulation is applicable to products that can be contacted, inhaled or absorbed by human beings such as cosmetics, food, pharmaceuticals, etc. in South Korea. The main amendments are as follows:

1. The regulation name is changed.

The regulation's name is changed from "*Regulation on Hazard Assessment Methods and Procedures*" to "*Regulation on Hazard Assessment of Human Applied Products*". The scope of objects required hazard assessment is expanded to human applied products, which include:

|   |
|---|
| <b>Food, food additives, food utensils, container/packaging specified in <i>Food Sanitation Act</i></b>     |
| Health functional food specified in <i>Health Functional Foods Act</i>                                      |
| Cosmetics specified in <i>Cosmetics Act</i>   |
| Agricultural and fishery products specified in <i>Agricultural and Fishery Products Quality Control Act</i> |
| Livestock products specified in <i>Livestock Products Sanitary Control Act</i>                              |
| Pharmaceuticals, preparations and quasi drugs specified in <i>Pharmaceutical Affairs Act</i>                |

**On 17 April 2019, South Korea amended and implemented Regulations on Hazard Assessment of Human Applied Products.**

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|   |
|---|
| <b>Food, food additives, food utensils, container/packaging specified in <i>Food Sanitation Act</i></b> |
|---|

|   |
|---|
| Medical devices specified in <i>Medical Devices Act</i> |
|---|

|   |
|---|
| Hygiene products specified in <i>Hygiene Products Act</i> |
|---|

|                                  |
|----------------------------------|
| Other products specified by MFDS |
|----------------------------------|

Among them, the products which require hazard assessment are:

1) Human applied products pose a risk to human health as established by international institutions or foreign government and are prohibited from manufacturing/selling;

2) Human applied products that use new ingredients, adopt new technologies, or do not have safety standards;

3) Other human applied products that may do harm to human health

MFDS plans to formulate a list of 60 hazardous substances with high risks and will give priority to conduct comprehensive hazard assessment of those substances by 2020.

2. Hazard Assessment Committee is established.

Hazard Assessment Committee is established to provide consulting services. The consultation scope includes, 1) hazard assessment methods, 2) cross-checking of hazard assessment results, 3) procedures and methods of toxicological tests, etc.

3. The methods and procedures of comprehensive hazard assessment are clarified and toxicological tests' methods and procedures of hazardous substances in human applied products are newly added.

Chemlinked, 10 May 2019

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

### The Philippines Clarifies COO Requirements for Cyanide and Cyanide Compounds

2019-05-17

Recently, the Philippine Environment Management Bureau (EMB) issued a circular to clarify provisions with regard to cyanide and cyanide compounds in the Chemical Control Order (CCO), specifically procedural requirements for the registration and licensing of these substances. The

**Recently, the Philippine Environment Management Bureau (EMB) issued a circular to clarify provisions with regard to cyanide and cyanide compounds in the Chemical Control Order**

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EMB specified several important issues which were provided in the circular, including:

- For transactions regarding cyanide and cyanide compounds conducted between companies in the Philippines, such businesses should have a memorandum of agreement in which the quantity of distributed/purchased/used cyanide should comply with their CCO Registration;
- In the case of sodium cyanide, the EMB Central Office will be involved in the evaluation of the CCO Importation Clearance;
- The Importation Clearance shall be valid within six (6) months after its issuance and for "single shipment only".

It is hoped that the circular can help to regulate the improper use of cyanide and cyanide compounds and curb their negative effects on the environment and human health. Further information is available at: [EMB Circular](#)

Chemlinked, 9 May 2019

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

## AMERICA

### California Moving to Prohibit Use of Chlorpyrifos

2019-05-17

On 8 May 2019, California Environmental Protection Agency (CalEPA) announced that the state's Department of Pesticide Regulation is acting to ban the use of the pesticide chlorpyrifos in California by initiating a cancellation of the pesticide. CalEPA and the California Department of Food and Agriculture also announced that Gov. Gavin Newsom will propose \$5.7 million in new funding in the May Revision budget proposal to support the transition to safer, more sustainable alternatives, and plans to convene a working group to recommend alternative pest management solutions. "California's action to cancel the registration of chlorpyrifos is needed to prevent the significant harm this pesticide causes children, farmworkers, and vulnerable communities," said CalEPA Secretary Jared Blumenfeld. "This action also represents a historic opportunity for California to develop a new framework for alternative pest management practices." "The agency reported that the decision to ban chlorpyrifos follows mounting evidence, including recent findings by the state's independent Scientific Review Panel on Toxic Air Contaminants, that the

**On 8 May 2019, California Environmental Protection Agency (CalEPA) announced that the state's Department of Pesticide Regulation is acting to ban the use of the pesticide chlorpyrifos in California by initiating a cancellation of the pesticide.**

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pesticide causes serious health effects in children and other sensitive populations at lower levels of exposure than previously understood. In April, chlorpyrifos was formally listed as a toxic air contaminant, which California law defines as “an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.” The listing requires DPR to develop control measures to protect the health of farmworkers and others living and working near where the pesticide is used. DPR has determined, in consultation with CDFA, the Office of Environmental Health Hazard Assessment, and the California Air Resources Board that sufficient additional control measures are not feasible. As a result, DPR intends to begin the process of cancelling the registrations for products containing chlorpyrifos and convening a cross-sector working group to identify safer alternatives to avoid replacing chlorpyrifos with an equally harmful pesticide. DPR also will consult with county agricultural commissioners and local air pollution control districts before filing for cancellation. The cancellation process could take up to two years. During the cancellation process, DPR’s recommendations to county agricultural commissioners for tighter permit restrictions on the use of chlorpyrifos will remain in place. These include a ban on aerial spraying, quarter-mile buffer zones, and limiting use to crop-pest combinations that lack alternatives. DPR will support aggressive enforcement of these restrictions, CalEPA reported. The proposed cancellation would apply to dozens of agricultural products containing the pesticide. The pesticide has been prohibited by the U.S. Environmental Protection Agency for residential uses since 2001.

Environmental Protection News, 8 May 2019

<http://www.eponline.com>

### **EPA Seeks Public Input on Draft Study of Oil and Gas Extraction Wastewater Management**

2019-05-17

The United States Environmental Protection Agency (EPA) is seeking public input on a draft study that takes a holistic look at how the agency, states, tribes and others view the current state of regulation and management of wastewater from the oil and gas industry and provides insight into how this wastewater might be returned to beneficial use in the water cycle. “EPA’s draft study leverages the expertise of states, industry, and others in determining the opportunities and challenges surrounding the beneficial reuse of wastewater from the oil and gas sector,” said EPA Office of Water Assistant Administrator David Ross. “EPA looks forward to

**The United States Environmental Protection Agency (EPA) is seeking public input on a draft study that takes a holistic look at how the agency, states, tribes and others view the current state of regulation and management of wastewater from the oil and gas industry and provides insight into how this wastewater might be returned to beneficial use in the water cycle.**

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continued public engagement regarding practical, environmentally-sound approaches to encouraging greater reuse and more holistic management of this water.”“In an arid state like Utah, no potential source of water can be ignored,” said Utah Department of Environmental Quality Executive Director Alan Matheson. “We appreciate the valuable information EPA has compiled in this study and commit to work with EPA, states, and stakeholders to address the water quantity and quality challenges associated with produced water.”“Wyoming has long recognised the importance of beneficial reuse of produced water from the oil and gas sector through implementation of sound practices that are protective of water quality standards,” said Wyoming Department of Environmental Quality (WY DEQ) Director Todd Parfitt. “In particular, beneficial reuse of produced water provides significant benefit to wildlife, agriculture, and riparian habitat. WY DEQ looks forward to working with EPA and states in assessing and evaluating options for all produced water management opportunities.” In May 2018, EPA announced the initiation of a *Study of Oil and Gas Extraction Wastewater Management*. The agency conducted a robust outreach effort to gather input from state, tribal, industrial, academic, environmental, public health and other entities for the study. This included meeting with individual entities, accepting written input through a public docket on [regulations.gov](https://www.regulations.gov), and hosting a national public meeting in October 2018 to report on what EPA had learned to date and to provide stakeholders an additional opportunity to provide input. The draft *Study of Oil and Gas Extraction Wastewater Management* was developed using the feedback the agency received from these engagements and comments submitted to the public docket. Many entities expressed support for increasing opportunities for discharge of oil and gas extraction wastewater to surface waters—especially where these wastewaters could address critical water resource needs. Some entities expressed concern that discharges to surface waters may, at least at this time, potentially impact the environment. EPA will accept input on the draft study until 1 July 2019. Interested parties may email their input to [oil-and-gas-study@epa.gov](mailto:oil-and-gas-study@epa.gov). After consideration of the feedback received, the agency will finalise the study in summer 2019. EPA will determine at that time what, if any, future agency actions are appropriate to encourage the beneficial reuse of oil and gas extraction wastewater under the Clean Water Act; this could include regulatory and/or non-regulatory approaches. For more information on the draft study, visit EPA’s website at: [www.epa.gov/eg/study-oil-and-gas-extraction-wastewater-management](http://www.epa.gov/eg/study-oil-and-gas-extraction-wastewater-management)

### Background

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Large volumes of wastewater are generated from both conventional and unconventional oil and gas extraction at onshore facilities and projections show that these volumes will likely increase significantly with expanded production activity and enhanced drilling and hydraulic fracturing techniques. Currently, most of this wastewater is managed by disposing of it using a practice known as deep underground injection, where that water can no longer be accessed or used. The limits of injection are evident in some areas and new approaches are becoming necessary. Some states and stakeholders have questioned whether it makes sense to continue to waste this water, particularly in water scarce areas of the country, and what steps would be necessary to treat and renew it for other purposes.

U.S EPA, 15 May 2019

<http://www.epa.gov>

### **EPA to Hold Public Meeting on Revisions to Draft Framework on Endangered Species Act Process for Pesticides**

2019-05-17

The United States Environmental Protection Agency (EPA) is seeking comment on draft revisions to the framework used to evaluate the impacts pesticides have on endangered species under the Federal Insecticide, Fungicide, and Rodenticide Act. The draft revisions would ensure this process is efficient, protective, transparent, and based on the best available science. "EPA's draft framework allows the agency to consider real-world data that will better reflect where pesticides are actually used, and which species could be affected and those that are not likely to be affected," said EPA Office of Chemical Safety and Pollution Prevention Assistant Administrator Alexandra Dapolito Dunn. "Making these revisions to the framework will follow through on EPA's commitments under the 2018 Farm Bill and will help EPA target environmental protections where they are needed, and ensure that pesticides can continue to be used safely without impacting endangered species." The 10 June public meeting will be part of the federal government's coordinated effort to improve the Endangered Species Act (ESA) process that is used when pesticides are federally registered. New provisions in the 2018 Farm Bill call for the establishment of an interagency working group to provide recommendations and implement a strategy to improve the pesticide registration process. Input from the public meeting and the public comment period on the draft revised method will be used by the working

**Revisions respond to 2018 Farm Bill requirements to streamline and improve the process the agency follows to review the impacts pesticides have on endangered species**

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group to make these improvements. As part of the EPA's efforts to engage with stakeholders on this important issue, the agency will host a public meeting on 10 June 2019, at its Potomac Yard South Building in Arlington, Virginia. The public meeting will be held from 9 a.m. to Noon EDT in the lobby-level conference centre. Those wishing to attend either in person or via teleconference/webinar must register by 30 May 2019. To register: <https://www.eventbrite.com/e/us-epa-public-meeting-on-revised-method-for-esa-pesticide-assessments-registration-61651229487>

Upon publication in the Federal Register, the EPA will accept public comments for 45 days in docket EPA-HQ-OPP-2019-0185 on the draft revised method on [www.regulations.gov](http://www.regulations.gov). The draft revised method and a summary of the major draft changes will be found in the docket. The draft revised method can also be found here: <https://www.epa.gov/endangered-species/draft-revised-method-national-level-endangered-species-risk-assessment-process>. Under the ESA, federal agencies are required to determine whether their actions may affect endangered and threatened species and their designated critical habitat. More information: <https://www.epa.gov/endangered-species>

U.S EPA, 10 May 2019

<http://www.epa.gov>

### U.S. Department of Labor's OSHA Issues Rule to Revise Requirements in Safety and Health Standards

2019-05-17

The United States Occupational Safety and Health Administration (OSHA) has issued a final rule that revises 14 provisions in the recordkeeping, general industry, maritime, and construction standards that may be confusing, outdated, or unnecessary. The revisions are expected to increase understanding and compliance with the provisions, improve employee safety and health, and save employers an estimated \$6.1 million per year. OSHA proposed the changes in October 2016. This is the fourth final rule under OSHA's Standards Improvement Project, which began in 1995 in response to a Presidential memorandum to improve government regulations. Other revisions were issued in 1998, 2005, and 2011.

U.S OSHA, 13 May 2019

<http://www.osha.gov>

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### **EPA Issues Memorandum Formally Initiating TSCA Inventory “Inactive” Chemical Designation Period**

2019-05-17

On 9 May 2019, the United States Environmental Protection Agency (EPA) released a pre-publication copy of a *Federal Register* notice announcing the availability of a signed memorandum that formally identifies chemicals for “inactive” designation under the TSCA Inventory Notification (Active-Inactive) Requirements rule. Signature of the memorandum served to initiate the 90-day delayed effective date for inactive chemical designations that were included in the updated TSCA Inventory released 19 February 2019. Accordingly, inactive designations will become effective on 5 August 2019. Significantly, EPA had earlier indicated via a webinar that the effective date for inactive designations would be 20 May 2019, or 90-days after EPA’s 19 February 2019 release of the updated Inventory. As a result of this action, beginning 5 August 2019 any person who intends to manufacture, import, or process an inactive chemical for a non-exempt purpose must submit a Notice of Activity (NOA) Form B before, but not more than 90-days prior to, the anticipated date of such manufacture, import, or processing. To avoid business disruption, under certain circumstances the regulations also allow submission of an NOA Form B during the period between designation of inactive status and August 4, 2019. The Agency’s action is intended to clarify uncertainty regarding the effective date of inactive chemical designations. It also provides industry with additional time to comply with the NOA Form B requirement. As of March 13, 2019, EPA indicated that 45,573, or 53%, of the 86,228 substances on the TSCA Inventory are designated as inactive.

National Law Review, 10 May 2019

<http://www.natlawreview.com>

## **EUROPE**

### **EC JRC Announces Publication of Article on Measuring Nanoparticles in Medicinal Products**

2019-05-17

On 10 May 2019, the European Commission’s (EC) Joint Research Centre (JRC) announced publication of an article entitled “Measuring particle size distribution of nanoparticle enabled medicinal products, the joint view of EUNCL and NCI-NCL. A step by step approach combining

**On 9 May 2019, the United States Environmental Protection Agency (EPA) released a pre-publication copy of a Federal Register notice announcing the availability of a signed memorandum that formally identifies chemicals for “inactive” designation under the TSCA Inventory Notification (Active-Inactive) Requirements rule.**

## Regulatory Update

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orthogonal measurements with increasing complexity” in the 10 April 2019, issue of the *Journal of Controlled Release*. JRC, in close collaboration with researchers from the French Commissariat à l'énergie atomique et aux énergies alternatives (CEA), Swiss Eidgenössische Material- und Prüfungs-Anstalt (EMPA), U.S. National Cancer Institute's Nanotechnology Characterization Laboratory (NCI-NCL), and Irish Trinity College, has developed a common strategy for measuring the particle size distribution of nanomedicines. According to JRC, “[a] quick preliminary step to assess sample integrity and stability by low resolution techniques is followed by the combination of complementary high-resolution sizing measurements performed both in simple buffers and in complex biological media.” The work is part of the collaboration between NCI-NCL and the European Nanomedicine Characterisation Laboratory (EUNCL). JRC states that it has led to “high quality, accurate, determination of particle size distribution.” Standard operating procedures for the assessment of nanomedicines, including the measurements of particle size distribution, are publicly available, and EUNCL and NCI-NCL are offering wide access to their “state of the art” characterisation platforms.

Nano & Other Emerging Technologies Blog, 10 May 2019

<http://nanotech.lawbc.com>

### Veterinary drug residues: compliance remains high

2019-05-17

Monitoring data on the presence of residues of veterinary medicines and contaminants in animals and animal-derived food show high rates of compliance with recommended safety levels. Presence of prohibited substances was also low. The percentage of samples that exceeded maximum levels was 0.35% for the year 2017. This figure is within the range of 0.25%-0.37% reported over the previous 10 years. Non-compliance for chemical contaminants such as metals was higher than for other groups of substances, with cadmium, lead, mercury and copper the most frequently identified. This is the first time that EFSA has collected these data from Member States; in the past the information was submitted to the European Commission. The European Food and Safety Authority (EFSA) collected data in the same way as it does in areas such as food additives, chemical contaminants, pesticides residues and antimicrobial resistance. Harmonised data will allow comparisons to be made across years and enable better analysis of the risks to human and animal health. The data will be made available shortly on [Knowledge Junction](#), EFSA's curated, open repository, which was set up to improve transparency,

**Monitoring data on the presence of residues of veterinary medicines and contaminants in animals and animal-derived food show high rates of compliance with recommended safety levels.**

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reproducibility and reusability of evidence in food and feed safety risk assessments. Further information is available at: [Report for 2017 on the results from the monitoring of veterinary medicinal product residues and other substances in live animals and animal products](#)

EFSA, 13 May 2019

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

### Cosmetic Products Regulation Annexes II and VI amended

2019-05-17

The following substances have been added to Annex II of the Cosmetic Products Regulation (EC) No. 1223/2009 (CPR) as per Commission Regulation (EU) 2019/681 of 30 April 2019:

- 2-Chloro-p-Phenylenediamine
- 2-chloro p-phenylenediamine sulphate
- 2-chlorobenzene-1,4-diammonium dichloride

The following substance has been added to Annex VI of the CPR as per Commission Regulation (EU) 2019/680 of 30 April 2019:

- 3,3 -(1,4-Phenylene) bis(5,6-diphenyl1,2,4-triazine)

Yorda's Hive, 15 May 2019

<https://www.yordasgroup.com/hive/news>

### Plant protection products Regulation list of approved active substances updated

2019-05-17

On 7 May 2019, the approval of the following active substances under the Plant protection products Regulation (EC) No. 1107/2009 has been renewed as per Commission Implementing Regulation (EU) 2019/706 and Commission Implementing Regulation (EU) 2019/707:

- Carvone
- Famoxadone
- Metalaxyl-M
- Flumioxazine
- Foramsulfuron
- Cyazofamid

**3 new substances have been added to Annex II of the Cosmetic Products Regulation and 1 to Annex VI.**

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- Alpha-cypermethrin
- Benalaxyl
- Bromoxynil
- Desmedipham
- Phenmedipham
- S-metolachlor
- Etoxazole
- Bifenazate
- Milbemectin
- Fenamiphos
- Ethephon
- Captan
- Folpet
- Formetanate
- Methiocarb
- Dimethoate
- Dimethomorph
- Metribuzin
- Phosmet
- Propamocarb
- Pirimiphos-methyl
- Bflubutamid
- Bentiavalicarb
- Boscalid
- Fluoxastrobin
- Paecilomyces lilacinus (Thom)
- Prothioconazole
- Diuron
- Tebuconazole

As a result, these substances have now been updated in the list of approved active substances (the Annex to Commission Implementing Regulation (EU) No. 540/2011).

Yorda's Hive, 15 May 2019

<https://www.yordasgroup.com/hive/news>

## REACH Update

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### New web pages on the database of articles containing Candidate List substances

2019-05-16

The European Chemicals Agency (ECHA) is developing a database with information on articles containing substances of very high concern from the Candidate List, under the Waste Framework Directive. Companies producing, importing or supplying such articles will need to submit information to ECHA as of January 2021. The web pages provide background information on the database and on the project's next steps. Further information is available at: [Understanding the Waste Framework Directive](#)

ECHA News, 15 May 2019

<http://echa.europa.eu>

### New proposal to harmonise classification and labelling

2019-05-16

A new proposal to harmonise the classification and labelling of oxamyl (ISO); N,N'-dimethylcarbamoyl(methylthio)methylenamine N-methylcarbamate (EC 245-445-3, CAS 23135-22-0) has been submitted. Further information on the proposal is available at: [Registry of CLH intentions](#).

ECHA News, 15 May 2019

<http://echa.europa.eu>

### Public consultation on harmonised classification and labelling

2019-05-16

The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposals for:

- 2-(2-methoxyethoxy)ethanol (EC 203-906-6; CAS 111-77-3);
- pyridine-2-thiol 1-oxide, sodium salt; pyriithione sodium; sodium pyriithione (EC 223-296-5, 240-062-8; CAS 3811-73-2 15922-78-8). It is an active substance mainly used in biocidal products as a preservative and disinfectant; and
- methyl methacrylate methyl 2-methylprop-2-enoate; methyl 2-methylpropenoate (EC 201-297-1, CAS 80-62-6).

**The European Chemicals Agency (ECHA) is developing a database with information on articles containing substances of very high concern from the Candidate List, under the Waste Framework Directive.**

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The deadline for comments is 5 July 2019. Further information is available at: [Give comments](#)

ECHA News, 15 May 2019

<http://echa.europa.eu>

### New Chair of the Board of Appeal

2019-05-16

Antoine Buchet has been selected as the new Chair of the European Chemicals Agency's Board of Appeal. He will join on 16 August 2019. He is currently employed as a legal adviser in the Commission's Legal Service. He is French with substantial experience in EU law, international courts, public administration and institutional European law. Further information is available at: [Board of Appeal](#)

ECHA News, 15 May 2019

<http://echa.europa.eu>

### PACT updated with 8 new intentions for Hazard assessments

2019-05-16

On 14 May 2019, the European Chemicals Agency's (ECHA) Public Activities Coordination Tool (PACT) was updated with the following new intentions for Hazard assessments:

- 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropan-1-one;
- 3-phenoxybenzyl-2-(4-ethoxyphenyl)-2-methylpropyl ether;
- Chrysanthemum cinerariaefolium extract from open and mature flowers of Tanacetum cinerariifolium obtained with supercritical carbon dioxide;
- Cyanamide;
- Formic acid;
- K-HDO;
- Ozone; and
- Sulphur dioxide

**Antoine Buchet has been selected as the new Chair of the European Chemicals Agency's Board of Appeal.**

# Bulletin Board

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This update brought the number of PACT RMOA and hazard assessment substances to 460.

Yorda's Hive, 14 May 2019

<https://www.yordasgroup.com/hive/news>

## Janet's Corner

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### Trouble bonding

2019-05-17



## Hazard Alert

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### Toluene diisocyanate

2019-04-29

Toluene diisocyanate (TDI) is an organic compound with the formula  $\text{CH}_3\text{C}_6\text{H}_3(\text{NCO})_2$ . Two of the six possible isomers are commercially important: 2,4-TDI (CAS: 584-84-9) and 2,6-TDI (CAS: 91-08-7). 2,4-TDI is produced in the pure state, but TDI is often marketed as 80/20 and 65/35 mixtures of the 2,4 and 2,6 isomers respectively. [1] TDI exist at room temperature as a clear, colourless to pale-yellow liquid with a pungent odour. It decompose in water, but are very soluble in acetone and benzene, and are miscible with ether, diglycol monomethyl ether, carbon tetrachloride, chlorobenzene, kerosene, and olive oil. They are combustible when exposed to heat or flame and darken when exposed to sunlight (IARC 1999, HSDB 2009). [2]

### USES [2]

TDI is used primarily to manufacture flexible polyurethane foams for use in furniture, bedding, and automotive and airline seats. Other, smaller uses are for polyurethane elastomers (for automobile bumper covers, industrial rollers, sport soles and boots, and mechanical goods) and coatings (for automotive refinishing, wood finishes, and high-performance anti-corrosion coatings). Toluene diisocyanate-based rigid polyurethane foam is used in household refrigerators and for residential sheathing or commercial roofing in board or laminate form. "Pour-in-place" or "spray-in" rigid foam is used as insulation for truck trailers, railroad freight cars, and cargo containers. Polyurethane-modified alkyds contain approximately 6% to 7% isocyanate, mostly toluene diisocyanates, and are used as coating materials, such as floor finishes, wood finishes, and paints. Moisture-curing coatings are used as wood and concrete sealants and floor finishes. Aircraft, truck, and passenger-car coatings often are composed of toluene diisocyanate prepolymer systems. Castable urethane elastomers are used in applications requiring strength, flexibility, and shock absorption, and are resistant to oil, solvents, and ultraviolet radiation. They are used in adhesive and sealant compounds and in automobile parts, shoe soles, rollerskate wheels, pond liners, and blood bags. They are also used in oil fields and mines. Certain elastomer products are produced from the pure 2,4 isomer rather than the 80:20 mixture.

**Toluene diisocyanate (TDI) is an organic compound with the formula  $\text{CH}_3\text{C}_6\text{H}_3(\text{NCO})_2$ .**

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### SOURCES OF EMISSION & ROUTES OF EXPOSURE

#### Sources of Emission [3]

- Industry sources: Industrial emissions to air (especially companies producing the materials listed above) or spills.
- Diffuse sources: Emission to air (by outgassing) from products containing TDI.
- Natural sources: There are no known or expected natural sources of TDI emissions.
- Transport sources: No significant mobile emission sources.
- Consumer products: Polyurethane coatings, cement sealers, polyurethane mastic sealants, and polyurethane cushions and pads. Very low emissions of TDI have been infrequently detected from cushions.

#### Routes of Exposure [4]

The main routes of exposure to TDI are inhalation, ingestion, skin and/or eye contact.

### HEALTH EFFECTS [5]

#### Acute Effects

Acute exposure to high levels of 2,4-toluene diisocyanate in humans, via inhalation, results in severe irritation of the skin, eyes, and nose, and causes nausea and vomiting. Acute animal tests in rats have shown 2,4-toluene diisocyanate to have moderate to extreme acute toxicity from inhalation exposure and low acute toxicity from oral exposure.

#### Chronic Effects

Chronic inhalation exposure to 2,4-toluene diisocyanate in workers has caused significant decreases in lung function, an asthma-like reaction characterised by wheezing, dyspnea, and bronchial constriction. Animal studies have reported irritation of respiratory tissues, bronchopneumonia, and weight loss from chronic exposure to 2,4-toluene diisocyanate. EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for 2,4-toluene diisocyanate. However, EPA has established an RfC of 0.00007 milligrams per cubic metre ( $\text{mg}/\text{m}^3$ ) for the mixture of toluene 2,4- and 2,6-diisocyanate based on respiratory effects in humans.

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### Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of 2,4-toluene diisocyanate in humans. No reproductive or developmental effects were observed in rats exposed to a mixture of toluene 2,4- and 2,6-diisocyanate via inhalation.

### Cancer Risk

Information is not adequate to determine the carcinogenic effects of 2,4-toluene diisocyanate in humans. Three epidemiology studies did not find an increased occurrence of cancer among exposed workers. Animal studies have reported significantly increased incidences of tumours of the pancreas, liver, and mammary glands from exposure to 2,4-toluene diisocyanate via gavage. Animal studies, via inhalation, did not report an increased incidence of tumours. A study by the National Toxicology Program (NTP) on a mixture of toluene 2,4- and 2,6-diisocyanate administered by gavage showed an increase in tumours of subcutaneous tissues in male and female rats, the pancreas in male rats, mammary gland and liver in female rats, and liver and circulatory system in female mice. EPA has not classified 2,4-toluene diisocyanate for carcinogenicity. IARC has classified 2,4-toluene diisocyanate as a Group 2B, possible human carcinogen.

### SAFETY [6]

#### First Aid Measures

- **Eye contact:** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Use lukewarm water if possible. Use fingers to ensure that eyelids are separated and that the eye is being irrigated. Then remove contact lenses, if easily removable, and continue eye irrigation for not less than 15 minutes. Get medical attention.
- **Skin contact:** Immediately remove contaminated clothing and shoes. Wash off with soap and water. Use lukewarm water if possible. Wash contaminated clothing before re-use. For severe exposures, immediately get under safety shower and begin rinsing. Get medical attention if irritation develops.
- **Inhalation:** Move to an area free from further exposure. Get medical attention immediately. Administer oxygen or artificial respiration as needed. Asthmatic symptoms may develop and may be immediate or

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delayed up to several hours. Extreme asthmatic reactions can be life threatening.

- Ingestion: Do NOT induce vomiting. Wash mouth out with water. Do not give anything by mouth to an unconscious person. Get medical attention.
- Notes to physician: Eyes: Stain for evidence of corneal injury. If cornea is burned, instil antibiotic/steroid preparation as needed. Workplace vapours could produce reversible corneal epithelial oedema impairing vision. Skin: This compound is a skin sensitiser. Treat symptomatically as for contact dermatitis or thermal burn. Ingestion: Treat symptomatically. There is no specific antidote. Inducing vomiting is contraindicated because of the irritating nature of the compound. Inhalation: Treatment is essentially symptomatic. An individual having a dermal or pulmonary sensitisation reaction to this material should be removed from further exposure to any diisocyanate.

### Exposure Controls & Personal Protection

#### Engineering Controls

Local exhaust should be used to maintain levels below the threshold values whenever diisocyanate is handled, processed, or spray-applied. At normal room temperatures (70 F) TDI levels quickly exceed the TLV or PEL unless properly ventilated. Standard reference sources regarding industrial ventilation should be consulted for guidance about adequate ventilation. To ensure that published exposure limits have not been exceeded, monitoring for airborne diisocyanate should become part of the overall employee exposure characterisation program.

#### Personal Protective Equipment

- Respiratory protection: At normal room temperatures, airborne TDI can exceed limits; therefore, in inadequately ventilated environments, respiratory protection must be worn. The type of respiratory protection selected must comply with the requirements set forth in OSHA's Respiratory Protection Standard (29 CFR1910.134). The type of respiratory protection available includes (1) an atmosphere-supplying respirator such as a self-contained breathing apparatus (SCBA) or a supplied air respirator (SAR) in the positive pressure or continuous flow mode, or (2) an air-purifying respirator (APR). If an APR is selected then (a) the cartridge must be equipped with an end-of-service life indicator (ESLI) certified by NIOSH, or (b) a change out schedule, based on objective information or data that will ensure that the cartridges

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are changed out before the end of their service life, must be developed and implemented. Furthermore, if an APR is selected, the airborne diisocyanate concentration must be no greater than 10 times the TLV or PEL. An organic vapour (OV) cartridge is recommended for APR use.

- Hand protection: Gloves should be worn. Nitrile rubber showed excellent resistance. Butyl rubber, neoprene, and PVC are also effective.
- Eye protection: When directly handling liquid product, eye protection is required. Examples of eye protection include a chemical safety goggle, or chemical safety goggle in combination with a full-face shield when there is a greater risk of splash.
- Skin and body protection: Avoid all skin contact. Depending on the conditions of use, cover as much of the exposed skin area as possible with appropriate clothing to prevent skin contact.

### REGULATION [3,7]

#### United States

| Exposure Limit  | Limit Values                                  | HE Codes | Health Factors and Target Organs                    |
|---|---|----------|---|
| OSHA Permissible Exposure Limit (PEL) - General Industry See <a href="#">29 CFR 1910.1000 Table Z-1</a> | 0.02 ppm (0.14 mg/m <sup>3</sup> )<br>Ceiling | HE9      | Allergic sensitisation of respiratory tract; asthma |
| OSHA PEL - Construction Industry See <a href="#">29 CFR 1926.55 Appendix A</a>                          | 0.02 ppm (0.14 mg/m <sup>3</sup> )<br>Ceiling | HE9      | Allergic sensitisation of respiratory tract; asthma |
| OSHA PEL - Shipyard Employment See <a href="#">29 CFR 1915.1000 Table Z-Shipyards</a>                   | 0.02 ppm (0.14 mg/m <sup>3</sup> )<br>Ceiling | HE9      | Allergic sensitisation of respiratory tract; asthma |

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| Exposure Limit  | Limit Values   | HE Codes | Health Factors and Target Organs  |
|---|--|----------|---|
| National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) <a href="#">See Appendix A</a> | Lowest Feasible Concentration<br>Ca  | HE2      | Carcinogenicity (pancreas, liver, skin, mammary glands, and circulatory system) |
| American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2004)*                         | 0.005 ppm (0.036 mg/m <sup>3</sup> ) TWA<br>0.02 ppm (0.14 mg/m <sup>3</sup> ) STEL A4; SEN            | HE9      | Allergic sensitisation of respiratory tract; asthma                             |
|   |  | HE11     | Bronchitis, pneumonitis, pulmonary oedema                                       |
|   |  | HE14     | Eye, mucous membrane, and respiratory irritation                                |
| <a href="#">CAL/OSHA PELs</a>   | 0.005 ppm (0.04 mg/m <sup>3</sup> ) TWA<br>0.02 ppm Ceiling<br>0.02 ppm (0.15 mg/m <sup>3</sup> ) STEL | HE9      | Allergic sensitisation of respiratory tract; asthma                             |
|   |  | HE11     | Bronchitis, pneumonitis, pulmonary oedema                                       |
|   |  | HE14     | Eye, mucous membrane, and respiratory irritation                                |

### Australia

Safe Work Australia lists the following exposure Standard:

- 0.02 mg per cubic metre (0.00002 grams per cubic metre), on a time weighted average basis (TWA)
- 0.07 mg per cubic metre (0.00007 grams per cubic metre), for short term exposures (STEL)

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### REFERENCES.

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3. <http://www.npi.gov.au/resource/toluene-24-diisocyanate>
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7. [https://www.osha.gov/dts/chemicalsampling/data/CH\\_272400.html](https://www.osha.gov/dts/chemicalsampling/data/CH_272400.html)

## Gossip

### CHEMWATCH

### How slippery surfaces allow sticky pastes and gels to slide

2019-04-30

An MIT research team that has already conquered the problem of getting ketchup out of its bottle has now tackled a new category of consumer and manufacturing woe: how to get much thicker materials to slide without sticking or deforming. The slippery coatings the team has developed, called liquid-impregnated surfaces, could have numerous advantages, including eliminating production waste that results from material that sticks to the insides of processing equipment. They might also improve the quality of products ranging from bread to pharmaceuticals, and even improve the efficiency of flow batteries, a rapidly developing technology that could help to foster renewable energy by providing inexpensive storage for generated electricity. These surfaces are based on principles initially developed to help foods, cosmetics, and other viscous liquids slide out of their containers, as devised by Kripa Varanasi, a professor of mechanical engineering at MIT, along with former students Leonid Rapoport Ph.D. '18 and Brian Solomon Ph.D. '16. The new work is described in the journal *ACS Applied Materials and Interfaces*. Like the earlier surfaces they developed, which led to the creation of a spinoff company called LiquiGlide, the new surfaces are based on a combination of a specially textured surface and a liquid lubricant that coats the surface and remains trapped in place through capillary action and other intermolecular forces associated with such interfaces. The new paper explains the fundamental design principles that can achieve almost 100 percent friction reduction for these gel-like fluids.

#### Needing a squeeze

Such materials, known as yield-stress fluids, including gels and pastes, are ubiquitous. They can be found in consumer products such as food, condiments, and cosmetics, and in products in the energy and pharmaceuticals industries. Unlike other fluids such as water and oils, these materials will not start to flow on their own, even when their container is turned upside down. Starting the flow requires an input of energy, such as squeezing the container. But that squeezing has its own effects. For example, bread-making machinery typically includes scrapers that constantly push the sticky dough away from the sides of its container, but that constant scraping can result in over-kneading and a denser loaf. A slippery container that requires no scraping could thus produce better-tasting bread; Varanasi says. By using this system, "beyond getting everything out of the container, you now add higher quality" of the

**An MIT research team that has already conquered the problem of getting ketchup out of its bottle has now tackled a new category of consumer and manufacturing woe: how to get much thicker materials to slide without sticking or deforming.**

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resulting product. That may not be critical where bread is concerned, but it can have great impact on pharmaceuticals, he says. The use of mechanical scrapers to propel drug materials through mixing tanks and pipes can interfere with the effectiveness of the medicine, because the shear forces involved can damage the proteins and other active compounds in the drug. By using the new coatings, in some cases it's possible to achieve a 100 percent reduction in the drag the material experiences—equivalent to “infinite slip,” Varanasi says. “Generally speaking, surfaces are enablers,” says Rapoport. “Superhydrophobic surfaces, for example, enable water to roll easily, but not all fluids can roll. Our surfaces enable fluids to move by whichever way is more preferable for them—be it rolling or sliding. In addition, we found that yield-stress fluids can move on our surfaces without shearing, essentially sliding like solid bodies. This is very important when you want to maintain the integrity of these materials when they are being processed.” Like the earlier version of slippery surfaces Varanasi and his collaborators created, the new process begins by making a surface that is textured at the nanoscale, either by etching a series of closely spaced pillars or walls on the surface, or mechanically grinding grooves or pits. The resulting texture is designed to have such tiny features that capillary action—the same process that allows trees to draw water up to their highest branches through tiny openings beneath the bark—can act to hold a liquid, such as a lubricating oil, in place on the surface. As a result, any material inside a container with this kind of lining essentially only comes in contact with the lubricating liquid, and slides right off instead of sticking to the solid container wall. The new work described in this paper details the principles the researchers came up with to enable the optimal selection of surface texturing, lubricating material, and manufacturing process for any specific application with its particular combination of materials.

#### Helping batteries to flow

Another important application for the new coatings is in a rapidly developing technology called flow batteries. In these batteries, solid electrodes are replaced by a slurry of tiny particles suspended in liquid, which has the advantage that the capacity of the battery can be increased at any time simply by adding bigger tanks. But the efficiency of such batteries can be limited by the flow rates. Using the new slippery coatings could significantly boost the overall efficiency of such batteries, and Varanasi worked with MIT professors Gareth McKinley and Yet-Ming Chiang on developing such a system led by Solomon and Xinwei Chen, a former postdoc in Chiang's lab. These coatings could resolve a conundrum

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that flow battery designers have faced, because they needed to add carbon to the slurry material to improve its electrical conductivity, but the carbon also made the slurry much thicker and interfered with its movement, leading to “a flow battery that couldn’t flow,” Varanasi says. “Previously flow batteries had a trade-off in that as you add more carbon particles the slurry becomes more conductive, but it also becomes thicker and much more challenging to flow,” says Solomon. “Using slippery surfaces lets us have the best of both worlds by allowing flow of thick, yield-stress slurries.” The improved system allowed the use of a flow electrode formulation that resulted in a fourfold increase in capacity and an 86 percent savings in mechanical power, compared with the use of traditional surfaces. These results were described recently in the journal ACS Applied Energy Materials. “Apart from fabricating a flow battery device which incorporates the slippery surfaces, we also laid out design criteria for their electrochemical, chemical, and thermodynamic stability,” explains Solomon. “Engineering surfaces for a flow battery opens up an entirely new branch of applications that can help meet future energy storage demand.”

Phys.org, 22 April 2019

<http://phys.org>

### **New technique produces longer-lasting lithium batteries**

2019-04-30

The grand challenge to improve energy storage and increase battery life, while ensuring safe operation, is becoming ever-more critical as we become increasingly reliant on this energy source for everything from portable devices to electric vehicles. A Columbia Engineering team led by Yuan Yang, assistant professor of materials science and engineering, has announced that they have developed a new method for safely prolonging battery life by inserting a nano-coating of boron nitride (BN) to stabilise solid electrolytes in lithium metal batteries. Their findings are outlined in a new study published by Joule. While conventional lithium ion (Li-ion) batteries are currently widely used in daily life, they have low energy density, resulting in shorter battery life, and, because of the highly flammable liquid electrolyte inside them, they can short out and even catch fire. Energy density could be improved by using lithium metal to replace the graphite anode used in Li-ion batteries: lithium metal’s theoretical capacity for the amount of charge it can deliver is almost 10 times higher than that of graphite. But during lithium plating, dendrites

**Researchers have developed a new method for safely prolonging battery life by inserting a nano-coating of boron nitride to stabilise solid electrolytes in lithium metal batteries.**

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often form and if they penetrate the membrane separator in the middle of the battery, they can create short-circuits, raising concerns about battery safety. "We decided to focus on solid, ceramic electrolytes. They show great promise in improving both safety and energy density, as compared with conventional, flammable electrolytes in Li-ion batteries," says Yang. "We are particularly interested in rechargeable solid-state lithium batteries because they are promising candidates for next-generation energy storage." Most solid electrolytes are ceramic, and therefore non-flammable, eliminating safety concerns. In addition, solid ceramic electrolytes have a high mechanical strength that can actually suppress lithium dendrite growth, making lithium metal a coating option for battery anodes. However, most solid electrolytes are unstable against Li—they can be easily corroded by lithium metal and cannot be used in batteries. "Lithium metal is indispensable for enhancing energy density and so it's critical that we be able to use it as the anode for solid electrolytes," says Qian Cheng, the paper's lead author and a postdoctoral research scientist in the department of applied physics and applied mathematics who works in Yang's group. "To adapt these unstable solid electrolytes for real-life applications, we needed to develop a chemically and mechanically stable interface to protect these solid electrolytes against the lithium anode. It is essential that the interface not only be highly electronically insulating, but also ionically conducting in order to transport lithium ions. Plus, this interface has to be super-thin to avoid lowering the energy density of batteries." To address these challenges, the team worked with colleagues at Brookhaven National Lab and the City University of New York. They deposited 5~10 nm boron nitride (BN) nano-film as a protective layer to isolate the electrical contact between lithium metal and the ionic conductor (the solid electrolyte), along with a trace quantity of polymer or liquid electrolyte to infiltrate the electrode/electrolyte interface. They selected BN as a protective layer because it is chemically and mechanically stable with lithium metal, providing a high degree of electronic insulation. They designed the BN layer to have intrinsic defects, through which lithium ions can pass through, allowing it to serve as an excellent separator. In addition, BN can be readily prepared by chemical vapor deposition to form large-scale (~dm level), atomically thin scale (~nm level), and continuous films. "While earlier studies used polymeric protection layers as thick as 200  $\mu\text{m}$ , our BN protective film, at only 5~10 nm thick, is record-thin—at the limit of such protection layers—without lowering the energy density of batteries," Cheng says. "It's the perfect material to function as a barrier that prevents the invasion of lithium metal to solid electrolyte. Like a bullet-proof vest, we've developed a lithium-metal-proof 'vest' for unstable solid electrolytes and, with that innovation,

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achieved long cycling lifetime lithium metal batteries."The researchers are now extending their method to a broad range of unstable solid electrolytes and further optimize the interface. They expect to fabricate solid-state batteries with high performance and long-cycle lifetimes.

Phys.org, 22 April 2019

<http://phys.org>

### Wristband samplers show similar chemical exposure across three continents

2019-04-30

To assess differences and trends in personal chemical exposure, Oregon State University researchers deployed chemical-sampling wristbands to individuals on three continents. After they analysed the wristbands that were returned, they found that no two wristbands had identical chemical detections. But the same 14 chemicals were detected in more than 50 percent of the wristbands returned from the United States, Africa and South America. "Whether you are a farmworker in Senegal or a preschooler in Oregon, you might be exposed to those same 14 chemicals that we detected in over 50 percent of the wristbands," said Holly Dixon, a doctoral candidate at Oregon State and the study's lead author. The study, funded by the National Institutes of Health, is published in the journal Royal Society Open Science. This study demonstrates that the wristbands, which absorb chemicals from the air and skin, are an excellent screening tool for population exposures to organic chemicals, said Kim Anderson, an OSU environmental chemist and leader of the research team. It's notable, she said, that most of the 14 common chemicals aren't heavily studied. "Some of these are not on our radar, yet they represent an enormous exposure," she said. "If we want to understand the impact of chemical exposures, this was very enlightening." Anderson and her team invented the wristband samplers several years ago. They have been used in other studies, including one that measured Houston residents' exposure in floodwaters after Hurricane Harvey. In this study, 242 volunteers from 14 communities in four countries -- the United States, Senegal, South Africa and Peru -- wore a total of 262 wristbands. The Houston residents were included in the study. Oregon State researchers analysed the wristbands for 1,530 unique organic chemicals. The number of chemical detections ranged from four to 43 per wristband, with 191 different chemicals detected. And 1,339 chemicals weren't detected in any wristband. They detected 36 chemicals in common in the United States, South America and Africa. Because the wristbands don't measure chemical levels, the study authors

**Researchers have deployed chemicals to individuals on three continents, they found that no two wristbands had identical chemical detections. But the same 14 chemicals were detected in more than 50 percent of the wristbands returned from the United States, Africa and South America.**

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didn't make any conclusions regarding health risks posed by the wearers of wristbands. But certain levels of chemical exposures are associated with adverse health outcomes. For example, exposure to certain polycyclic aromatic hydrocarbons (PAHs) has been associated with cancer, self-regulatory capacity issues, low birth weight and respiratory distress. These chemicals were found in many of the wristbands. Exposure to specific flame retardants, which were found in wristbands in the U.S. and South America, has been associated with cancer, neurotoxicity and cardiotoxicity. And exposure to endocrine-disrupting chemicals (EDCs) has been linked to health effects such as low semen quality, adverse pregnancy outcomes and endocrine-related cancers. The researchers detected 13 potential EDCs in more than half of all the wristbands. Other notable findings in the study included:

- Consumer product-related chemicals and phthalates -- a group of chemicals found in plastics and vinyl -- were a high percentage of chemical detections across all study locations.
- U.S. children -- 11 years old or younger -- had the highest percentage of flame-retardant detections compared with all other participants.
- Wristbands worn in the Houston area immediately after Hurricane Harvey had the highest mean number of chemical detections -- 28 -- compared with other study locations, where the means ranged from 10-25.
- Flame retardants were not detected in any wristbands in Africa. The absence of flame retardants in Senegal and South Africa wristbands may reflect a difference in flammability protection standards, housing materials and/or furniture used in certain Africa communities compared with communities in the U.S. and South America.

Toxicological and epidemiological studies often focus on one chemical or chemical class, yet people are exposed to complex chemical mixtures, rather than to a single chemical or an individual chemical class. The results reveal common chemical mixtures across several communities that can be prioritised for future study, Dixon said. The study authors noted two significant limitations. They relied on a convenience sample of volunteers and did not randomly recruit participants, so the chemical exposures they reported may not be representative of all chemical exposures in the 14 communities. Also, deployment length varied depending on the specific

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project. But they didn't detect a difference in the number of chemicals detected based on how long a participant wore a wristband.

Science Daily, 22 April 2019

<http://www.sciencedaily.com>

### Sensors made from gummy bears could monitor how children chew

2019-04-30

Don't tell the dentist, but electrical engineers want to give sweets to children to check how children chew. A team has used Haribo gummy bears to build a cheap medical device to measure the pressure exerted by teeth and it could help measure signs of child development. Donghyun Lee and Beelee Chua, who created the device at Korea University in Seoul, believe the idea will catch on because the child gets to eat the gummy bear afterwards. "Conventional medical devices often taunt children and some adults with fear with their metallic weirdly shaped appearances," says Lee. Familiar materials should help. "Especially knowing there is a sweet treat at the end," he says. The device is designed to be recyclable, with the gummy bear held between bamboo cantilevers wrapped in conducting aluminium foil. Its name is a mouthful too: a gnathodynamometer. The duo tested the gnathodynamometer with three adults, asking them to bite down for five seconds. The results showed a predictable change in voltage, which though imperceptible to the chewer could be recorded and monitored via two wires connected to the device. This happens because when the sweets are squeezed, their conductivity changes. "Children's masticatory function is an important indicator of their developmental stage," says Lee. Although the device is still in its early stages, it could be used to measure how hard children can bite down to check on how well they have learned to chew, which is important for proper muscle growth around the jaw. This isn't the first time that scientists have investigated the possible electrical applications of a gummy bear. A team in Germany last year printed electrical circuitry onto the sweets as a way to test diagnostic devices made from softer materials. Parents take note: the inventors point out the standard gummy bear used in their gnathodynamometer trials could be replaced with the multi-vitamin variety.

New Scientist, 26 April 2019

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

**There's a sweet new method for studying chewing**

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### Sticky proteins could protect crops more safely than chemical pesticides

2019-04-30

Many pesticides have an inherent weakness: The active ingredients don't adhere well to the plants they protect. After the chemicals are sprayed onto crops, rain can wash them off into the soil and groundwater. Farmers must spray again and hope for dry weather. Now, researchers have devised a stickier approach to protecting plants, one that could be applied less frequently than chemical pesticides and might be less toxic. They have designed a molecule with two separate chains of amino acids, called peptides. One peptide embeds itself in the waxy surface of a leaf, holding tight in the rain; the other juts out like a spear to attack microbial pests. In a proof of concept published this month in *Green Chemistry*, lab tests showed the molecules lessened symptoms of soybean rust, a dreaded fungus that causes one of the world's worst agricultural diseases. The peptides will face many challenges before they can reach the market. But plant pathologists say they could be a flexible new way to protect crops. "With the current scale of the soybean rust problem, and the rapid evolution of resistance against multiple fungicides, any addition to the toolbox would be welcome," says Nichola Hawkins at Rothamsted Research in Harpenden, U.K. Ralph Hückelhoven at the Technical University of Munich in Germany also considers the technique promising. "It opens a treasure box of solutions," he says. "It's a bit surprising that no one has done this before." To make the new pesticide, plant pathologist Uwe Conrath and protein engineer Ulrich Schwaneberg of RWTH Aachen University in Germany teamed up. Schwaneberg specialises in the directed evolution of peptides—adding genes to microbes to produce them, for example, and relying on rounds of mutation and selection to develop strains that produce peptides with improved traits. He has created peptides that attach to slick surfaces such as polypropylene. The team found two that also anchor themselves onto soy leaves. Attaching a fluorescent protein to the anchor peptides showed that about 60% to 70% of the leaf remained covered with them, even after the plant was doused in a rain simulation chamber. These two anchor peptides also clung well to the leaves of barley, corn, blueberry, and other crops. Schwaneberg says they can be engineered to adhere more or less tightly, as desired. The next step was to attach an antimicrobial peptide to the anchor. The team chose dermaseptin, a peptide discovered years ago in the skin of tree frogs. Dermaseptin attacks a broad array of microbes, including bacteria and fungi, somehow rupturing their cell membranes. Conrath notes that pathogens are much less likely to evolve resistance—a problem with

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chemical pesticides—because it is difficult to change the basic structure of cell membranes. When tested on glass slides, the fused peptide was about as effective against soybean rust spores as chemical fungicides. But in lab tests on plants, the peptide reduced symptoms of rust by only about 30%. “It’s not enough,” says Emilio Montesinos, a plant pathologist and agronomist at the University of Girona in Spain. “If you want to extend these results for crop protection, you need to do much more work.” Conrath thinks a tactic already used by industry for other pesticides could yield more potent peptides: adding chemicals to distribute them evenly across leaves. He acknowledges that the peptides are only at the beginning of the pesticide development process, which can last a decade and cost \$200 million on average. RWTH Aachen has patented the concept, and Conrath and Schwaneberg plan to start a company to pursue deals with large pesticide manufacturers. They will need help lowering the cost of making the peptides. One way—engineering microbes to produce the peptides themselves in industrial vats—can be tricky when the desired protein tends to kill the microbes that make it. Another question is safety. Dermaseptin would need to be evaluated for its possible toxicity to humans, as well as the accidental harm it could cause to beneficial insects, fungi, or microbes. “It’s broad-spectrum and it’s persistent, and that creates a regulatory concern,” says Roma Gwynn, who runs Rationale, a pesticide consultancy in Duns, U.K. Studies indicate that dermaseptin does not harm mammalian cells, and any residues could be removed by washing the plant product with enzymes. Microbes would likely break down peptides remaining in the fields, Conrath says. As for target pathogens, the team is already thinking beyond soybean rust. They have showed that dermaseptin-based peptides can help protect maize from the common fungus *Colletotrichum graminicola*. They also want to try attaching the anchor peptide to *Bacillus thuringiensis*, or Bt, an insect-killing microbial toxin widely used by organic farmers and engineered into transgenic crops. Before that, however, Conrath and Schwaneberg plan to outfit their anchors with tiny amounts of copper, commonly used by vineyards and organic farms to fight fungi and other pathogens. This fall, with a €1 million grant from Germany’s Federal Ministry of Food and Agriculture, the team will test the approach in vineyards in southern Germany, which could reduce copper spraying and the runoff that contaminates soil. They’re hoping the idea will stick.

Science, 25 April 2019

<http://sciencemag.org/>

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### New polymer films conduct heat instead of trapping it

2019-04-30

Polymers are usually the go-to material for thermal insulation. Think of a silicone oven mitt, or a Styrofoam coffee cup, both manufactured from polymer materials that are excellent at trapping heat. Now MIT engineers have flipped the picture of the standard polymer insulator, by fabricating thin polymer films that conduct heat—an ability normally associated with metals. In experiments, they found the films, which are thinner than plastic wrap, conduct heat better than many metals, including steel and ceramic. The team's results, published in the journal *Nature Communications*, may spur the development of polymer insulators as lightweight, flexible, and corrosion-resistant alternatives to traditional metal heat conductors, for applications ranging from heat dissipating materials in laptops and cellphones, to cooling elements in cars and refrigerators. "We think this result is a step to stimulate the field," says Gang Chen, the Carl Richard Soderberg Professor of Power Engineering at MIT, and a senior co-author on the paper. "Our bigger vision is, these properties of polymers can create new applications and perhaps new industries, and may replace metals as heat exchangers." Chen's co-authors include lead author Yanfei Xu, along with Daniel Kraemer, Bai Song, Jiawei Zhou, James Loomis, Jianjian Wang, Migda Li, Hadi Ghasemi, Xiaopeng Huang, and Xiaobo Li from MIT, and Zhang Jiang of Argonne National Laboratory. In 2010, the team reported success in fabricating thin fibres of polyethylene that were 300 times more thermally conductive than normal polyethylene, and about as conductive as most metals. Their results, published in *Nature Nanotechnology*, drew the attention of various industries, including manufacturers of heat exchangers, computer core processors, and even race cars. It soon became clear that, in order for polymer conductors to work for any of these applications, the materials would have to be scaled up from ultrathin fibres (a single fibre measured one-hundredth of the diameter of a human hair) to more manageable films. "At that time we said, rather than a single fibre, we can try to make a sheet," Chen says. "It turns out it was a very arduous process." The researchers not only had to come up with a way to fabricate heat-conducting sheets of polymer, but they also had to custom-build an apparatus to test the material's heat conduction, as well as develop computer codes to analyse images of the material's microscopic structures. In the end, the team was able to fabricate thin films of conducting polymer, starting with a commercial polyethylene powder. Normally, the microscopic structure of polyethylene and most polymers resembles a spaghetti-like tangle of molecular chains. Heat has a difficult time flowing through this jumbled mess, which explains a polymer's

**MIT engineers have flipped the picture of the standard polymer insulator, by fabricating thin polymer films that conduct heat—an ability normally associated with metals.**

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intrinsic insulating properties. Xu and her colleagues looked for ways to untangle polyethylene's molecular knots, to form parallel chains along which heat can better conduct. To do this, they dissolved polyethylene powder in a solution that prompted the coiled chains to expand and untangle. A custom-built flow system further untangled the molecular chains, and spit out the solution onto a liquid-nitrogen-cooled plate to form a thick film, which was then placed on a roll-to-roll drawing machine that heated and stretched the film until it was thinner than plastic wrap. The team then built an apparatus to test the film's heat conduction. While most polymers conduct heat at around 0.1 to 0.5 watts per metre per kelvin, Xu found the new polyethylene film measured around 60 watts per meter per kelvin. (Diamond, the best heat-conducting material, comes in at around 2,000 watts per meter per kelvin, while ceramic measures about 30, and steel, around 15.) As it turns out, the team's film is two orders of magnitude more thermally conductive than most polymers, and also more conductive than steel and ceramics. To understand why these engineered polyethylene films have such an unusually high thermal conductivity, the team conducted X-ray scattering experiments at the U.S. Department of Energy's Advanced Photon Source (APS) at the Argonne National Laboratory. "These experiments, at one of the world's most bright synchrotron X-ray facilities, allow us to see the nanoscopic details within the individual fibres that make up the stretched film," Jiang says. By imaging the ultrathin films, the researchers observed that the films exhibiting better heat conduction consisted of nanofibers with less randomly coiled chains, versus those in common polymers, which resemble tangled spaghetti. Their observations could help researchers engineer polymer microstructures to efficiently conduct heat. "This dream work came true in the end," Xu says. Going forward, the researchers are looking for ways to make even better polymer heat conductors, by both adjusting the fabrication process and experimenting with different types of polymers. Zhou points out that the team's polyethylene film conducts heat only along the length of the fibres that make up the film. Such a unidirectional heat conductor could be useful in carrying heat away in a specified direction, inside devices such as laptops and other electronics. But ideally, he says the film should dissipate heat more effectively in any direction. "If we have an isotropic polymer with good heat conductivity, then we can easily blend this material into a composite, and we can

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potentially replace a lot of conductive materials," Zhou says. "So, we're looking into better heat conduction in all three dimensions."

Phys.org, 29 April 2019

<http://phys.org>

### Bridge over coupled waters: Scientists 3D-print all-liquid 'lab on a chip'

2019-04-30

Researchers at DOE's Lawrence Berkeley National Laboratory (Berkeley Lab) have 3D-printed an all-liquid device that, with the click of a button, can be repeatedly reconfigured on demand to serve a wide range of applications -- from making battery materials to screening drug candidates. "What we demonstrated is remarkable. Our 3D-printed device can be programmed to carry out multistep, complex chemical reactions on demand," said Brett Helms, a staff scientist in Berkeley Lab's Materials Sciences Division and Molecular Foundry, who led the study. "What's even more amazing is that this versatile platform can be reconfigured to efficiently and precisely combine molecules to form very specific products, such as organic battery materials." The study's findings, which were reported in the journal *Nature Communications*, is the latest in a series of experiments at Berkeley Lab that fabricate all-liquid materials with a 3D printer. Last year, a study co-authored by Helms and Thomas Russell, a visiting researcher from the University of Massachusetts at Amherst who leads the Adaptive Interfacial Assemblies Toward Structured Liquids Program in Berkeley Lab's Materials Sciences Division, pioneered a new technique for printing various liquid structures -- from droplets to swirling threads of liquid -- within another liquid. "After that successful demonstration, a bunch of us got together to brainstorm on how we could use liquid printing to fabricate a functioning device," said Helms. "Then it occurred to us: If we can print liquids in defined channels and flow contents through them without destroying them, then we could make useful fluidic devices for a wide range of applications, from new types of miniaturised chemical laboratories to even batteries and electronic devices." To make the 3D-printable fluidic device, lead author Wenqian Feng, a postdoctoral researcher in Berkeley Lab's Materials Sciences Division, designed a specially patterned glass substrate. When two liquids -- one containing nanoscale clay particles, another containing polymer particles -- are printed onto the substrate, they come together at the interface of the two liquids and within milliseconds form a very thin channel or tube about 1 millimetre in diameter. Once the channels are

**Researchers have 3D-printed an all-liquid "lab on a chip" that, with the click of a button, can be repeatedly reconfigured on demand to serve a wide range of applications - from making battery materials to screening drug candidates.**

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formed, catalysts can be placed in different channels of the device. The user can then 3D-print bridges between channels, connecting them so that a chemical flowing through them encounters catalysts in a specific order, setting off a cascade of chemical reactions to make specific chemical compounds. And when controlled by a computer, this complex process can be automated “to execute tasks associated with catalyst placement, build liquid bridges within the device, and run reaction sequences needed to make molecules,” said Russell. The multitasking device can also be programmed to function like an artificial circulatory system that separates molecules flowing through the channel and automatically removes unwanted by-products while it continues to print a sequence of bridges to specific catalysts, and carry out the steps of chemical synthesis. “The form and functions of these devices are only limited by the imagination of the researcher,” explained Helms. “Autonomous synthesis is an emerging area of interest in the chemistry and materials communities, and our technique for 3D-printing devices for all-liquid flow chemistry could help to play an important role in establishing the field.” Added Russell: “The combination of materials science and chemistry expertise at Berkeley Lab, along with world-class user facilities available to researchers from all over the world, and the young talent that is drawn to the Lab is unique. We couldn’t have developed this program anywhere else.” The researchers next plan to electrify the walls of the device using conductive nanoparticles to expand the types of reactions that can be explored. “With our technique, we think it should also be possible to create all-liquid circuitry, fuel cells, and even batteries,” said Helms. “It’s been really exciting for our team to combine fluidics and flow chemistry in a way that is both user-friendly and user-programmable.”

Science Daily, 25 April 2019

<http://www.sciencedaily.com>

### Cleaner, cheaper ammonia: Cheaper fertiliser

2019-04-30

Ammonia -- a colourless gas essential for things like fertiliser -- can be made by a new process which is far cleaner, easier and cheaper than the current leading method. UTokyo researchers use readily available lab equipment, recyclable chemicals and a minimum of energy to produce ammonia. Their Samarium-Water Ammonia Production (SWAP) process promises to scale down ammonia production and improve access to ammonia fertiliser to farmers everywhere. In 1900, the global population was under 2 billion, whereas in 2019, it is over 7 billion. This population

**Researchers dramatically clean up ammonia production and cut costs**

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explosion was fuelled in part by rapid advancements in food production, in particular the widespread use of ammonia-based fertilisers. The source of this ammonia was the Haber-Bosch process, and though some say it's one of the most significant achievements of all time it comes with a heavy price. The Haber-Bosch process only converts 10 percent of its source material per cycle so needs to run multiple times to use it all up. One of these source materials is hydrogen ( $H_2$ ) produced using fossil fuels. This is chemically combined with nitrogen ( $N_2$ ) at temperatures of about 400-600 degrees Celsius and pressures of about 100-200 atmospheres, also at great energy cost. Professor Yoshiaki Nishibayashi and his team from the University of Tokyo's Department of Systems Innovation hope to improve the situation with their SWAP process. "Worldwide, the Haber-Bosch process consumes 3 to 5 percent of all-natural gas produced, around 1 or 2 percent of the world's entire energy supply," explained Nishibayashi. "In contrast, leguminous plants have symbiotic nitrogen-fixing bacteria that produce ammonia at atmospheric temperatures and pressures. We isolated this mechanism and reverse engineered its functional component -- nitrogenase." Over many years, Nishibayashi and his team used lab-made catalysts to try and reproduce the way nitrogenase behaves. Others have tried but their catalysts only produce dozens to several hundred ammonia molecules before they expire. Nishibayashi's special molybdenum-based catalyst produces 4,350 ammonia molecules in about four hours before it expires. "Our SWAP process creates ammonia at 300-500 times the rate of the Haber-Bosch process and at 90 percent efficiency," continued Nishibayashi. "Factor in the gargantuan energy savings in the process and sourcing of raw materials and the benefits really show." Anyone with the proper source materials can perform SWAP on a table-top chemistry lab, whereas the Haber-Bosch process requires large-scale industrial equipment. This could afford access to those who lack the capital to invest in such large, expensive equipment. The raw materials themselves are a huge saving in terms of cost and energy. "A strong motivation was to make the SWAP process possible on a desktop scale. I hope to see this process democratize production of fertilisers," said Nishibayashi. "So, it's not just about the upfront costs but also the continued cost and energy savings of raw materials. My team offers this idea to help agricultural practices in the places which need it the most." SWAP takes in nitrogen ( $N_2$ ) from the air -- as the Haber-Bosch process does -- but the special molybdenum-based catalyst combines this with protons ( $H^+$ ) from water and electrons ( $e^-$ ) from samarium ( $SmI_2$ ). Samarium -- also known as Kagan's reagent -- is currently mined and is used up in the SWAP process. However, samarium can be recycled with electricity to replenish its lost electrons and researchers aim to use cheap renewable sources for this in the future.

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"I was pleasantly surprised when we found something as common as water could serve as the proton source; a molybdenum catalyst does not normally allow this, but ours is special," concluded Nishibayashi. "It is the first artificial nitrogen-fixing reaction to reach a rate close to that we see nitrogenase produce in nature. And like the natural process, it is passive, too, so better for the environment. I hope my life's work can be of great benefit to humanity."

Science Daily, 25 April 2019

<http://www.sciencedaily.com>

### Water creates traps in organic electronics

2019-04-30

Poor-quality organic semiconductors can become high-quality semiconductors when manufactured in the correct way. Researchers at Linköping University show in an article in *Nature Materials* that the motion of charges in organic electronic devices is dramatically slowed down by minute amounts of water. The discovery that organic materials, such as polymers, can act as semiconductors led to a Nobel Prize in Chemistry in 2000. Since then, research within organic electronics has truly exploded, not least at Linköping University, which is home to world-leading research in the field. Organic semiconductors, however, do not conduct current as efficiently as, for example, semiconductors of silicon or other inorganic materials. The scientists have discovered that one of the causes of this is the formation of traps in the organic materials in which the charge carriers get stuck. Several research groups around the world have been working hard to understand not only where the traps are located, but also how they can be eliminated. "There are traps in all organic semiconductors, but they are probably a greater problem in n-type materials, since these are generally poorer semiconductors than p-type materials", says Martijn Kemerink, professor of applied physics in the Division for Complex Materials and Devices at Linköping University. Materials of p-type have a positive charge and the charge carriers consist of holes, while materials of n-type have charge carriers in the form of electrons, which gives the material a negative charge. Martijn Kemerink and his colleagues at Linköping University have concluded that water is the villain in the piece. Specifically, the water is thought to sit in nanometre-sized pores in the organic material and is absorbed from the environment. "In a p-type material the dipoles in the water align with their negative ends towards the holes, which are positively charged, and the energy of the complete system is lowered. You could say that the dipoles

**Poor-quality organic semiconductors can become high-quality semiconductors when manufactured in the correct way.**

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embed the charge carriers such that they cannot go anywhere anymore”, says Martijn Kemerink. For n-type materials, the water orients the other way around, but the effect is the same, the charge is trapped. Experiments have been carried out in which the material is heated, to dry it out and cause the water to disappear. It works fine for a while, but the material subsequently re-absorbs water from the surrounding air, and much of the benefit gained by drying disappears. “The more water, the more traps. We have also shown that the drier the films can be manufactured, the better conductors they are. The theoretical work by Mathieu Linares quantitatively confirmed our ideas about what was going on, that which was very satisfactory. Our article in Nature Materials shows not only how to get the water out, but also how to make sure that the water stays out, in order to produce an organic material with stable conductivity.” In order to prevent the reuptake of water into the material once it has been dried, the scientists have also developed a way to remove the voids into which water molecules otherwise would have penetrated. This method is based on a combination of heating the material in the presence of a suitable organic solvent. “Materials that were previously believed to be extremely poor semiconductors can instead become good semiconductors, as long as they are manufactured in a dry atmosphere. We have shown that dry-prepared materials tend to remain dry, while materials that are made in the presence of water can be dried. The latter are, however, extremely sensitive to water. This is true of the materials we have tested, but there’s nothing to suggest that other organic semiconducting materials behave differently”, says Martijn Kemerink.

Phys.org, 29 April 2019

<http://phys.org>

## Highly resorptive metal-organic frameworks

2019-04-30

Gases and pollutants can be filtered from air and liquids by means of porous, crystalline materials, such as metal-organic frameworks (MOFs). To further partition these pores and enhance their sorption capacity, a team of scientists have developed a fast and versatile two-in-one synthetic strategy, combining metal coordination with the covalent chemistry of light elements. As detailed in a study in the journal *Angewandte Chemie*, the new pore-space-partitioned material could be used as a highly efficient adsorbent of ammonia. The structure of MOFs is a coordinative network of metals with organic linkers, which builds up a large and symmetric three-dimensional porous network. Gases can diffuse in and

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out of the pores. Once in a MOF, gas molecules adsorb at adsorption sites provided by the metal ions and the linker molecules. However, small gas molecules such as CO<sub>2</sub>, acetylene, and ammonia do not need large pores to be trapped, and it turns out that sometimes a denser network and more adsorption sites can enhance the capacity of a MOF. Therefore, a team of scientists led by Pingyun Feng at the University of California, USA, attempted to partition the pores with covalent ligands—spacer molecules that assemble through chemical reactions. Partitioning has the additional advantage that it could make the MOF more stable. Instability is one of the reasons why MOFs have not found widespread use yet, although they are far more efficient gas sorption materials than, for example, zeolites and activated carbon. Feng's team, including graduate student Yanxiang Wang, chose the aromatic molecule pyridine-4-boronic acid as a partitioning molecule. This is an unusual ligand. It combines two different light elements with complementary reactivity: boron is a Lewis acid and tends to catch agents with high electron density, while the pyridinic nitrogen is a Lewis base searching for Lewis acids to react with. Under normal conditions, these molecules would simply attack each other and cause many non-targeted reactions. However, this did not happen here because the authors integrated the pyridine-4-boronic acid reaction into the metal coordination reaction that builds up the MOF. Both covalent and coordinative reactions acted synergistically and protected the pyridine-4-boronic acid from side reactions. A trimer formed that fitted neatly into the hexagonal pores of the MOF. The result was a MOF with an integrated covalent organic network, or "pore-space partitioned MOF", providing many new sites for gas adsorption. The scientists synthesised several of these MOFs, each with a different combination of metals and organic ligands. The new pore-space-partitioned MOFs showed better gas uptakes than those that were unpartitioned. Moreover, the exposed boron Lewis acid sites of the partitioning ligands permitted ammonia uptake with a high packing density. This work presents an advancement in MOF synthesis and performance. Reactions that were not deemed possible—such as neat trimerization of a pyridineboronic acid—are achieved and may lead to highly useful components.

Phys.org, 29 April 2019

<http://phys.org>

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### Extra Tough Supercapacitor Keeps Charge After 40 Hammer Strikes

2019-04-30

A new energy storage device can withstand a hammer striking it more than 40 times and is also non-flammable, unlike lithium-ion batteries, report researchers. "Accidentally dropping electronics, such as a laptop or cellphone, is a common scenario that may lead to the failure of the device," says Julio D'Arcy, assistant professor of chemistry at Washington University in St. Louis. "In some cases, energy storage devices catch on fire due to impact-caused failure. The chance of impact damage will only increase as electronics become more flexible and worn on the human body." By controlling the formation of rust in solution, researchers grew a micrometre-thick porous mat of conducting fibres affixed to a soft, pliable layer of organic plastic. The result is somewhat similar to an open-faced sandwich. "This is the same mechanism that is responsible for the formation of rust on the surface of a wet piece of steel," D'Arcy says. "Here, we have carefully designed the nanostructure orientation so that a polymer film assembles parallel to a rusted surface. It produces an interwoven mat of polymer nanofibers with a textile-like structure that is flexible and ideal for storing energy in a supercapacitor." The researchers bent their new material to different angles over and over again. They hammered it repeatedly, and they also tested it against an impact equivalent to a car collision at 30 mph. The same amount of impact would fracture other materials such as metal and carbon. The shatterproof supercapacitor held up well against these extreme tests: after the first hammer strike, it retained 80 percent of its ability to store energy at peak efficiencies; after 40 repeated strikes, it was still at 74 percent.

Futurity, 28 April 2019

<http://www.futurity.org>

### Amazing Device Turns Thoughts Into Audible Sentences

2019-04-30

A new brain-computer interface device decodes brain activity to figure out what someone is trying to say, and uses that data to synthesise full, audible sentences. The device is far from perfect and the research is still in its early stages, but the device is the first to recreate a full sentence in a way that was understandable to someone else, according to Scientific American — a ray of hope for people who who've lost their ability to communicate from strokes or other conditions. The University

**A new energy storage device can withstand a hammer striking it more than 40 times and is also non-flammable, unlike lithium-ion batteries, report researchers.**

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of California, San Francisco researchers behind the device found that trying to directly translate the brain's behaviour into audible speech was too complex, according to research published in the journal Nature on Thursday. Instead, they used artificial intelligence to correlate signals that the brain sent to participants' vocal tracts that corresponded with specific vocabulary, ultimately simulating the vocal tract's behaviour to generate realistic-sounding words. In a test run, the device was able to synthesize speech while people were silently mouthing words. People who listened to and tried to transcribe the machine-generated sentences misunderstood at least one word more than half the time, but the fact that they ever got it right represents progress over existing systems. "For someone who's locked in and can't communicate at all, a few minor errors would be acceptable," Northwestern University neuroengineer Marc Slutzky, who has pursued similar projects, told SciAm. "Obviously you'd want to [be able to] say any word you'd want to, but it would still be a lot better than having to type out words one letter at a time, which is the [current] state of the art."

Futurism, 25 April 2019

<https://futurism.com>

### Distribution of World's First Malaria Vaccine Begins

2019-04-30

A program to vaccinate young children in high-risk areas for malaria begins 23 April in Malawi, and will soon roll out in Ghana and Kenya, the World Health Organization announced. WHO plans to pilot the use of the vaccine in conjunction with other preventive measures such as mosquito nets and insecticides. The immunisation requires four doses per child and prevents four in 10 cases of malaria, according to clinical trials. "This is a bold thing to do, but it's not a silver bullet," Thomas Churcher, a malaria expert at Imperial College London, tells the Associated Press. "As long as using the vaccine doesn't interfere with other efforts, like the urgent need for new insecticides, it is a good thing to do." The vaccine, made by GSK, is the first against a parasite, STAT notes. While its effectiveness is far lower than that of most vaccines, and delivering the required four doses may present logistical challenges, WHO hopes it will boost efforts to combat malaria, which kills 250,000 children each year in Africa alone. "We have seen tremendous gains from bed nets and other measures to control malaria in the last 15 years, but progress has stalled and even reversed in some areas. We need new solutions to get the malaria response back on track, and this vaccine gives us a promising tool to get there," says WHO

**The World Health Organization and its partners will test the public health effect of immunisation in parts of Malawi, Ghana, and Kenya.**

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Director-General Tedros Adhanom Ghebreyesus in the agency's statement. "The malaria vaccine has the potential to save tens of thousands of children's lives." The pilot program aims to reach about 360,000 children each year.

The Scientist, 23 April 2019

<http://www.the-scientist.com>

### Squid skin inspires creation of next-generation space blanket

2019-04-30

Drawing design inspiration from the skin of stealthy sea creatures, engineers at the University of California, Irvine have developed a next-generation, adaptive space blanket that gives users the ability to control their temperature. The innovation is detailed in a study published today in Nature Communications. "Ultra-lightweight space blankets have been around for decades -- you see marathon runners wrapping themselves in them to prevent the loss of body heat after a race -- but the key drawback is that the material is static," said co-author Alon Gorodetsky, UCI associate professor of chemical & biomolecular engineering. "We've made a version with changeable properties so you can regulate how much heat is trapped or released." The UCI researchers took design cues from various species of squids, octopuses and cuttlefish that use their adaptive, dynamic skin to thrive in aquatic environments. A cephalopod's unique ability to camouflage itself by rapidly changing colour is due, in part, to skin cells called chromatophores that can instantly change from minute points to flattened disks. "We use a similar concept in our work, where we have a layer of these tiny metal 'islands' that border each other," said lead author Erica Leung, a UCI graduate student in chemical & biomolecular engineering. "In the relaxed state, the islands are bunched together and the material reflects and traps heat, like a traditional Mylar space blanket. When the material is stretched, the islands spread apart, allowing infrared radiation to go through and heat to escape." Gorodetsky said he has many more applications in mind for the novel material: as reflective inserts in buildings to provide an insulation layer that adapts to different environmental conditions; to fabricate tents that would be exceptionally good at keeping occupants comfortable outdoors; and to effectively manage the temperature of valuable electronic components. Clothing would be a particularly fitting application for the new, bio-inspired material, according to Gorodetsky, who collaborates on research projects with counterparts at athletic apparel manufacturer Under Armour Inc.

**Drawing design inspiration from the skin of stealthy sea creatures, engineers have developed a next-generation, adaptive space blanket that gives users the ability to control their temperature.**

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"The temperature at which people are comfortable in an office is slightly different for everyone. Where one person might be fine at 70 degrees, the person at the next desk over might prefer 75 degrees," he said. "Our invention could lead to clothing that adjusts to suit the comfort of each person indoors. This could result in potential savings of 30 to 40 percent on heating and air conditioning energy use." And those marathon runners who wrap themselves in space blankets might be able to type in a number on a garment-integrated user interface to achieve the desired level of thermal comfort, optimizing performance during races and recovery afterward. Other benefits Leung mentioned include the material's light weight, ease and low cost of manufacturing, and durability. She noted that it can be stretched and returned to its original state thousands of times.

Science Daily, 29 April 2019

<http://www.sciencedaily.com>

### Record solar hydrogen production with concentrated sunlight

2019-04-30

Hydrogen will play a key role in reducing our dependence on fossil fuels. It can be sustainably produced by using solar energy to split water molecules. The resulting clean energy can be stored, used to fuel cars or converted into electricity on demand. But making it reliably on a large scale and at an affordable cost is a challenge for researchers. Efficient solar hydrogen production requires rare and expensive materials - for both the solar cells and the catalyst - in order to collect energy and then convert it. Scientists at EPFL's Laboratory of Renewable Energy Science and Engineering (LRESE) came up with the idea of concentrating solar irradiation to produce a larger amount of hydrogen over a given area at a lower cost. They developed an enhanced photo-electrochemical system that, when used in conjunction with concentrated solar irradiation and smart thermal management, can turn solar power into hydrogen with a 17% conversion rate and unprecedented power and current density. What's more, their technology is stable and can handle the stochastic dynamics of daily solar irradiation. The results of their research have just been published in Nature Energy. "In our device, a thin layer of water runs over a solar cell to cool it. The system temperature remains relatively low, allowing the solar cell to deliver better performance," says Saurabh Tembhurne, a co-author of the study. "At the same time, the heat extracted by the water is transferred to catalysts, thereby improving the chemical reaction and increasing the hydrogen production rate," adds Fredy

**Scientists at EPFL's Laboratory of Renewable Energy Science and Engineering (LRESE) came up with the idea of concentrating solar irradiation to produce a larger amount of hydrogen over a given area at a lower cost.**

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Nandjou, a researcher at the LRESE. Hydrogen production is therefore optimised at each step of the conversion process. The scientists used the LRESE's unique solar simulator to demonstrate the stable performance of their device. The results from the lab-scale demonstrations were so promising that the device has been upscaled and is now being tested outdoors, on EPFL's Lausanne campus. The research team installed a 7-metre diameter parabolic mirror that concentrates solar irradiation by a factor of 1,000 and drives the device. The first tests are under way.

#### Hydrogen stations

The scientists estimate that their system can run for over 30,000 hours - or nearly four years - without any part replacements, and up to 20 years if some parts are replaced every four years. Their solar concentrator turns and follows the sun across the sky in order to maximise its yield. Sophia Haussener, the head of the LRESE and the project lead, explains: "In sunny weather, our system can generate up to 1 kilogram of hydrogen per day, which is enough fuel for a hydrogen-powered car to travel 100 to 150 kilometres." For distributed, large-scale hydrogen generation, several concentrator systems could be used together to produce hydrogen at chemical plants or for hydrogen stations. Tembhurne and Haussener are planning to take their technology from the lab to industry with a spin-off company called SoHHytec.

#### Open source software

Thanks to an open interface, it will be possible to monitor the instantaneous performance of the system. As part of their research, the scientists also performed a technological and economic feasibility study and developed an open-source software program called SPECDO (Solar PhotoElectroChemical Device Optimization, <http://specdo.epfl.ch>). This program can help engineers design components for low-cost photoelectrochemical systems for producing solar hydrogen. Additionally, they provided a dynamic benchmarking tool called SPECDC (Solar PhotoElectroChemical Device Comparison), for the comparison and assessment of all photoelectrochemical system demonstrations.

EurekAlert, 29 April 2019

<http://www.eurekalert.org>

**Researchers have discovered that graphene is capable of purifying water, making it drinkable, without further chlorination.**

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### How to purify water with graphene

2019-04-30

Scientists from the National University of Science and Technology "MISIS" together with their colleagues from Derzhavin Tambov State University and Saratov Chernyshevsky State University have figured out that graphene is capable of purifying water, making it drinkable, without further chlorination. "Capturing" bacterial cells, it forms flakes that can be easily extracted from the water. Graphene separated by ultrasound can be reused. The article on the research is published in Materials Science & Engineering C. Graphene and graphene oxide (a more stable version of the material in colloidal solutions) are carbon nanostructures that are extremely promising for Biomedicine. For example, it can be used for targeted drug delivery on graphene "scales" and for tumour imaging. Another interesting property of graphene and graphene oxide is the ability to destroy bacterial cells, even without the additional use of antibiotic drugs. Scientists from the National University of Science and Technology "MISIS" together with their colleagues from Derzhavin Tambov State University and Saratov Chernyshevsky State University have conducted an experiment, injecting graphene oxide into solutions (nutrient medium and the saline) containing E.coli. Under the terms of the experiment, saline "simulated" water, and the nutrient medium simulated human body medium. The results showed that the graphene oxide along with the living and the destroyed bacteria form flakes inside the solutions. The resulting mass can be easily extracted, making water almost completely free of bacteria. If the extracted mass is then treated with ultrasound, graphene can be separated and reused. "As working solutions, we chose a nutrient medium for the cultivation of bacteria (it is to the natural habitat of bacteria), as well as ordinary saline, which is used for injections. As a tested bacterial culture, E. coli modified with a luminescent agent was used to facilitate visualisation of the experiments, was used", Aleksandr Gusev, one of the authors, Associate Professor of NUST MISIS Department of Functional Nanosystems and High-Temperature Materials, comments. Graphene oxide was added to the nutrient solution in different concentrations - 0.0025 g/l, 0, 025 g/l, 0.25 g/l and 2.5 g/l. As it turned out, even at a minimum concentration of graphene oxide in saline (water), the observed antibacterial effect was significantly higher than in the nutrient medium (human body). Scientists believe that this indicates not a mechanical, but a biochemical nature of the mechanism of action, that is, since there are far fewer nutrients in the saline solution, the bacteria moved more actively and was "captured" by the scales of graphene oxide more often. According to the fluorescent test data, confirmed by

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laser confocal microscopy and scanning electron microscopy, at 2.5 g/l concentration of graphene oxide, the number of bacteria decreased several times compared to the control group and became close to zero. While it is not yet known exactly how the further destruction of bacteria occurs, researchers believe that graphene oxide provokes the formation of free radicals that are harmful to bacteria. According to scientists, if such a purification system is used for water, it will be possible to avoid additional chlorination. There are other advantages: decontamination with graphene oxide has a low cost, in addition, this technology is easy to scale to the format of large urban wastewater treatment plants.

EurekaAlert, 29 April 2019

<http://www.eurekaalert.org>

### **Chemists make thermoset polymer using amine and triketone that is recyclable**

2019-04-30

A team of researchers at Lawrence Berkeley National Laboratory has devised a way to make a type of recyclable thermoset plastic. In their paper published in the journal *Nature Chemistry*, the group describes combining two particular types of monomers to form a common type of polymer that can be recycled using an acid. Coralie Jehanno and Haritz Sardon with the University of the Basque Country UPV/EHU have published a News and Views piece outlining the work by the team in California in the same journal issue. Plastics have become an environmental problem. Companies make them and use them in a wide variety of applications. Other businesses and consumers make use of the plastics and then discard them. But because they do not degrade very rapidly, they are building up in landfills and the ocean. One particular polymer, known as a thermoset, is particularly troublesome because it is widely used and does not recycle easily. In this new effort, the researchers report a way to make a type of thermoset that can be broken down into its component parts using an acid and then recycled. To come up with the right ingredients, the researchers looked for monomers they could use in a closed-loop cycle (in which the monomer building blocks are recovered) as part of recycling. They finally landed on the monomers amine and triketone. The researchers found they could use them to make a thermoset polymer simply by grinding the two together. Further work showed that if the polymer was soaked in a strong acid for 12 hours, the diketoenamine bonding network would release its bonds, separating the monomers. Next, they found the monomers could be separated and

**A team of researchers at Lawrence Berkeley National Laboratory has devised a way to make a type of recyclable thermoset plastic.**

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collected using an operationally simple procedure and then reused to make new thermosets that were nearly identical in nature to the original they had made. The researchers then tested their technique in conditions with other materials in the resultant polymer, such as fiberglass or flame retardants. They report that such additives did not prevent the recovery of the monomers or contaminate the new thermosets that were made from them. They also note that much more testing of their technique is required to make sure the thermosets are safe to use and that they do not create other environmental problems.

Phys.org, 29 April 2019

<http://phys.org>

### Ice-proof coating for big structures relies on a 'beautiful demonstration of mechanics'

2019-04-30

A new class of coatings that sheds ice effortlessly from even large surfaces has moved researchers closer to their decades-long goal of ice-proofing cargo ships, airplanes, power lines and other large structures. The spray-on coatings, developed at the University of Michigan, cause ice to fall away from structures—regardless of their size—with just the force of a light breeze, or often the weight of the ice itself. A paper on the research is published in *Science*. In a test on a mock power line, the coating shed ice immediately. The researchers overcame a major limitation of previous ice-repellent coatings—while they worked well on small areas, researchers found in field testing that they didn't shed ice on very large surfaces as effectively as they had hoped. That's an issue, since ice tends to cause the biggest problems on the biggest surfaces—sapping efficiency, jeopardising safety and necessitating costly removal. They cleared this hurdle with a "beautiful demonstration of mechanics." Anish Tuteja, an associate professor of materials science and engineering, described how he and his colleagues turned to a property that isn't well-known in icing research. "For decades, coating research has focused on lowering adhesion strength—the force per unit area required to tear a sheet of ice from a surface," Tuteja said. "The problem with this strategy is that the larger the sheet of ice, the more force is required. We found that we were bumping up against the limits of low adhesion strength, and our coatings became ineffective once the surface area got large enough." The new coatings solve the problem by introducing a second strategy: low interfacial toughness, abbreviated LIT. Surfaces with low interfacial toughness encourage cracks to form between ice and the surface. And

**Researchers at the University of Michigan have created a coating that sheds ice off large surfaces.**

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unlike breaking an ice sheet's surface adhesion, which requires tearing the entire sheet free, a crack only breaks the surface free along its leading edge. Once that crack starts, it can quickly spread across the entire iced surface, regardless of its size. "Imagine pulling a rug across a floor," said Michael Thouless, the Janine Johnson Weins Professor of Engineering in mechanical engineering. "The larger the rug, the harder it is to move. You are resisted by the strength of the entire interface between the rug and floor. The frictional force is analogous to the interfacial strength. "But now imagine there's a wrinkle in that rug. It's easy to keep pushing that wrinkle across the rug, regardless of how big the rug is. The resistance to propagating the wrinkle is analogous to the interfacial toughness that resists the propagation of a crack." Thouless said the concept of interfacial toughness is well known in the field of fracture mechanics, where it underpins products like laminated surfaces and adhesive-based aircraft joints. But until now, it hadn't been applied in ice mitigation. The advance came when Thouless learned of Tuteja's previous work and saw an opportunity. "Traditionally, fracture mechanics researchers only care about interfacial toughness, and ice mitigation researchers often only care about interfacial strength," Thouless said. "But both parameters are important for understanding adhesion. "I pointed out to Anish that if he were to test increasing lengths of ice, he would find the failure load would rise while interfacial strength was important, but then plateau once toughness became important. Anish and his students tried the experiments and ended up with a really beautiful demonstration of the mechanics, and a new concept for ice adhesion." To test the idea, Tuteja's team used a technique he honed during previous coating research. By mapping out the properties of a vast library of substances and adding interfacial toughness as well as adhesion strength to the equation, they were able to mathematically predict the properties of a coating without the need to physically test each one. This enabled them to concoct a wide variety of combinations, each with a specifically tailored balance between interfacial toughness and adhesion strength. They tested a variety of coatings on large surfaces—a rigid aluminium sheet approximately 3 feet square, and a flexible aluminium piece approximately 1 inch wide and 3 feet long, to mimic a power line. On every surface, ice fell off immediately due to its own weight. It stuck fast, however, to the control surfaces, which were identical in size—one was uncoated and another was coated with an

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earlier icephobic coating. The team's next step is to improve its durability of the LIT coatings.

Phys.org, 25 April 2019

<http://phys.org>

### Caffeine gives solar cells an energy boost

2019-04-30

Scientists from the University of California, Los Angeles (UCLA) and Solargiga Energy in China have discovered that caffeine can help make a promising alternative to traditional solar cells more efficient at converting light to electricity. Their research, published April 25 in the journal *Joule*, may enable this cost-effective renewable energy technology to compete on the market with silicon solar cells. The idea began as a joke over morning coffee. "One day, as we were discussing perovskite solar cells, our colleague Rui Wang said, 'If we need coffee to boost our energy then what about perovskites? Would they need coffee to perform better?'" recalls Jingjing Xue, a PhD candidate in Professor Yang Yang's research group at the Department of Materials Science and Engineering at UCLA. The offhand comment led the team to recall that the caffeine in coffee is an alkaloid compound containing molecular structures that could interact with the precursors of perovskite materials -- compounds with a particular crystal structure that form the light-harvesting layer in a class of solar cells. Previous attempts to improve the thermal stability of these solar cells have included enhancing the perovskite layer by introducing compounds such as dimethyl sulfoxide, but researchers have struggled to boost the cells' efficiency and long-term stability. No one had tried caffeine. Realising they might be onto something, the team set aside their coffee and began investigating further. They added caffeine to the perovskite layer of forty solar cells and used infrared spectroscopy (which uses infrared radiation to identify chemical compounds) to determine that the caffeine had successfully bonded with the material. Conducting further infrared spectroscopy tests, they observed that the carbonyl groups (a carbon atom double bonded to an oxygen) in caffeine interacted with lead ions in the layer to create a "molecular lock." This interaction increased the minimum amount of energy required for the perovskite film to react, boosting the solar cell efficiency from 17 percent to over 20 percent. The molecular lock continued to occur when the material was heated, which could help prevent heat from breaking down the layer. "We were surprised by the results," says Wang, who is also a PhD candidate in Yang's research group at UCLA. "During our first try incorporating caffeine, our

**Scientists have discovered that caffeine can help make a promising alternative to traditional solar cells more efficient at converting light to electricity.**

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perovskite solar cells already reached almost the highest efficiency we achieved in the paper." But while caffeine appears to significantly improve the performance of cells that utilise perovskite to absorb sunlight, the researchers do not think it will be useful for other types of solar cells. The unique molecular structure of caffeine only allows it to interact with perovskite precursors, which may give this solar cell variety an edge on the market. Perovskite solar cells already have the advantage of being cheaper and more flexible than their silicon counterparts. They are also easier to manufacture -- perovskite cells can be fabricated from solution-based precursors as opposed to solid crystal ingots. With further research, Wang believes caffeine may facilitate large-scale production of perovskite solar cells. "Caffeine can help the perovskite achieve high crystallinity, low defects, and good stability," he says. "This means it can potentially play a role in the scalable production of perovskite solar cells." In order to continue enhancing the solar cells' efficiency and stability, the team next plans to further investigate the chemical structure of the caffeine-incorporated perovskite material and to identify the best protective materials for perovskites.

Science Daily, 25 April 2019

<http://www.sciencedaily.com>

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### **Chemical burns and toxic sludge: workers expose shocking conditions inside the Melbourne factory that blew up**

2019-05-01

Long before Melbourne's northern suburbs were choked with acrid smoke from a mammoth factory fire earlier this month, workers inside were finishing their shifts covered in toxic sludge and struggling to breathe. It's now known the factory was home to a vast illegal chemical waste dump — one internal EPA documents allege was linked to a criminal network responsible for more than a dozen similar illicit waste dumps around Melbourne. But multiple employees at the Campbellfield company describe a warehouse in the lead-up to the fire where chemical drums were not correctly stored and where workers wearing inadequate safety equipment were frequently covered in chemicals that caused physical and respiratory problems. "I had burns all over my body due to handling some chemicals. They did not tell me what chemicals they were," said one worker, Muththukirishnan Karththikeyan. "Sometimes, it burns. If I tell them that I got burns from the chemicals, they would say 'that's how it is. It'll just be like that for a short period of time,' and then they would just apply a cream." Employees told the ABC that the company — Bradbury Industrial Services — were able to get away with it, as managers were forewarned days ahead of EPA inspections and would order workers to hide chemicals to deceive inspectors. "They would tell us that EPA is coming a day or two prior to EPA coming. They took away all the things from there to another store. They transferred using a truck," said another worker, who did not want to be named. Employees also told the ABC they would only be given appropriate safety clothing during inspections by the EPA, but would otherwise have to supply their own basic cotton or polyester uniforms. "If EPA comes, they would make the company seem safe, only that day," Mr Karththikeyan said. "If EPA is coming, on that particular day, all safety goggles must be worn, and a mask must be worn. Protective outfit would also be provided. Everything has to be worn only on the day EPA comes." Bradbury eventually had its license suspended for storing three times the amount of waste it was entitled to and was being investigated in the days prior to the massive fire on April 5. The fire shut down nearby schools in Melbourne's northern suburbs and families were urged to stay indoors, while there were reports of chemical drums being sent flying dozens of metres into the air as a result of the explosion. In a statement, EPA chief executive Cathy Wilkinson acknowledged the regulator did flag inspections in advance, but in

**Long before Melbourne's northern suburbs were choked with acrid smoke from a mammoth factory fire earlier this month, workers inside were finishing their shifts covered in toxic sludge and struggling to breathe.**

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the wake of the two warehouse fires, it was increasing its number of unannounced inspections. "EPA conducts a combination of announced and unannounced inspections with an increased focus on unannounced inspections," Dr Wilkinson said. "EPA is investing \$5.5 million to switch to a fully GPS electronic waste tracking system to better record the production, movement and receipt of prescribed industrial waste which will provide improved quality data, helping us to detect potential risks and intervene earlier. "With the Bradbury situation under multiple investigations, EPA is limited about what can be discussed." Many of the workers at the Campbellfield premises are Sri Lankan Tamils and speak limited English. One worker — Vignesh Varatharaj — was badly injured and had his face burned on the day of the fire after he says a chemical barrel exploded next to him. A crowdfunding page has so far raised over \$24,000 to help with his medical costs. A photograph supplied to the ABC appears to show a separate worker's torso covered in blisters, which his colleagues said was a result of him being exposed to chemicals while working prior to the factory fire. "All the chemicals caused blisters all over his body. They didn't take him to the hospital. He went on his own," Mr Karththikeyan said. "I think they told him at the hospital that the chemical was the problem, which caused an allergic reaction and hence this resulted. When he told this to the manager lady, the boss told him 'it was not caused by the chemicals. Your body has allergy.'" Employees said they were too afraid to complain about the conditions at the warehouse because they risked losing their jobs. "You can't complain like that there. You can't say that to them. If you tell them, they would say that they would fire you from work. They would scare us by saying that they would fire us from work if we talk too much," said Mr Karththikeyan. He provided the ABC with photographs of him and a colleague during a shift after having their skin and clothing caked in toxic sludge. He said if workers complained about having difficulty breathing while being exposed to chemicals, they were told to simply take chemical drums outside and continue working.

#### Criminal links swirl around factory's owners

Last year, Bradbury was forced to back-pay a number of workers who were found to have been underpaid. It is understood that the former manager of Bradbury, Mark Anderson, was convicted in 2007 in Victoria of stealing more than \$1.3 million from a New South Wales car dealership of which he was the managing director. It appears that he was known by another name when he was prosecuted. The EPA documents obtained by the ABC suggest that Mr Anderson also has links to greyhound trainers in NSW who were banned after their dogs tested positive for illicit substances.

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The documents also suggest that some clients of Bradbury, who paid the company to remove and dispose of chemicals, may have known Bradbury was incorrectly storing the products. The documents also list a number of clients, which include medical laboratories and some of Australia's biggest paint manufacturers. A number of industry sources have told the ABC that Bradbury was undercutting other companies by offering dramatically lower prices to dispose of chemicals. They said other players in the industry wondered how Bradbury could have lawfully disposed of the quantities of chemicals the company was taking in. One man allegedly linked by the EPA to Bradbury, Graham Leslie White, was recently jailed for illegally possessing weapons, including a loaded machine gun. It is also suspected that White was dumping toxic and flammable solvents at a property near Kaniva, in the west of Victoria. Representatives from Bradbury did not respond to the ABC's attempts to seek comment.

ABC News, 22 April 2019

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

### Gold Coast stonemason Anthony White dies from silicosis

2019-05-01

A young Gold Coast stonemason who became the face of the silicosis crisis in the industry has died. Anthony White passed away in the early hours of Saturday morning, his younger brother Shane told nine.com.au. He was just 36 years old. Mr White is believed to be the first stonemason to die of the irreversible lung disease since warnings over the potential scale of the health epidemic were raised last year. Doctors fear the disease could be the "next asbestos" after identifying a sudden spike in the number of stonemasons diagnosed with the condition. Silicosis is caused by long-term exposure to silica dust, which is created when artificial or engineered stone - popular in kitchen bench tops and bathroom vanities - is cut. After working in the industry for more than 10 years, Mr White was diagnosed with silicosis in November 2017 after developing a chest infection that would not clear up. With his health failing and facing the need for a double lung transplant, he spoke out about the lack of regulation in the industry and urged other tradies to get tested. Although he had been ill a for long time, Shane White said his brother's death still came as a shock to his family as his health had seemed to be improving recently. "He said he was starting to feel better. He was saying I feel like everything is starting to go well," he said. Just last week, doctors had judged Mr White's health stable enough to put him on the waiting list for a lung transplant.

**A young Gold Coast stonemason who became the face of the silicosis crisis in the industry has died.**

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“Everything was starting to go on the up for him, so it was quite sudden in that way,” the grieving brother said. Despite the tragedy, he said he was thankful that his brother had not died in a hospital bed. “He was enjoying himself. He was down at the pub. He wasn’t drinking or anything like that. He was just playing the pokies,” he said. Concerned bar staff found Mr White unconscious in the rest room and attempted CPR before calling an ambulance. Although the immediate cause of his death is still unknown, it appears likely that Mr White’s oxygen levels were too low, causing him to lose consciousness. Mr White’s death came at an already difficult time for the family. Just last week Shane, who is also a stonemason, was also diagnosed with silicosis. The brothers worked alongside each other at the same small stone cutting company for the best part of a decade. “When I got my diagnosis, I told Ant straight away. Me and my brother always confided in each other. He was always there for me and I was always there for him,” he said. Doctors have told him his silicosis is less severe than his brother’s. However, it has still meant that he has needed to quit his job and will never work in the industry again. Shane said his brother was quick to find the silver lining. “He told me at least now you are out of the industry. I think he was relieved about that,” he said. In Queensland, 98 stonemasons have so far been diagnosed with silicosis, with 15 of those cases identified as terminal, WorkCover told nine.com.au. The number is expected to increase substantially with a further 800 Queensland workers still waiting on health screenings to be tested for the lung disease. WorkSafe Victoria said it received 29 claims related to silicosis last year, 23 of which were lodged by wall and floor tilers and stonemasons. In NSW last year there were three cases. Silicosis can take up to 15 years to develop. During the same time frame the popularity of engineered stone benchtops has exploded in Australia. The demand for engineered stone, rose so sharply over the years that the White brothers would often work 60-70-hour weeks to keep up with orders, exposing them to even more of the deadly silica dust. Health and safety regulations in the industry were lax, Shane White said. “Everyone was talking about how great it was. It’s a cheap product, easy to handle, and they could make more money off it in the long run. But why wasn’t there a lot more thought put into the hazards of it?,” he said. “In the whole time I was in the industry there was only a handful of companies that I know of that you would get fired from for not wearing your mask. Any other ones it would be a slap on the wrist and put your mask on.” The Queensland government has now banned the dry cutting of engineered stone and there are calls for the rest of the states to follow suit. In October last year, the Council of Australian Governments (COAG) said it would consider starting up a national lung dust disease register for workers. A quiet and unassuming man, Shane said his brother was never

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comfortable in the media spotlight, but was determined to speak out. "As soon as my brother exposed it, it all hit the fan. He has saved lives," he said. Shane said his brother wanted those who failed to regulate the industry or warn of the dangers of silica dust to be held responsible, something that was yet to happen. "Where were the regulations. Someone had to know about how bad this product was previously in Australia. Someone has got to stand up and take responsibility," he said. "How can they keep getting away with this? It baffled us which is why he spoke out about it."

Nine News, 12 March 2019

<http://nine.com.au>

### Review of More Than 300 Studies Shows Whether Caffeine Can Really Boost Your Workout

2019-05-01

Coffee is one of the most popular drinks in the world. Nearly half the adult population in Australia drink it. Aside from enjoying the taste, the main reason we drink coffee is to get caffeine into our bloodstream. Caffeine can help keep you awake, increase alertness, improve your concentration, enhance cognitive performance, and sharpen short-term memory and problem-solving skills. It can also enhance physical performance.

#### We've reviewed the evidence

In a recent umbrella review, we summarised the findings from all meta-analyses that explored the effects of caffeine on exercise performance. A meta-analysis is a method that allows us to combine results from multiple studies to estimate the true effect. Our review included more than 300 primary studies with more than 4,800 participants. We found improvements in sports performance following caffeine intake that range from 2 percent to 16 percent. Those who respond most strongly to caffeine might see improvements of around 16 percent, but this is unusual. For the average person, improvements will likely be between about 2 percent and 6 percent. This may not seem like much in the context of everyday life. But particularly in competitive sports, relatively small improvements in performance can make a big difference. We found caffeine can enhance our ability to run and cycle for longer periods, or to complete a given distance in a shorter time frame. It could also allow us to perform more repetitions with a given weight in the gym, or to increase the total weight lifted.

How does caffeine have these effects?

**A new study has found that caffeine enhances physical performance.**

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When we get tired, a chemical called adenosine binds to its receptors in the brain. The chemical structure of caffeine is similar to that of adenosine, and when ingested, it competes with adenosine for these receptors – which tell our brains how fatigued we are. During waking hours, adenosine slows down brain activity and results in feelings of fatigue. When we have caffeine, the caffeine binds to the adenosine receptors and has the opposite effect of adenosine. It reduces fatigue and our perception of effort (for example, how hard it feels to perform an exercise). Researchers once thought the effects of caffeine would be reduced in people who regularly drink a lot of coffee, but studies have shown that caffeine has performance-enhancing effects regardless of habits.

#### Does coffee = caffeine?

In one study, drinking coffee or taking caffeine in a capsule resulted in similar improvements in cycling performance. When the caffeine dose is matched, caffeine and coffee seem to be equally beneficial for improving performance. But the dose of caffeine in a coffee may vary based on the type of coffee bean, preparation method, and size of the cup. It may also vary between different coffee brands, and even within the same brand at different times. On average though, one cup of brewed coffee usually contains between 95 and 165mg of caffeine. Experts believe caffeine doses between 3 and 6 mg/kg are needed to improve performance. That's 210 to 420mg for a 70-kilogram person (150 pounds), or about two cups of coffee. For safety reasons, those who don't normally drink coffee should begin with a lower dose. The optimal dose, of course, varies between individuals, so there's room to experiment a little. Aside from caffeine capsules or coffee, researchers are exploring other sources of caffeine for their effects on exercise performance. These include chewing gums, bars, mouth rinses, and energy drinks. But this area of research is relatively new and needs further investigation.

How long before my workout should I drink coffee? Experts recommend ingesting caffeine roughly 45-90 minutes before exercising. Some forms of caffeine such as caffeine gum are absorbed faster and can elicit a performance-enhancing effect even when consumed ten minutes before exercise. Does this mean we should all start loading up on caffeine? Well, perhaps not just yet. Although people who ingest caffeine usually improve their performance, for some, the effects may be negligible. And overdosing on caffeine can have some really unpleasant side effects, including insomnia, nervousness, restlessness, stomach irritation, nausea, vomiting, and headaches. A certain amount of individual experimentation is needed to find out if caffeine will improve your exercise performance,

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or just give you a headache. But for those looking for simple ways to gain a slight performance edge, getting more caffeine into your bloodstream might just be the ticket.

Science Alert, 21 April 2019

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

### How to understand the risk of a bacon sandwich giving you bowel cancer

2019-05-01

Is there anything that has not been claimed to cause cancer? In the past few years, we have learned, among other things, that drinking very hot cups of tea leads to an eightfold increase in the risk of developing oesophageal cancer; that a quarter of a grapefruit a day increases breast cancer risk by 30 per cent in post-menopausal women; and, most deliciously, that a daily bacon sandwich raises the likelihood of bowel cancer by 20 per cent. This last finding was encapsulated by the British tabloid *The Sun* in the headline "Careless pork costs lives". These assertions may or may not be valid, but hidden within them is a more important and insidious source of confusion. The figures quoted measure relative risks: how much more likely you are to get ill when indulging in the supposedly dangerous substance or activity compared with not indulging. But they tell you nothing about what that increase in risk amounts to in absolute terms, so there is no way of telling whether it is something worth being concerned about.

#### Scary or not?

"For an average person, the chance of getting bowel cancer at some point in their life is around 5 per cent," says Spiegelhalter. So, a 20 per cent relative increase in bowel cancer risk translates to an absolute increase in risk from 5 per cent to 6 per cent – just 1 per cent. That's big enough not to ignore, but less of a deterrent to those who like their daily bacon sandwich. Journalists are by no means the only ones who exploit the greater headline-grabbing potential of relative risk; health professionals do it too. "One of the most misleading, but rather common, trick is to use relative risks when talking about the benefits of a treatment, while potential harms are given in absolute risks," says Spiegelhalter. This technique is known as mismatched framing. In his book *Reckoning with Risk*, psychologist Gerd Gigerenzer of the Max Planck Institute for Human Development in Berlin, Germany, quotes the example of a patient

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information leaflet concerning hormone replacement therapy. It claimed that HRT cuts the risk of bowel cancer by 50 per cent (a relative risk), but leads to 6 extra cases of breast cancer per 1000 women (an absolute risk). At first glance, the benefit here seems to hugely outweigh the additional breast cancer risk of just 0.6 per cent. But until we know the absolute rates of bowel cancer in the target population, we are none the wiser. Assuming that rate is 5 per cent, as it is in the general population, the reduction in risk is 2.5 per cent, putting the benefit to harm ratio in a very different light. Once you are aware of this trick, it's relatively easy to spot, but this doesn't eradicate it even from peer-reviewed medical journals. According to a study published in 2007, one-third of papers reporting on the benefits and harms of medical interventions in the BMJ, The Lancet and The Journal of the American Medical Association presented them using a mixture of different measures (Medical Care, vol 45, p S23).

New Scientist, 17 April 2019

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

### Dirty air wreaks harm long before birth

2019-05-01

In chunky black glasses and a patterned scarf, her dark hair pulled back, Beate Ritz still looks more the sophisticated European than the casual Californian, even after decades in America. Sunshine streams through a window into her home in the Santa Monica Mountains, above Los Angeles, as we speak on Skype, and she pours herself a cup of tea. Ritz is an epidemiologist at UCLA, and she knows it can be nearly impossible to link one individual's health problem to a specific environmental cause. But the work that would shape her career began with a nagging, personal worry. The smog blanketing L.A. came as a foul shock when she arrived from her native Germany. She was expecting her first child, and the pregnancy was smooth and easy; she swam regularly right until the end. So, when her son was born surprisingly small, the only explanation she could come up with was that exhaust from busy I-10, which passed right above her apartment, must have been to blame. The fear piqued her professional interest, and she began scouring research journals for hints on what the air a woman breathed while pregnant might do to her baby. It was 1990, and Ritz was dismayed to discover there had been almost no studies on the question. Answering it would become her life's work. But first, she had to protect her family, so she and her husband found a new home far from L.A.'s smoggy centre. By the time her second son was born, they'd moved to the coastal enclave of Topanga. He was two pounds heavier than his older brother

**The changes pollution inscribes in pregnancy haunt us not just during childhood, but throughout life**

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had been. Second babies are often bigger than their older siblings, and Ritz knew she couldn't draw any wider conclusions. "That's anecdotal, and as a scientist you wouldn't believe it at all." So, as her little boys grew into young men, she devoted herself to the hard, slow task of gathering the data that would invest her hunch with the authority of science. For she knew that it is not just at the end of life, but also its beginning—before the beginning, even—that the human body is most vulnerable. She would search for the roots of disease in those early months when we are shielded from the world, our lungs not yet drawing breath. She met resistance along the way. Some in her field doubted there could be any link between air quality and the well-being of a foetus, let alone the health of the child it would become. It was easy to believe pollution could affect a woman's lungs, the reviewers considering one of Ritz's early grant applications said, but they couldn't credit the notion that it might travel deeper within her body, deep enough to reach the baby she carried.

An early hint those judges were wrong came when Ritz learned a colleague in Prague had found the molecular fingerprint of central Europe's ubiquitous coal smoke in the placentas and umbilical cord blood of newborns. If contaminants from Czech coal could reach growing foetuses, she knew, American car exhaust could too. The next question was, what did it do to them? The answers, she believed, could be found in the birth certificates of tens of thousands of Californian babies and in the state's registries of congenital defects and childhood cancers. Ritz broke out each child's vital statistics by address, then matched the addresses against local air pollution levels. The analyses took weeks to run on the computers of the 1990s, but got quicker as the technology gained power. Eventually, she found what she was looking for. She tells me how, gradually, she discovered one ailment after another was more prevalent in the children of mothers who had breathed dirty air while pregnant. The particular worry that had started her on this path was borne out: Underweight babies were 10 percent more common for women living near heavy traffic. So were premature births; worse still, extremely premature births were 80 percent more likely. Those findings have serious ramifications, because prematurity and low birth weight are both linked to health problems later in life. Ritz found risks of pre-eclampsia, a potentially serious pregnancy complication, increased with pollution levels too. When I ask whether she now blames pollution for her own son's small size, her reply reflects the scientific rigor that has always guided her: "It's unknowable." Other researchers have linked miscarriage and infertility to pollution. That latter fact touches a painful scar for me, a reminder of the years we spent, and the endless medical appointments, trying to conceive

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the second child I'd always imagined having, the brother or sister that my daughter Anna never got. It's a sadness I've mostly put behind me now, grateful for the healthy, happy kid whose mom I do get to be. But there was a time, not so long ago, when stumbling across a study linking infertility to the kind of pollution my husband and I have breathed for years might have sent me back down a fruitless trail of anger and grief. London's air, of course, may have had nothing to do with our troubles, with the lost dream of that longed-for baby. Some things, as Beate Ritz says, are simply unknowable. That unknowability, the statistical language in which pollution's dangers are inevitably framed, unmoored from any one life, strikes me as yet another reason they are so hard to grasp. Because we don't care, really, about percentages. We care about people, the people we live with, the people we love. So, air pollution has a statistically significant relationship with infertility, with cardiovascular disease. What do I do with that? Is it why I have one child, not two? Did it cause the heart attack that terrified us, years ago, but from which my father, thankfully, recovered fully? There are no answers to those questions. Most of us are not epidemiologists, trained to accept such uncertainty. But so many of the risks in our complicated world present just like this: real, and well documented, shouting for our attention from the headline of a story someone posts online. Yet intangible, diffuse, impossible to pin down. It's a strange, and very modern, kind of anxiety. That is not to say, of course, that the statistics don't matter. When it comes to air pollution, they matter immensely, even when the danger appears, at first blush, to be small. Because the unforgiving logic of mathematics means that when even an innocuous-sounding, single-digit bump in risk is spread over an entire city, region, or nation, more people will draw an unlucky hand than when a health gamble whose odds look scarier is taken by a smaller group, like those who smoke or drink heavily. Ten percent may not sound so bad, but if an extra 10 percent of all babies in the polluted parts of L.A.—or Louisville, or Lagos—are born early, as Beate Ritz found, that adds up to a lot of premature babies. Because we all breathe tainted air, billions of us, just about everywhere, even a tiny upward tick in the incidence of a given ailment translates into vast numbers of victims. The only mystery, really, is who they are.

#### The findings grow more troubling

When the time came to present her first findings, Ritz worried how her colleagues might respond. "I was scared to death to have reviewers tell me again that the foetus does not breathe, and what was I doing," she recalls. As it turned out, she got the opposite response. Scientists were waking up

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to pollution's dangers, and they were eager to hear what she had found. And while Ritz did her work, others had begun similar studies. "Within a few years, it really mushroomed and you could find papers from all over the world reproducing what I've seen in L.A." Many of those studies have been done in China, a nation now engaged in the painful task of grappling with dirty air's effects on its children. As Ritz pressed on, her findings grew more troubling. Low birthweight and early arrival are relatively common. Cancer in children, thankfully, is rarer, so she had to draw on nearly two decades of records to draw firm conclusions. She concentrated on those diagnosed at five or younger, the cases in which, if a connection to some prenatal exposure existed, it would be easiest to trace. What she discovered was chilling. Paediatric leukaemia, kidney cancer, eye tumours, and malignancies in the ovaries and testes of young girls and boys were all more common in children whose mothers breathed traffic exhaust during pregnancy. Diving deeper into the records, she found, too, that babies' death rates—from breathing problems and the unexplained tragedy of SIDS, sudden infant death syndrome—climbed along with pollution levels. Ritz had tied the exhaust floating from millions of tailpipes to the worst kind of grief. She found, too, that heart malformations—tiny, imperfect valves and aortas, holes in the cardiac wall—were three times more common in the children of mothers who had lived with pollution early in pregnancy, when the foetal heart is taking shape. More recently, Ritz added a new wrinkle to the struggle to understand the causes of autism with her finding that women who breathe polluted air while pregnant are more likely to have an autistic child. "We are a whole. Only we have weaknesses." Scientists examining dirty air's effects on adults can look to the bodies of mice and other lab animals to unpick the mechanisms of harm. But those creatures' pregnancies are too dissimilar to ours to offer useful insights, so we know little about exactly how pollution's damage is wrought in utero. Its invisible work may be done as early as the days after conception, when two sets of DNA twist together into one. Toxics might penetrate tiny, developing organs a bit later. Or they could interfere with development indirectly, by sparking reactions in the mother's immune system that have a domino effect on the growing baby. It's entirely possible that the changes pollution inscribes before birth haunt us not just during childhood, but throughout life. It would take decades-long studies to illuminate such connections. And of course, with every year that passes come other experiences and exposures that contribute to the onset of illness, making direct links to prenatal life hard to untangle. But the groundwork that the nine months of gestation, and the first years of childhood, lay for the sickness and health of a lifetime is a burgeoning area of research. Scientists are starting to ask whether airborne toxics might

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wield their power in slow motion, creating a hidden susceptibility that lies dormant for decades, until it is touched by some fresh exposure or trauma. Even those of us apparently unaffected by what we've breathed, in other words, may not have escaped the consequences. We just haven't felt them yet. I tell Ritz how surprised I've been by the sheer range of illnesses linked to dirty air, the terrifying variety of the marks it leaves on us. "It's not surprising to me," she replies. "If you see it all as independent effects on different diseases," then each one is a new, and shocking, piece of news. But if you look at the bigger picture, the interconnected nature of the human body and all its systems, it makes more sense. "We are a whole. Only we have weaknesses. And I guess the disease we get is the one where our weakness kind of overwhelms our defences."

Environmental Health News, 29 April 2019

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

### Is the EPA Stifling Science on Chemical Toxicity Reports?

2019-05-01

The United States Environmental Protection Agency is changing its approach to chemical toxicity oversight, according to a report issued recently by the Government Accountability Office. In the overhaul, the EPA reassigned staff from its Integrated Risk Information System (IRIS)—a program that conducts comprehensive scientific reviews—to duties related to the Toxic Substances Control Act, which has a narrower mandate. The agency has also reduced the number of its ongoing chemical toxicity assessments from 20 to three. Former EPA officials contend the shake-up takes chemical assessments out of the hands of career scientists, potentially to the detriment of public health. The EPA also recently halted release of a long-awaited formaldehyde toxicity assessment. In testimony before a congressional oversight committee on 9 April, EPA Administrator Andrew Wheeler said the study, which had already been completed by IRIS, will instead be reconducted under the TSCA program. Formaldehyde, which is used in manufacturing pressed wood, adhesives and insulation, has been linked to leukaemia. IRIS was created in 1985 to study chemicals' toxicity to humans. The program's assessments "are the preferred source of toxicity information used by the EPA," according to the agency's website, which says EPA program offices (units responsible for specific areas such as air pollution or water quality) use IRIS toxicity values to determine public health risks posed by chemicals. The TSCA, passed in 1976, more narrowly authorises the EPA to review and regulate chemicals determined to pose an "unreasonable

**Critics say changes to the agency's review process will harm public health**

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risk” to human health and the environment. An EPA official, who spoke on the condition of anonymity due to not being authorised to talk to the media, says IRIS and TSCA are “very different” in their approaches to chemical safety regulation. “One could make the argument that this is political interference, in that high-level people are saying which methodology we should be using to assess the safety of a chemical,” the official says. “And the policy’s pretty clear that they’re not supposed to do that.” Under the changes, EPA leadership also now requires a program office to make a formal request for a chemical toxicity assessment before IRIS can release it to the public. According to the GAO report, the EPA’s Office of Research and Development (ORD) informed IRIS officials in June 2018 of this new requirement. The report adds that at the same time, the EPA administrator (then Scott Pruitt, who was succeeded by Wheeler the following month) directed IRIS officials to request reconfirmations of 20 chemical assessments—which were then already under way—from program and regional offices. While those were being compiled, the report says, ORD leadership instructed IRIS not to publicly release any assessment documentation—including chemical assessment documents that were ready for agency or peer review or for public comment. Possibly as a result of these changes, IRIS did not release a new chemical assessment for the remainder of 2018. Genna Reed, a science and policy analyst at the Union of Concerned Scientists, says TSCA has become politicised, and that “shifting IRIS scientists to a more political process to look at these chemicals is undermining the work of EPA’s own scientists.” As evidence of politicisation, Reed points to the 2017 appointment of Nancy Beck—a former lobbyist for the American Chemistry Council—to deputy assistant administrator of the EPA’s Office of Chemical Safety and Pollution Prevention, which implements TSCA. “I really see this as part of a restructuring of EPA in such a way that science will have very little to do with what EPA is basing its regulation on, and that we will end up with much weaker regulations in terms of protecting the public health,” says Bernard Goldstein, who served as EPA assistant administrator for research and development in 1983–85. “It’s troubling, in large part because it’s very consistent with an overall approach—a very astute approach—to take out inconvenient facts.” Thomas Burke, a former EPA lead science adviser and the Deputy Assistant Administrator of the ORD from 2015-17, says “any reduction” of the number of IRIS chemical assessments “is a loss for public health and, unfortunately, puts populations who are exposed at risk.” The IRIS assessment of formaldehyde toxicity was reportedly ready to be made public as early as 2017, but its release was suspended in December 2018. On April 9 this year, EPA Administrator Wheeler told a Congressional Energy and Commerce Committee hearing that the EPA “will not be

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moving forward” with the assessment. Wheeler told the committee formaldehyde will instead be reviewed under the TSCA program; when asked whether the IRIS assessment would ever be made public, he did not answer directly. The EPA office of public affairs had not responded to repeated requests for comment by the time of publication. “If any IRIS assessment has stood the test of review, formaldehyde is one of them,” Burke says. “I think it’s a shame to see that slow-walked and shifted over to [TSCA], where there is a much narrower definition of evaluating potential exposures ... rather than providing a big, robust evaluation of the full body of evidence.” “I am concerned that the EPA under Administrator Wheeler is not carrying out its fundamental responsibility to protect Americans from exposure to harmful toxic chemicals as outlined in the GAO report,” says Representative Mikie Sherrill (D–N.J.), who chairs the House Subcommittee on Investigations and Oversight. Sherrill says the committee “needs to ensure that political interference within the EPA, such as suppressing the formaldehyde report, does not interfere with sound science and our safety.” Wheeler testified that formaldehyde was not one of the chemicals a program office had designated as high-priority during last summer’s review. According to Wheeler, the advantage of using the TSCA risk evaluation process is that it allows for regulation at the end of the process. “If we were to move ahead with the formaldehyde IRIS assessment, it would be a minimum of 18 months,” Wheeler told the committee. “And we decided it was more important to put formaldehyde through the TSCA program, because at the end of the day you can regulate formaldehyde under TSCA.” Burke disagrees with this characterization. The EPA “can use the [IRIS] evidence base for a pervasive environmental contaminant and use the full extent of the statutes,” Burke says. “Moving it to the TSCA program, where the scope would be greatly narrowed, and the evidence base would be narrowed—I wouldn’t agree with that.” Rita Schoeny, who was a senior science advisor at the EPA until 2015, says it is accurate “on paper” that IRIS does not have specific regulatory authority—but that Wheeler’s characterization could lead to misinterpretation. “IRIS is not toothless; it carries a lot of weight,” Schoeny says. “The science, the risk assessment, is an enormous driver in terms of how regulations are set.”

Scientific American, 26 April 2019

<http://www.sciam.com>

**While much of the world struggles to clean up contamination from the toxic industrial compound PFOS, Brazil is still adding to the massive environmental mess with its large-scale production, use, and export of sulfluramid, a pesticide that degrades into PFOS.**

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### Brazil's Pesticide Industry Is Creating Massive PFOS Contamination

2019-05-01

While much of the world struggles to clean up contamination from the toxic industrial compound PFOS, Brazil is still adding to the massive environmental mess with its large-scale production, use, and export of sulfluramid, a pesticide that degrades into PFOS. Linked to low birth weight, weakened immune response, liver effects, high cholesterol, thyroid dysfunction, cancer, and other health problems, PFOS is no longer made or used in most countries. The chemical, which was phased out in the U.S. by 2015, was originally developed by 3M and was a critical component of Scotchgard and firefighting foam. In the 182 countries that are party to the Stockholm Convention, an international treaty (unsigned by the U.S.) that governs persistent pollutants, the use of PFOS has been severely restricted since 2009. But the Stockholm Convention carved out several loopholes for PFOS, including one for its use in killing leaf-cutting ants. Sulfluramid is made from PFOS and breaks down into that and several other chemicals within weeks. Brazil, the only country governed by the treaty that has permission to produce the pesticide, has been able to export it without notifying the convention because the treaty restricts PFOS, but makes no mention of sulfluramid, which is now used widely in Uruguay, Brazil, Argentina, Paraguay, Colombia, and Venezuela, among other countries. Recently, delegates of the Stockholm Convention are meeting in Geneva to discuss whether to close loopholes in the PFOS ban. Environmentalists are pushing to name sulfluramid in the treaty, which would require Brazil to report its sales outside the country and to put a five-year limit on the loophole allowing its use to kill leaf-cutting ants. Pesticide makers from Brazil are expected to push back. Abrisca, a trade association representing the main manufacturers of the pesticide in Brazil, insists that sulfluramid is necessary "to ensure the safety of people and the environment." While green organisations point out that there are ways to kill leaf-cutting ants that don't involve creating persistent toxic waste, the industry group has argued that there are no effective alternatives to sulfluramid. Abrisca did not respond to requests for comment.

"Sulfluramid is Brazil's dirty little secret."

In recent years, as PFOS has been phased out in most of the world, the Brazilian sulfluramid industry has blossomed. In 2008, the country made some 30 tons of the pesticide. By 2015, production had grown to between 40 and 60 tons in 2015, according to the most recent estimates. While the Stockholm treaty language specifically allowed for the use of

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the chemical only to control two species of leaf-cutting ants, products containing sulfluramid such as Mirex-S, Atta Mex-S, and Dinagro-S are now widely available in stores and online for fighting all sorts of insects in Brazil, according to Zuleica Nycz, coordinator of chemical safety and environmental health for the Brazilian group Toxisphera. Yet there is little consumer awareness regarding the hazards of this widely restricted compound. Many households may be sprinkling the chemical, which vegetables can absorb from the soil, in their home gardens without realising its dangers, according to Joe DiGangi, a senior adviser to the international environmental group IPEN. "Sulfluramid is Brazil's dirty little secret," said DiGangi, who will be attending the Geneva meeting. Not surprisingly, as sulfluramid use has grown, there has been a parallel explosion of PFOS contamination in the country. Between 2004 and 2015, sulfluramid production there resulted in up to 487 metric tons of PFOS being released into the environment — a sizable portion of the chemical's global contamination. Meanwhile, PFOS, which persists indefinitely in the environment, has increasingly turned up in soil, plants, coastal waters, and rivers in Brazil. DuPont used to produce sulfluramid in the U.S., where it was sold in products marketed to kill ants, roaches, and termites. New York banned sulfluramid in the 1990s. And in 2001, when the state levied the largest penalty in its history against a company distributing a sulfluramid-containing pesticide, the New York attorney general noted that "if a child ingested the bait, he or she could suffer irreversible reproductive damage, and boys could be rendered infertile." In 2008, DuPont voluntarily cancelled its registration of the chemical. The ongoing use of sulfluramid in Brazil despite widespread knowledge of its dangers shows just how difficult it is to control the entire family of toxic chemicals to which PFOS belongs. Those chemicals, known as PFAS, now pollute water around the world. While delegates of the Stockholm Convention will be debating how to close the loopholes around PFOS and whether to enact a global ban on the closely related chemical PFOA, well over 1,000 other PFAS chemicals are still in active use.

The Intercept, 30 April 2019

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### **One overlooked way to fight climate change? Dispose of old CFCs.**

2019-05-01

At city waste recycling in Accra, Ghana, owners Jürgen Meniel and Vivian Ahiayibor mostly focus on plastics and metals, but they also reclaim

**The banned refrigerants not only degrade ozone, they act as greenhouse gases. New models are making it easier to get rid of old stocks.**

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refrigerants from old equipment. Several years ago, they learned of a large cache of unused canisters of a refrigerant called CFC-12. The containers looked like small propane tanks, but the gas inside was illegal. Outlawed thirty years ago by the Montreal Protocol because of their harmful effects on the stratospheric ozone layer, CFCs have also been found to have a second, destructive effect on the climate. A single molecule of CFC-12 can hold nearly 11,000 times the heat of carbon dioxide, making it an extraordinarily potent greenhouse gas. The small, dark shed where the refrigerant cache was gathering dust held nearly 30,000 pounds of CFCs. If released into the atmosphere, those CFCs would hold the same heat as the carbon dioxide emissions from burning 16 million gallons of gasoline. Last year, a coalition of scientists and policy experts at the non-profit Drawdown ranked the top one hundred climate change solutions by level of impact. No one guessed that refrigerant management, which includes CFCs and two other classes of chemicals known as HCFCs and HFCs, would top the list. But it did. The Drawdown study estimated that properly disposing of old refrigerants, rather than letting them leak into the air, would be equivalent to preventing nearly 90 gigatons of carbon dioxide from reaching the atmosphere. That's more than 17 years of U.S. CO<sub>2</sub> emissions. So, the science is clear: cleaning up the world's legacy CFCs would help prevent additional greenhouse gases from further changing the climate. Yet actually doing this, particularly in developing countries, is still being worked out, thanks to financial and logistical challenges. Still, a new wave of entrepreneurs think they have found solutions that work both for the climate and companies.

### What was left in the bank?

The Montreal Protocol, which controls the release of refrigerants into the atmosphere, is heralded as one of the most successful environmental treaties, in part because of the speed and unanimity with which the nations of the world responded to the threat to the ozone layer. Within just four years of the discovery of the thinning ozone hole, the agreement was in force. But the Montreal Protocol is also important because of what it did for the climate. Ozone-depleting gases turned out to be potent greenhouse gases. The Montreal Protocol is estimated to have prevented the equivalent of 10 gigatons of CO<sub>2</sub> per year from reaching the atmosphere, or about a quarter of the world's annual carbon dioxide emissions. There's no doubt that if not for the Montreal Protocol, climate change would already be much more dire. But in order to achieve consensus, negotiators of the Montreal Protocol had to be forward-looking. The nations of the world agreed to ban future production of

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ozone-depleting chemicals but quantities of ozone-depleting gases that already existed, materials that have come to be known as “banks,” were left out of the agreement. The banks weren’t insignificant either. In 1988, the year before the protocol went into effect, the size of the CFC bank was slightly more than that year’s global emissions of CO<sub>2</sub>. Today those CFC banks have decreased in size; most of the gas has already leached into the atmosphere. The majority of today’s refrigerant bank is a chemical class known as HFCs. Its production was recently banned in the Kigali Amendment to the Montreal Protocol in October 2016. If the world holds to the agreement, the Kigali Amendment is set to avoid nearly a degree Fahrenheit temperature increase by the end of the century. Disposing of the bank properly could do even more. Because there’s no requirement for tracking them, getting a handle on the size of older CFC banks includes some modelling. Estimates are based on historical inventories of equipment that contains refrigerants. Unused canisters of CFCs, like the ones in the shed in Ghana, are probably not included in those models since they were never put into equipment. That means that the banks of refrigerants—even as large as they are—are an underestimate of what’s out there.

#### Finding—and funding—a solution

By phone from Accra, City Waste Recycling’s Meniel explained that when he found the canisters in the shed, he knew they couldn’t be sold because “CFCs are banned everywhere.” Yet, the canisters full of CFCs were like a slowly rusting climate bomb. Something had to be done. “Otherwise, it will stay there forever, and eventually escape into the atmosphere.” There’s no technical hurdle to overcome to dispose of CFCs. The gas can be incinerated in special kilns, breaking the molecules into a benign mixture. But with no disposal facilities in all of Ghana, indeed all of West Africa, the problem is financial. Without the weight of a regulation like the Montreal Protocol, who’s going to foot the bill? Chicago entrepreneurs Tim Brown and Gabe Plotkin believe the answer lies with the private sector. They work at Tradewater, a company that develops projects that reduce greenhouse gas emissions. Their business model is based on being able to sell those reductions as carbon offset credits on carbon markets. In California, the cap-and-trade market buys and sells such carbon credits. However, for a CFC disposal project to qualify in California, the CFCs must be sourced domestically. That rule is one reason why most of the CFCs in the U.S. have already been destroyed, but a project to dispose of CFCs from Ghana can’t be sold in California’s market. So, Plotkin and Brown turned to the voluntary carbon market. The voluntary carbon market

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is where individuals and corporations go to buy carbon offsets, not because they are required to, but because they choose to meet personal or internal goals for carbon neutrality. Offset projects on the voluntary market range from wind farms in Asia to reforestation in South America to clean cookstove projects in Africa. "The voluntary carbon market really is an innovator," said Saskia Feast, vice president at Natural Capital Partners, a company that works with large corporations like Microsoft and the media company Sky, to achieve their sustainability goals. The money that corporations feed in to the voluntary market makes it possible for entrepreneurs like Brown and Plotkin to develop projects to reduce greenhouse gases that might not otherwise happen. While the voluntary market encourages creative business solutions to climate change problems, there's also risk. According to a 2017 report by Ecosystem Marketplace, which tracks trends in environmental finance, "it's a buyer's market—almost as many offsets remain unsold as sold." To see if the voluntary market would support a CFC destruction project, Tradewater's Brown and Plotkin ran a pilot test. They bought a small portion of the City Waste's CFCs and contracted a third-party verifier to certify the contents and document the destruction of the CFCs inside under a rigorous protocol called the Verified Carbon Standard. The project generated nearly 20,000 carbon credits, the equivalent of preventing 20,000 tons of carbon dioxide from entering the atmosphere. Tradewater offered the credits on the voluntary market, and waited for a buyer.

#### Spurring a new market

A buyer arrived in the software company Intuit, known for its TurboTax and QuickBooks products. Sean Kinghorn is the company's senior sustainability program manager, responsible for setting the strategy for Intuit's environmental footprint. That includes offsetting all carbon emissions from fuel burned at their facilities to electricity to turn on the lights to emissions from employees' commutes. Even by that expansive measure, Intuit has been carbon neutral since 2015. One way they achieve their neutrality goals is through the voluntary market. "Renewable energy is fantastic, but it gets all the press," said Kinghorn. "We need dozens and dozens of different types of solutions. So, this is absolutely critical. He explained that Tradewater's CFC project resonated with Intuit because they were aware of the overlooked problem of refrigerant management. "It's a carbon offset, but it's also spurring a new market somewhere where it's needed. Hopefully it makes a difference." It already has. Because of the sale, Tradewater was able to return to Ghana last December. Over the course of two days, Brown and Plotkin removed the remaining 771

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cylinders from that dark shed, packing them onto 24 pallets. The pallets were loaded onto a ship to cross the Atlantic. They arrived at the Port of Houston in February and were aggregated the CFCs into one tank and shipped by truck to East Liverpool, Ohio, where they were destroyed in April. The process generated over 130,00 carbon credits and averted the equivalent of a year's emissions from 27,601 cars from reaching the atmosphere. If the market supports this second project, Brown and Plotkin will likely return to Ghana. Meniel says there are more CFCs to be collected. "There's still more in the system. We are still trying to sweep up in Ghana and then go to neighbouring countries. Yes, because there's plenty." The story doesn't end there. Curious about working with Costa Rica's carbon market, Brown and Plotkin travelled to San Jose, where they discovered more unused cylinders of CFCs. That work in Costa Rica led them to look in Colombia, and they will head to Argentina in May. "We are gearing up to go after this stuff as much as we can," Plotkin said. "We know that this material is out there and we know we have the ability to go find it and collect it and destroy it. We can't turn away from it. It's not going to happen but for that market. It's an essential part of the equation."

National Geographic, 29 April 2019

[www.nationalgeographic.com.au](http://www.nationalgeographic.com.au)

### Scientists say they're closer to possible blood test for chronic fatigue

2019-05-01

Scientists in the United States say they have taken a step toward developing a possible diagnostic test for chronic fatigue syndrome, a condition characterised by exhaustion and other debilitating symptoms. Researchers at Stanford University School of Medicine said a pilot study of 40 people, half of whom were healthy and half of whom had the syndrome, showed their potential biomarker test correctly identified those who were ill. Chronic fatigue syndrome (CFS), also known as myalgic encephalomyelitis or ME, is estimated to affect some 2.5 million people in the United States and as many as 17 million worldwide. Symptoms include overwhelming fatigue, joint pain, headaches and sleep problems. No cause or diagnosis has yet been established and the condition can render patients bed- or house-bound for years. The research, published in the journal *Proceedings of the National Academy of Sciences* on Monday, analysed blood samples from trial volunteers using a "nanoelectronic assay" - a test that measures changes in tiny amounts of energy as a proxy for the health of immune cells and blood plasma. The scientists "stressed"

**Scientists in the United States say they have taken a step toward developing a possible diagnostic test for chronic fatigue syndrome, a condition characterised by exhaustion and other debilitating symptoms.**

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the blood samples using salt, and then compared the responses. The results, they said, showed that all the CFS patients' blood samples creating a clear spike, while those from healthy controls remained relatively stable. "We don't know exactly why the cells and plasma are acting this way, or even what they're doing," said Ron Davis, a professor of biochemistry and of genetics who co-led the study. "(But) we clearly see a difference in the way healthy and chronic fatigue syndrome immune cells process stress." Other experts not directly involved in this work cautioned, however, that its findings showed there is still a long way to go before a biomarker is found that can establish CFS diagnosis and distinguish it from other conditions with similar symptoms. Simon Wessely, chair of psychiatry at King's College London's Institute of Psychiatry Psychology & Neuroscience, who has worked with CFS patients for many years, said the study was the latest of many attempts to find a biomarker for CFS, but had not been able to solve two key issues: "The (first) issue is, can any biomarker distinguish CFS patients from those with other fatiguing illnesses? And second, is it measuring the cause, and not the consequence, of illness?" he said in an emailed comment. "This study does not provide any evidence that either has finally been achieved."

Reuters Health, 30 April 2019

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

### Keen sense of smell linked to longer life

2019-05-01

Older adults with a poor sense of smell may die sooner than their counterparts who have keen olfactory abilities, a U.S. study suggests. Researchers asked 2,289 adults, ages 71 to 82, to identify 12 common smells, awarding scores from zero to as high as 12 based on how many scents they got right. When they joined the study, none of the participants were frail: they could walk a quarter mile, climb 10 steps, and independently complete daily activities. During 13 years of follow-up, 1,211 participants died. Overall, participants with a weak nose were 46 percent more likely to die by year 10 and 30 percent more apt to pass away by year 13 than people with a good sense of smell, the study found. "The association was largely limited to participants who reported good-to-excellent health at enrolment, suggesting that poor sense of smell is an early and sensitive sign for deteriorating health before it is clinically recognisable," said senior study author Dr. Honglei Chen of Michigan State University in East Lansing. "Poor sense of smell is likely an important health marker in older adults beyond what we have already

**Older adults with a poor sense of smell may die sooner than their counterparts who have keen olfactory abilities, a U.S.**

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known about (i.e., connections with dementia, Parkinson's disease, poor nutrition, and safety hazards)," Chen said by email. People who started out the study in excellent or good health were 62 percent more likely to die by year 10 when they had a poor sense of smell than when they had a keen nose, researchers report in the *Annals of Internal Medicine*. But smell didn't appear to make a meaningful difference in mortality rates for people who were in fair to poor health at the start of the study. With a poor sense of smell, people were more likely to die of neurodegenerative and cardiovascular diseases, but not of cancer or respiratory conditions. Poor sense of smell may be an early warning for poor health in older age that goes beyond neurodegenerative diseases that are often signal the beginning of physical or mental decline, the results also suggest. Dementia or Parkinson disease explained only 22 percent of the higher death risk tied to a poor sense of smell, while weight loss explained just six percent of this connection, researchers estimated. That leaves more than 70 percent of the higher mortality rates tied to a weak nose unexplained. The connection between a poor sense of smell and mortality risk didn't appear to differ by sex or race or based on individuals' demographic characteristics, lifestyle, and or chronic health conditions. One limitation of the study is that the older adult participants were relatively functional, making it possible results might differ for younger people or for frail elderly individuals, the study team writes. Researchers also only tested smell at one point in time, and they didn't look at whether changes in olfactory abilities over time might influence mortality. Researchers also lacked data on certain medical causes of a weak nose such as nasal surgery or chronic rhinosinusitis that are not related to aging. "The take-home message is that a loss in the sense of smell may serve as a bellwether for declining health," said Vidyulata Kamath of the Johns Hopkins University School of Medicine in Baltimore, co-author of an accompanying editorial. "As we age, we may be unaware of declining olfactory abilities," Kamath said by email. "Given this discrepancy, routine olfactory assessment in older adults may have clinical utility in screening persons at risk for illness, injury or disease for whom additional clinical work-up and/or intervention may be warranted."

Reuters Health, 30 April 2019

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

**For people with peanut allergies, undergoing immunotherapy may actually increase their risk of having allergic or anaphylactic reactions.**

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### **Peanut allergy immunotherapy may actually do more harm than good**

2019-05-01

For people with peanut allergies, undergoing immunotherapy may actually increase their risk of having allergic or anaphylactic reactions. Immunotherapy is an experimental treatment for allergies that involves repeated exposure to the allergen in gradually increasing doses, aiming to desensitise the patient's immune system. To get a better understanding of how safe and effective it is, Derek Chu of McMaster University, Canada, and colleagues compiled data from 12 trials involving 1041 patients in total, most of them children aged five to 12. Some of the trials compared immunotherapy with a placebo, while in others, the comparison group were simply told to avoid peanut exposure. Patients who received immunotherapy had a 22 per cent risk of anaphylaxis – a life-threatening allergic reaction – during the follow-up period, which lasted around a year in most studies. That's around three times higher than the risk for patients who did not have the therapy. Despite this, many trials have reported that immunotherapy is successful because participants passed a test in the clinic in which they eat some peanut without having a reaction.

#### Unpredictable reactions

Chu says these tests are not the most important outcome measure for patients. Even if patients don't show a reaction in the clinic, they may not be fully protected, and can go on to have severe reactions. "Common situations patients face can break their protection, often in an unpredictable manner," says Chu. "Maybe they're sick that day or tired or have an empty stomach; even having a hot shower – that can break their protection." Immunotherapy usually involves daily doses of allergen, often taken by the patient at home. If doses are missed, this can also result in a loss of protection and an allergic reaction to the next dose. In all the trials, patients were told to avoid exposure to peanuts except for the therapeutic doses, so it's likely that the therapy itself caused the increase in reactions. Food allergies affect up to 8 per cent of children in Europe and North America, and the incidence is rising. Unlike milk and egg allergies, peanut allergy is lifelong in around 80 per cent of cases. Chu says these results provide patients with the best summary of immunotherapy's benefits and risks based on current evidence, and more carefully designed trials are needed to improve outcomes for patients. "We need new, safer

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approaches to this treatment, whether it's using immunotherapy or completely different approaches," he says.

New Scientist, 25 April 2019

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

### Fungus is the next 'superbug' to threaten human health

2019-05-01

Humans and fungi have always coexisted. In fact, among microbes, fungi are our closest relatives, with far fewer genetic differences than there are for bacteria or viruses. So why are we now hearing so much about "mysterious" infections and "killer superbugs" emerging from the fungal world? When they hear "fungus", most people think of mushrooms. Or in terms of health: maybe thrush. Benign organisms, living on the peripheries. And this is fairly accurate — fungi spend their lives quietly decomposing the planet's organic waste, freeing nutrients into the environment to be utilised by others. They are also increasingly recognised as an important part of our own internal environment, with the right mix of fungi in a "mycobiome" playing a role in gut and skin health. But they can also threaten human health, and lately there have been numerous reports focusing on just that. Most recently, *Candida auris* caused global panic. This previously unknown yeast, from the family of bugs that causes thrush, first grew from an ear swab taken in Japan in 2009. In the decade since, it has appeared on five continents, including Australia, causing often fatal infections in critically ill patients. It can be resistant to all three major classes of anti-fungal drug, making treatment difficult, and is so tenacious that contaminated hospitals have had to close down to get rid of it. Although it tends not to infect healthy people, those who are sick for other reasons, or require surgery, are at risk. So much so that the American Centre for Disease Control and Prevention (CDC), the European Centre for Disease Control (ECDC) and Public Health England (PHE) have all issued public health alerts.

#### Spores that can grow inside us

Another largely ignored fungus, *Aspergillus fumigatus*, has also gained notoriety recently. A mould, *Aspergillus* thrives in warm dark places with organic matter to decompose. It's the main player in a compost heap. However, its spores can be inhaled and it will grow inside our bodies too, given the right conditions (such as weakened immunity, or lungs damaged by disease, smoking, or pollution). This leads to disease ranging from isolated fungal balls through to deadly pneumonias. *Aspergillus* infections

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are treated with a class of anti-fungals called azoles and occasionally surgery.

### Growing resistance

These azoles are cheap, potent, and non-toxic — they are one of the main medical weapons against fungi. However, they are not only relied upon by doctors to treat patients, but by farmers who need to protect their crops. Azoles are among the top used pesticides globally, from the tulip growers of the Netherlands to rice farmers of the Mekong. Such wide-spread use of azoles in agriculture has had the unintended effect of pushing *Aspergillus* to develop resistance. Extensive trade and transport networks have ensured that the resistance spread. Now, across the world, patients who have never taken anti-fungal drugs are turning up with infections that are already resistant to azoles. Many of the remaining drug choices are toxic, expensive, or need to be given intravenously. Before *Candida auris* and azole-resistant *Aspergillus*, there was cryptococcal meningitis. Although this bug was known for hundreds of years, it only leapt to prominence with the HIV epidemic, where it was one of the biggest killers. Although most cryptococcal infections occur in HIV, one member of the family, *Cryptococcus gattii*, causes outbreaks in healthy individuals, especially in tropical and subtropical areas. It is endemic in Australia, where researchers showed its preferred home was the eucalyptus tree. Here, it was long known as a rare but devastating cause of meningitis in forestry workers and koalas. In 1999, the global story of *Cryptococcus gattii* changed. This low-level background infection gave way to an outbreak, which started in Vancouver Island and quickly spread along the north western seaboard of North America. This new strain was stronger than the strains endemic to Australia, and more fertile. In that new temperate environment, it went on to kill hundreds of people, as well as a wide spectrum of animals including dolphins. The outbreak is ongoing.

### Where will the next threat come from?

Together *Candida*, *Aspergillus*, and *Cryptococcus* kill over one million people each year. But as these three stories illustrate, the disease they cause is unpredictable. They can move into new environments, or new hosts, or develop resistance. Man-made impacts may play a role too — contamination of the environment with anti-fungals and climate change being the obvious examples. So far, humans have been spared the worst. A fungal disease outbreak in frogs illustrates the worst-case scenario. This epidemic, first discovered in Australia, has been a calamity for amphibian populations, with more than 200 species extinct or in decline as a result

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of the disease. The next big fungal threat to humans could come from anywhere, which is why surveillance is so important. We need to take fungi more seriously, and start getting to know them better.

ABC News, 17 April 2019

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

### Can Chronic Stress Cause or Worsen Cancer? Here's What the Evidence Shows.

2019-05-01

The fast-paced world we live in is a perfect driver of stress. The racing heart, knots in the stomach and vague sense of agitation are an unavoidable part of the human condition. But chronic stress can, over time, harm the body, causing everything from inflammation to cardiometabolic disease. In some cases, stress may play a role in cancer. But just how tightly are these two conditions linked? Studies suggest several ways that stress may influence cancer development, said Shelley Tworoger, an associate professor of population science at the Moffitt Cancer Centre in Tampa, Florida. Tworoger spoke about these links during a talk earlier this month at the annual American Association for Cancer Research meeting in Atlanta. In those who already have certain types of cancer, stress can accelerate progression and worsen outcomes, increasing evidence suggests. But "there's more question" about whether or not chronic stress can cause cancer in the first place, Tworoger told Live Science. Indeed, according to the National Cancer Institute, the evidence that stress can cause cancer is weak. Even so, "there's a lot of biologic reasons to think that an association could exist," Tworoger said. Here's what we know about chronic stress and the risk of cancer.

**Chronic stress can, over time, harm the body, causing everything from inflammation to cardiometabolic disease. In some cases, stress may play a role in cancer.**

#### Stress and the body

Acute stress is completely normal and helps us react to dangerous situations. For instance, if a "lion is chasing you or you're almost in a car accident," the body's stress response makes your heart race, sharpens your vision and can thus help you survive, she said. During a stressful situation, the body turns on two key pathways: the sympathetic nervous system, which triggers the fight or flight response, and the hypothalamic pituitary adrenal (HPA) axis, which releases a key stress hormone called cortisol. In the short term, these two axes "turn on, help you get through whatever the situation was and then, usually when the stress abates, they turn back off again," Tworoger said. But chronic stress and distress

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(extreme anxiety, sorrow or pain) continuously activate these pathways and release stress hormones, “in a way your body wasn’t really designed for,” Tworoger said. Past research has shown that chronic activation of both of these pathways can lead to changes in the body — including altered metabolism, increased levels of certain hormones and the shortening of telomeres, the caps at the ends of DNA that prevent damage. All of these changes could potentially influence the development and progression of cancer, she said during the talk. The long-term release of stress hormones can also induce DNA damage and affect DNA repair, said Melanie Flint, a senior lecturer in immunopharmacology at the University of Brighton in the United Kingdom, who also spoke during the talk. What’s more, chronic stress weakens the immune system. Since the immune system acts as the cleaning crew that destroys and mops up damaged cells with genetic or metabolic errors, a weakened immune system could be the doorway in for cancer cells, Tworoger said. There is “growing evidence that chronic stress can affect the cancer risk and progression through immune dysregulation,” said Dr. Elisa Bandera, a professor and chief of Cancer Epidemiology and Health Outcomes at the Rutgers Cancer Institute in New Jersey, who wasn’t a part of the talk. But “I don’t think you can say that there is an established link.” In fact, most evidence ties stress to cancer survival, not to the risk of getting cancer in the first place, she said.

#### Stress and cancer risk

It’s tricky to design a study to show that stress fuels cancer in part because the experience of stress is so subjective and hard to measure. Stress can also manifest itself in the body in very different ways depending on how an individual perceives and copes with it, Tworoger said, “Some people have a negative response to job stress and some people love being stressed out in their jobs,” Tworoger said. In fact, “they thrive on it.” This perception, in turn, affects how the body responds. As a result, many human studies rely on associations — rather than cause and effect— to show a link between stress levels and cancer incidence. Previous studies have suggested, for example, that chronic stress is associated with an increased risk of a number of cancers, including breast cancer and some gastrointestinal cancers. A Japanese study published in 2017 in the journal *Scientific Reports* looked at the correlation between stress levels and cancer in more than 100,000 people. They found no association between short-term stress and cancer incidence, but found that individuals, specifically men, who consistently had high-stress levels for a long time had an 11% greater risk of developing cancer than those with consistently low stress levels. In new research that has not yet been peer-reviewed,

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Tworoger and her team looked at the association between social isolation and ovarian cancer risk. They found that people who were socially isolated had about a 1.5-fold increased risk of developing ovarian cancer compared to those who weren't. They also found that people who had more post-traumatic stress disorder (PTSD) symptoms had an increased risk of developing ovarian cancer. Another analysis, to be published in a forthcoming issue of the *International Journal of Cancer*, scoured the literature for studies analysing the association between work stress and cancer risk. They found a significant association between work stress and the risk of colorectal, lung and oesophageal cancer — but no association with the risk of prostate, breast or ovarian cancer.

#### Will we ever know?

Many other studies have also found no association. For example, Tworoger and her team did not find an association with job strain and ovarian cancer risk in a 2017 study published in the journal *Psychosomatic Medicine*. What's more, a study published in 2018 in the *European Journal of Cancer* categorised the link between stress and cancer as a "myth." Some experts think that it's not the stress itself that's causing the cancer, but the unhealthy behaviours that come with being stressed. Indeed, "the general consensus seems to be that chronic stress does not cause cancer per se, but it can indirectly increase cancer risk," through stress-related behaviours such as smoking or heavy drinking, said Firdaus Dhabhar, a professor in the department of psychiatry and behavioural sciences at the University of Miami, who was not a part of the talk. Other unhealthy, stress-induced behaviours, such as eating a bad diet and not exercising, also increase the risk of certain cancers, according to the National Cancer Institute. Tworoger, however, thinks that sceptics are writing off the cancer-causing effects of stress too fast. Stress hormones can cause "other biologic effects that are involved in the development of cancer," Tworoger said. So "I think we do need more studies before we can say if [the link between chronic stress and risk of cancer] is a myth." Either way, there's "more and more evidence" that decreasing stress can improve survival and quality of life for patients who already have or had cancer, Tworoger said. "This has generated interest in mindfulness [and] yoga interventions for cancer survivors with promising results," Bandera added. And reducing stress and leading a healthy lifestyle is important for many reasons Tworoger said. We "don't know that stress causes cancer, but we do generally know

## Technical Notes

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[Halogenated organics generated during online chemical cleaning of MBR: An emerging threat to water supply and public health](#)

[The quantification of chlorinated paraffins in environmental samples by ultra-high-performance liquid chromatography coupled with Orbitrap Fusion Tribrid mass spectrometry](#)

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### MEDICAL RESEARCH

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[Lipoxygenase Protein Expression and Its Effect on Oxidative Stress Caused by Benzidine in Normal Human Urothelial Cell Lines](#)

[Association of in utero hexachlorocyclohexane exposure with gestational age](#)

[Associations between repeated measure of plasma perfluoroalkyl substances and cardiometabolic risk factors](#)

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### OCCUPATIONAL RESEARCH

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[Cytostatics as hazardous chemicals in healthcare workers' environment](#)

[Association of occupational exposures with cardiovascular disease among US Hispanics/Latinos](#)

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[Para-tertiary butyl catechol \(PTBC\), an industrial antioxidant induces human platelet apoptosis](#)

### **PUBLIC HEALTH RESEARCH**

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[Serum concentrations of PFASs and exposure-related behaviours in African American and non-Hispanic white women.](#)