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### CONTACT US

subscribers@chemwatch.net  
tel +61 3 9572 4700  
fax +61 3 9572 4777

1227 Glen Huntly Rd  
Glen Huntly  
Victoria 3163 Australia

**\* 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

#### **Workplace exposure standards open for public comment – Release 5 – Coal tar pitch volatiles to dichloroacetylene**

2019-10-18

Safe Work Australia are calling for comments on the recommendations for Release 5 – Coal tar pitch volatiles to dichloroacetylene. The agency is evaluating the Workplace exposure standards for airborne contaminants to ensure they are based on the highest quality evidence and supported by a rigorous scientific approach. Release 5: Coal tar pitch volatiles to dichloroacetylene is now open for public comment. Please note that this Release includes chemicals that do not currently have an Australian workplace exposure standard. These are: Cobalt hydrocarbonyl, cyanides and cyanide salts, diacetyl, 1,2-dibromo ethane and 1,4-dichloro-2-butene. In particular, comments are being sought of a technical nature regarding:

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

Access the consultation platform, Engage, to provide comments on the draft evaluation reports and recommendations for Release 5. Please note some evaluation reports have been deferred to Release 6. Public comment will close on 8 November 2019. The feedback received will be considered when making final recommendations for workplace exposure standards. The draft evaluation reports and recommendations for the remaining chemicals will be released throughout 2019 and 2020.

Safe Work Australia, 11 October 2019

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

#### **Memorandum of Understanding (MoU) with South Korea**

2019-10-18

On 23 September 2019, the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) entered into an Memorandum of Understanding (MoU) with the Republic of Korea's National Institute of Food and Drug Safety Evaluation (NIFDS). A focus of the MoU is to promote cooperation between Australia and South Korea on risk assessment of

**Safe Work Australia are calling for comments on the recommendations for Release 5 – Coal tar pitch volatiles to dichloroacetylene.**

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cosmetic ingredients. This MoU promotes scientific collaboration and regulatory cooperation, which helps to aid in the protection of people's health and the safety of both countries. It also paves the way for further collaboration in the future.

NICNAS, 11 October 2019

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

### Guidelines for using the TGA assessed claim on medicine labels

2019-10-18

The Therapeutic Goods Administration (TGA) has released guidelines for using the TGA assessed claim on medicine labels. The guidelines provide sponsors of listed assessed medicines and registered complementary medicines guidance on:

- what the TGA assessed claim is;
- how the TGA assessed claim can be used on medicine labels and in other advertising;
- how to apply to use the TGA assessed claim

#### The TGA assessed claim

The TGA assessed claim can be used to indicate that a medicine has had the efficacy of its indications assessed by the TGA. The claim must only be used in relation to listed assessed medicines or registered complementary medicines. The claim must be displayed as the approved TGA assessed statement, with or without the approved TGA assessed symbol. If the symbol is used, a statement authorised by the TGA must also be used. The statement may be used on its own without the TGA assessed symbol. The wording of the TGA assessed statement must not be changed.

#### Examples of compliant and non-compliant statements

**Compliant:** Evidence for the approved indications has been assessed by the TGA.

**Non-compliant:** The TGA has assessed our evidence and has approved all of our indications.

#### Using the TGA assessed claim on product labels

The TGA assessed claim may only be used in relation to a medicine when that use has been authorised by the TGA. Authorisation to use the TGA

**The Therapeutic Goods Administration (TGA) has released guidelines for using the TGA assessed claim on medicine labels.**

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assessed claim will only be issued for assessed listed medicines and registered complementary medicines that have undergone a pre-market assessment of efficacy by the TGA. The TGA assessed claim must be easily identifiable on medicine labels. The label of the medicine that will display the TGA assessed claim is also assessed as part of this process. The TGA assessed symbol and statement are standardised for easy identification on different product types. The requirements for using the TGA assessed claim on a medicine label are provided below.

### Location of the TGA assessed claim on a product label

The TGA assessed claim (the TGA assessed statement, with or without the TGA assessed symbol) can be displayed anywhere on the label, including the primary pack. The TGA assessed claim must be balanced against other information on the main label and primary pack to assist consumers in selecting and using a medicine. The size of the TGA assessed claim must not be more prominent than required label information. For more information on labelling requirements refer to Medicine labels: [Guidance on TGO 91 and TGO 92](#). Section 3(1) of the *Therapeutic Goods Act 1989* provides the following definitions of primary pack and label:

**primary pack**, in relation to therapeutic goods, means the complete pack in which the goods, or the goods and their container, are to be supplied to consumers.

**label**, in relation to therapeutic goods, means a display of printed information:

- on or attached to the goods; or
- on or attached to a container or primary pack in which the goods are supplied; or
- Text size of the TGA assessed claim

### Text size for the TGA assessed symbol

#### **Minimum text size for the TGA assessed symbol**

The minimum text size for the lower-case letters in the word 'assessed' included in the TGA assessed symbol is 1.5 millimetres. Therefore, the minimum overall size of the symbol/information box is equivalent to 6 mm high and 11 mm wide.

#### **Maximum text size for the TGA assessed symbol**

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The maximum text size for the word 'assessed' is no more than the text size of the lower-case letters for the active ingredients, warnings or other essential information included on the medicine label.

### Font style and colour of TGA assessed claim

#### **TGA assessed symbol font style and colour**

The TGA assessed symbol must be presented in black ink on a white background and surrounded by a black outline (as provided to the sponsor in an '.eps' file by the TGA).

#### **TGA assessed statement font style and colour**

To allow sponsors some flexibility in label design, you can choose the font style and colour for the TGA assessed statement; however, it must:

- be presented in a colour that contrasts strongly with the background it is printed on; and
- be consistent with the font style, colour and prominence of the surrounding label text, warnings or other essential information.

The sentence must be written in lower case, with the exception of the first letter of the sentence and TGA.

### Using the TGA assessed claim in other advertising materials

Advertisements may show images of the medicine label, including the TGA assessed claim (the TGA assessed statement with or without the TGA assessed symbol), but must not use the TGA assessed symbol or statement other than on the image of the label in the pack shot. An advertisement must not include any audible commentary or further written commentary on the TGA assessed claim. The TGA assessed claim must not be more prominent than the mandatory statements in an advertisement. The use of the TGA assessed claim in any advertising must comply with the advertising requirements set out in the *Therapeutic Goods Act 1989* and the *Therapeutic Goods Advertising Code (No.2) 2018*, as amended from time to time. The advertising must not imply that the TGA recommends the medicine or advocates the use of the medicine above other medicines that do not use the TGA assessed claim.

### Applying to use the TGA assessed claim

You can request the TGA assessed symbol file by emailing: [complementary\\_medicines@health.gov.au](mailto:complementary_medicines@health.gov.au). The file will be provided in an '.eps' format.

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Copies of proposed labels displaying the TGA assessed claim must be provided to the TGA with an application:

- for a new listed assessed medicine or a new registered complementary medicine; or
- to vary the labelling of a registered complementary medicine or listed assessed medicine included in the Australian Register of Therapeutic Goods.

In considering a label in relation to a medicine, the TGA will consider all aspects of the medicine's presentation for compliance with the various legislative requirements. Authorisation to use the TGA assessed claim will not be given in relation to a medicine where the presentation of that medicine (with the TGA assessed claim) is not acceptable - refer to the [Australian Regulatory Guidelines for Complementary Medicines](#) for further information.

TGA, 9 October 2019

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

### Taiwan to promote use of non-animal test data

2019-10-18

At an 18 September meeting organised by the Taiwanese legislative committee to discuss the need for alternative tests, the EPA's Toxic and Chemical Substances Bureau said:

- it will require companies to avoid using animals to test any imported chemicals when registering them "where possible";
- when it selects the next list of priority existing chemicals, it will also amend the registration rules to give preference to non-animal test data;
- it will use the OECD guidelines to assess the availability of alternatives to each of the toxicity tests required. It will also check with local chemical companies and testing organisations to understand current practices and the possibility of – and timeline for – switching from animal testing to alternative methods; and
- registrants using non-animal data could receive a discount on the registration fee.

During the meeting, Democratic Progressive Party (DPP) legislator Shu-Fen Lin asked the EPA if it was possible for the proposed rules on imports to apply from the end of this year. But the agency said that the regulation

**Taiwan's EPA has made a verbal commitment to encourage companies to use non-animal test methods, when registering chemicals under the Toxic and Concerned Chemical Substances Control Act (TCCSCA).**



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had only recently been amended in March, so further revisions this year were not possible.

### EPA to promote alternatives 'gradually'

"In order to encourage registrants to provide non-animal test reports, the EPA's TCSB is considering preferential discounts on the fees, which will be revised this year," said Shu-Lin Chen, its deputy director general. "The TCSB will gradually promote alternative methods for non-animal testing methods. First, we will [survey] the internationally feasible non-animal testing methods and discuss with Taiwan's domestic toxicological testing institutions," Ms Chen said. "Once the alternative testing methods, equipment and personnel are ready, the TCSB will set a start date [for their use]."

Sally Yao, researcher at NGO Environment Animal and Society Taiwan (EAST), who attended the meeting, said the TCSB had agreed to complete this survey by 18 March 2020, six months after the meeting.

### Updates to regulation

Ms Yao said EAST was encouraged that the TCSB had committed to giving preference to non-animal data. "However, because the next amendment of the Regulation is not expected to happen in the next two to three years, it is still too long, from our perspective," she added. On 1 January South Korea incorporated an amendment into the revised version of K-REACH that aims to reduce vertebrate animal testing. But Ms Chen confirmed that Taiwan does not plan to take the same approach. And, in June, China drew up draft measures to waive the mandatory requirement for pre-market animal testing on some imported cosmetics.

Chemical Watch, 9 October 2019

<http://chemicalwatch.com>

## AMERICA

### US EPA green-lights mice-control chemical

2019-10-18

The United States Environmental Protection Agency is proposing to allow the use of a rodenticide containing the active ingredient  $\alpha$ -chloralose to kill mice in homes and other buildings. The product, manufactured by France's Lodi Group, works by lowering the body temperature of small

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animals like mice. After eating  $\alpha$ -chloralose, mice get hypothermia and die within a few hours. The EPA believes that the product, sold under the name Black Pearl Paste, is a safer alternative to rodenticides that contain anticoagulants or neurotoxins. Anticoagulants suppress blood clotting, and neurotoxins attack the central nervous system. The agency expects human and pet exposure to the new product to be negligible because the company plans to sell it enclosed in a sachet inside a tamper-resistant bait station. The product would not be approved for outdoor use. "Even if children or large animals were to ingest [ $\alpha$ -chloralose], they are unlikely to be affected by body temperature changes caused by this chemical," the EPA says in a 7 October [statement](#). The agency is accepting comments on the proposal until 22 October.

Chemical & Engineering News, 22 October 2019

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

### **EPA Will Provide Minimum 30-Day Public Comment Period on Draft Risk Evaluations**

2019-10-18

On 11 October 2019, Alexandra Dapolito Dunn, Assistant Administrator for the United States Environmental Protection Agency's (EPA) Office of Chemical Safety and Pollution Prevention (OCSP) stated that EPA will provide more time for public comment on its draft risk evaluations before the Toxic Substances Control Act (TSCA) Science Advisory Committee on Chemicals (SACC) meets to peer review the draft documents. According to Dunn, the new schedule will include a comment period of at least 30 days before SACC meets. EPA plans to complete ten chemical risk evaluations by 22 June 2020. To date, EPA has released four draft chemical risk evaluations, and SACC has peer reviewed them. For the remaining six chemicals, EPA intends to release four of the draft risk evaluations for public comment by the end of 2019 and the other two in January 2020. SACC will peer review two of the draft risk evaluations in 2019 and the remaining four in 2020. Dunn stated that EPA will meet the Lautenberg Act's deadline to release all ten risk evaluations by June 2020.

National Law Review, 16 October 2019

<http://www.natlawreview.com>

**On 11 October 2019, Alexandra Dapolito Dunn, Assistant Administrator for the United States Environmental Protection Agency's (EPA) Office of Chemical Safety and Pollution Prevention (OCSP) stated that EPA will provide more time for public comment on its draft risk evaluations before the Toxic Substances Control Act (TSCA) Science Advisory Committee on Chemicals (SACC) meets to peer review the draft documents.**

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### EPA Proposes SNUR for Multiwalled Carbon Nanotubes (Generic)

2019-10-18

On 11 October 2019, the United States Environmental Protection Agency (EPA) published proposed significant new use rules (SNUR) for 31 chemical substances, including multiwalled carbon nanotubes (generic), that were the subject of premanufacture notices (PMN). 84 Fed. Reg. 54816. EPA notes that eight of the chemical substances are subject to orders under the Toxic Substances Control Act (TSCA) issued by EPA. The effective date of the TSCA Section 5(e) order for multiwalled carbon nanotubes (generic) was 3 May 2019. According to EPA, the PMN states that multiwalled carbon nanotubes (generic) will be used in heat transfer, heat storage, thermal emission, and general temperature management in heat-generating systems, such as electronics, to improve mechanical properties or electrical conductivities of other materials or products and for light absorption properties. The proposed SNUR states that EPA identified concerns for pulmonary toxicity based on carbon nanotube analogues and for aquatic toxicity when the substance is at low concentrations and in the presence of natural organic matter. EPA issued the consent order under TSCA Sections 5(a)(3)(B)(ii)(I) and 5(e)(1)(A)(ii)(I), based on a finding that in the absence of sufficient information to permit a reasoned evaluation, the substance may present an unreasonable risk of injury to human health and the environment. To protect against these risks, the TSCA Section 5(e) order requires:

- Use of personal protective equipment by workers to prevent dermal exposure where there is potential dermal exposure;
- Use of a National Institute of Occupational Safety and Health (NIOSH) certified respirators with an Assigned Protection Factor (APF) of at least 50 workers to prevent inhalation exposure where there is potential inhalation exposure;
- Refrain from using the PMN in applications that generates a dust, vapor, mist, or aerosol, unless such application method occurs in an enclosed process;
- Process and use of the PMN substance only as described in the PMN;
- No release of the PMN substance to surface waters; and
- Disposal only by incineration or landfill.

**On 11 October 2019, the United States Environmental Protection Agency (EPA) published proposed significant new use rules (SNUR) for 31 chemical substances, including multiwalled carbon nanotubes (generic), that were the subject of premanufacture notices (PMN).**

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The proposed SNUR would designate as a “significant new use” the absence of these protective measures. Comments are due 12 November 2019.

National Law Review, 15 October 2019

<http://www.natlawreview.com>

### EPA Issues Supplemental Proposal for Renewable Fuels Volumes

2019-10-18

The United States Environmental Protection Agency (EPA) issued a supplemental notice of proposed rulemaking seeking additional comment on the recently proposed rule to establish the cellulosic biofuel, advanced biofuel, and total renewable fuel volumes for 2020 and the biomass-based diesel volume for 2021 under the Renewable Fuel Standard (RFS) program. The recent notice does not change the proposed volumes for 2020 and 2021. Instead, it proposes and seeks comment on adjustments to the way that annual renewable fuel percentages are calculated. Annual renewable fuel percentage standards are used to calculate the number of gallons each obligated party is required to blend into their fuel or to otherwise obtain renewable identification numbers (RINs) to demonstrate compliance. Specifically, the agency is seeking comment on projecting the volume of gasoline and diesel that will be exempt in 2020 due to small refinery exemptions based on a three-year average of the relief recommended by the Department of Energy (DOE), including where DOE had recommended partial exemptions. The agency intends to grant partial exemptions in appropriate circumstances when adjudicating 2020 exemption petitions. The agency proposes to use this value to adjust the way we calculate renewable fuel percentages. The proposed adjustments would help ensure that the industry blends the final volumes of renewable fuel into the nation’s fuel supply and that, in practice, the required volumes are not effectively reduced by future hardship exemptions for small refineries. Consistent with the statute, the supplemental notice seeks to balance the goal of the RFS of maximizing the use of renewables while following the law and sound process to provide relief to small refineries that demonstrate the need. EPA will hold a public hearing on 30 October 2019 followed by a 30-day comment period from the date of the hearing to receive public input on these issues. The agency will finalize this action later this year.

**The United States Environmental Protection Agency (EPA) issued a supplemental notice of proposed rulemaking seeking additional comment on the recently proposed rule to establish the cellulosic biofuel, advanced biofuel, and total renewable fuel volumes for 2020 and the biomass-based diesel volume for 2021 under the Renewable Fuel Standard (RFS) program.**

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For more information, please visit: <https://www.epa.gov/renewable-fuel-standard-program/proposed-volumes-2020-and-biomass-based-diesel-volume-2021>

U.S EPA, 15 October 2019

<http://www.epa.gov>

### EUROPE

#### EU titanium dioxide classification adopted in 14th ATP to CLP

2019-10-18

The European Commission has adopted the 14th adaptation to technical progress (ATP) of the CLP Regulation. It includes the controversial classification of inhalable powder forms of titanium dioxide as a category 2 carcinogen. The European Parliament and Council of Ministers now have two months to object. The CLP amendments in Annex VI will be published if no objections are raised, and the harmonised classifications apply 18 months later. The Commission adopted the delegated Regulation containing the ATP on 4 October, despite a litany of criticisms from both within the EU and globally over titanium dioxide's classification. NGOs argue that the EU executive has deviated from scientific advice by excluding other forms and sizes of the substance from the classification and labelling. But industry insists the dust hazard is not specific to titanium dioxide and other measures, such as occupational exposure limits (OELs), should have been considered. Industry has also warned of downstream legal consequences of classification they said would seriously impact the EU's circular economy strategy. Titanium dioxide commands a huge market globally and has widespread uses, mainly in paints, coatings, printing inks and plastics but also in cosmetics, food and feedstuffs, textiles, rubber and pharmaceuticals. The Commission said in its delegated Regulation the comments it received during a public consultation – 489 in total – did not justify amending the draft, since “no new substantial information” that would challenge the opinion of ECHA's Risk Assessment Committee (RAC) was put forward. The 14th ATP also includes cobalt metal's classification as a category 1B carcinogen, another area of contention between the Commission and industry. Here, however, the Commission gave more ground, deciding not to introduce “for the time being” a specific concentration limit (SCL) of 0.01% w/w for all routes of exposure as RAC had proposed. A general concentration

**The European Commission has adopted the 14th adaptation to technical progress (ATP) of the CLP Regulation.**

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limit of 0.1% will apply, while the methodology used to derive the SCL is further assessed. Cobalt metal is used as a precursor in the manufacture of chemicals for batteries for various portable consumer goods, as well as the emerging market for electric vehicles. Industry had called for a review of the methodology, arguing that the SCL would hit them hard.

### Changes

The new requirement for titanium dioxide products to carry cancer warnings on the label applies only to mixtures in powder form containing 1% or more of the substance with aerodynamic diameter of 10µm or less. For other forms and mixtures, the classification suggests specific notes to inform the users of the precautionary measures that need to be taken to minimise hazard. This, the Commission says, will avoid unjustified classification of non-hazardous forms of the substance. Some NGOs, however, have questioned whether the suggested statements sufficiently convey the need for precaution. In total, the 14th ATP makes 28 changes to the harmonised classification and labelling of substances in Annex VI. They include the substance N-carboxymethyliminobis(ethylenitrilo) tetra(acetic acid) (DTPA), classified as toxic for reproduction. DTPA is used in coating products, fillers, polishes and waxes, as well as textile treatment products and dyes, among others. The ATP also includes harmonised acute toxicity estimate (ATE) values for certain substances to facilitate the harmonisation of the classification of mixtures and provide support for enforcement authorities. Additionally, it corrects the classification for the substance pitch, coal tar, high temperature, following an earlier erroneous classification. Further Information is available at:

- Regulation
- Annexes

Chemical Watch, 10 October 2019

<http://chemicalwatch.com>

### **HSE and Defra Brexit Events for Chemicals Stakeholders**

2019-10-18

The United Kingdom's Health and Safety Executive (HSE) and the Department for Environment, Food and Rural Affairs (Defra) will be holding two, one-day stakeholder events covering Brexit and its impact on the chemicals regimes in a no-deal scenario. Please continue to visit the

**The United Kingdom's Health and Safety Executive (HSE) and the Department for Environment, Food and Rural Affairs (Defra) will be holding two, one-day stakeholder events covering Brexit and its impact on the chemicals regimes in a no-deal scenario.**

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[HSE Brexit webpages](#) for latest health and safety information and guidance and further information on the events.

HSE, 9 October 2019

<http://www.hse.gov.uk/>

### INTERNATIONAL

#### Call for information and follow-up to the ninth meeting of the Conference of the Parties to the Stockholm Convention

2019-10-18

At its ninth meeting held in Geneva from 29 April to 10 May 2019, the Conference of the Parties to the Stockholm Convention agreed on the decisions contained in annex I to the report of the meeting, document UNEP/POPS/COP.9/30. Many of the decisions included invitations to Parties and others to provide information. A [letter](#) was sent to Parties and observers to solicit information sought in the decisions adopted by the Conference of the Parties to the Stockholm Convention at its ninth meeting. The individual invitations to submit information are organised by decisions. Information sought in each decision can be transmitted separately, since the deadlines for submission vary. Similar letters have also been prepared to solicit information sought in the decisions adopted by the conferences of the Parties to the Basel and Rotterdam conventions at their 2019 meetings and are available on the [Basel](#) and [Rotterdam](#) convention's websites.

Chemycal, 15 October 2019

<http://chemycal.com>

#### Developing countries insist on global fund for chemicals framework

2019-10-18

Latin American and Caribbean countries have said they will not accept a proposal for a post-2020 global chemicals framework, unless it includes a dedicated way to finance implementation. Diplomats, industry representatives and civil society organisations met in Bangkok last week to discuss whether the UN's global voluntary programme, the Strategic Approach to International Chemicals Management (Saicm),

**At its ninth meeting held in Geneva from 29 April to 10 May 2019, the Conference of the Parties to the Stockholm Convention agreed on the decisions contained in annex I to the report of the meeting, document UNEP/POPS/COP.9/30.**

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should continue beyond its 2020 mandate, evolve or be replaced with an alternative framework. Saicm's goal is to achieve sound chemicals management globally by 2020. "We learned the hard way that the 2020 goals were not achievable ... and we know we're not going to get anywhere if we don't have the means of implementation," said Argentina's Alejandra Acosta, speaking on behalf of the UN's Latin American and Caribbean countries. "We won't commit again to something we already know we won't get to have." Speaking to Chemical Watch after the negotiations, Ms Acosta said Latin American countries believe Saicm failed to reach its goal because of a lack of political attention and the financial means of implementation, and that both need to be addressed in a post-2020 framework. To address the resourcing issue, Latin countries propose creating an international fund that would receive contributions from developed countries, industry and other sources, like philanthropies and venture capital firms, that would provide sustainable and consistent financing to developing countries.

### Support for international fund

Other delegates also supported the idea of an international fund, which was first raised in a paper published jointly by developing countries in Africa, Latin America, Asia and the Middle East in April. "It's a burden on us already to fulfil our role [in Saicm]," Nigeria's Olubunmi Olusanya, representing African countries, told Chemical Watch. "We need sustainable resources and a mechanism in place that can guarantee our access to resources." Joe DiGangi, senior science and technical adviser at NGO International POPs Elimination Network (Ipen), called the meeting a "breakthrough" in terms of discussing industry financing of chemicals management. Ipen wants industry to contribute a portion of its \$5.7tn in sales to Saicm. "A no-strings-attached contribution of 0.1% of chemical industry sales to the international fund would provide the scale of financing needed to tackle chemical safety in a serious way," he said. However, the International Council of Chemical Associations (ICCA) has said it does not support mandatory industry contributions to the program. In a paper it issued ahead of the meeting, the ICCA said Saicm is primarily a governmental and UN initiative to manage global chemical issues. Governments therefore must play the most significant financial role, in much the same way that they must fund public health initiatives, education or other important societal programs.

It also told Chemical Watch, in a statement after the meeting, that the association would "not shy away from our financial commitments" but is "not sure whether an international fund will solve the current structural



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problems". "In our experience of working with emerging markets, it is often not the amount of funding that makes a difference but whether we can equip the right people developing chemical management programmes with the right skills," the association said. It proposed a "GHS global alliance" to help developing countries implement the UN's Globally Harmonised System for classifying and labelling chemicals, as well as the idea of developing a global substance information database. The ICCA said a workshop is being considered to discuss financing, ahead of the next meeting on a post-2020 framework in Romania. UN funding itself is in a parlous state with the organisation's secretary-general António Guterres warning that it is in "the worst cash crisis" in nearly a decade.

### Future work

Financing was one of four key areas on which diplomats began concrete text negotiations in Bangkok, one year ahead of a UN conference that is expected to formally decide the issue of a post-2020 framework. The talks were characterised by growing recognition of the amount of work to be done before the International Conference of Chemicals Management (ICCM5) next October, which will adopt a resolution on a future framework. "The Beyond 2020 process needs to play a serious game of 'catch-up' to complete its work," Mr DiGangi said. Germany will host another workshop early next year to discuss governance. There is a general consensus that Saicm will continue to be voluntary and multi-stakeholder. But delegates in Bangkok discussed the extent to which proposals put forward by Germany to raise the chemicals agenda within the UN should be included in the negotiating text. A technical working group has also been formed ahead of the Romania meeting, to review targets experts have been developing to track and measure progress towards Saicm's goals. The final outcome document from Bangkok will be published in the coming weeks. It will include significant portions of bracketed – or contested – text, which delegates will try to resolve in Romania. Further Information is available at:

- IP3 scenario note
- Documents from key thematic discussions
- UN 'cash crisis' press release
- Developing countries' financing paper

Chemical Watch, 10 October 2019

<http://chemicalwatch.com>

## REACH Update

CHEMWATCH

### Rules for registration of phase-in substances clarified

2019-10-17

The transitional regime for registering phase-in chemicals under REACH ended on 31 May 2018. The Commission has now clarified that certain provisions for phase-in substances will still apply until 31 December 2019. The Commission has set 31 December 2019 as the cut-off date after which some conditions stipulated in REACH for phase-in substances will no longer apply. Companies need to pay attention to the clarifications made in the Implementing Regulation published today. After the cut-off date, companies will need to calculate their manufactured or imported volume per calendar year for each of their substances. To enable registrants to continue with their data-sharing obligations, including for newcomers and updates of the registration dossier, the Implementing Regulation recommends that registrants should use similar informal communication platforms to those used for registering phase-in substances. From the cut-off date, companies that plan to register a substance will need to submit an inquiry to ECHA to get information on other registrants in order to begin data-sharing negotiations, and they can no longer rely on their pre-registrations. If data-sharing negotiations started within a substance information exchange forum (SIEF), respective data-sharing disputes can be submitted according to Article 30(3) of REACH until the cut-off date. After this date, all data-sharing disputes will be handled according to Article 27. Certain phase-in substances will continue to benefit from less stringent information requirements if they are registered at the lowest tonnage band, between 1 and 10 tonnes per year and they do not meet the criteria listed in Annex III to REACH. Further information is available at:

- [Commission Implementing Regulation](#)
- [Practical advice for companies](#)
- [Questions and answers](#)
- [Contact ECHA's Helpdesk](#)
- [Overview: comparison of the dispute procedures for pre-registrants and inquirers](#)

ECHA, 10 October 2019

<http://echa.europa.eu>

**The transitional regime for registering phase-in chemicals under REACH ended on 31 May 2018.**

## REACH Update

CHEMWATCH

### Call for evidence: restriction on lead in ammunition (shot and bullets) and fishing tackle

2019-10-17

The European Chemicals Agency (ECHA) have organised an online information session on the call for evidence on the possible restriction on the placing on the market and use of lead in ammunition (shot and bullets) and fishing tackle. The recording and presentations are now available at: [Watch recording](#)

ECHA News, 16 October 2019

<http://echa.europa.eu>

### New substance evaluation conclusion published

2019-10-17

The European Chemicals Agency has published a new substance evaluation conclusion for methyl vinyl ether. The new substance evaluation conclusion document is now available on ECHA's website for [methyl vinyl ether](#) (EC 203-475-4, CAS 107-25-5), added to the CoRAP list in 2018 and evaluated by Latvia. Further information is available at:

- [Community rolling action plan](#)
- [Substance evaluation](#)

ECHA News, 16 October 2019

<http://echa.europa.eu>

### Webinar: What's new in IUCLID 6.4?

2019-10-17

A new version of IUCLID will be released on 30 October 2019. The European Chemicals Agency (ECHA) has invited interested parties to join a webinar to hear about the latest features including new data fields for reporting nanoforms, changes covering the latest amendments (ATPs) to the CLP Regulation and new features for the upcoming database of substances of very high concern in articles (SCIP). To register, go to: [Register](#)

ECHA News, 16 October 2019

<http://echa.europa.eu>

**The European Chemicals Agency (ECHA) have organised an online information session on the call for evidence on the possible restriction on the placing on the market and use of lead in ammunition (shot and bullets) and fishing tackle.**

## REACH Update

CHEMWATCH

### Public consultation on harmonised classification and labelling

2019-10-17

The European Chemicals Agency (ECHA) is seeking comments on the 3 new harmonised classification and labelling proposals. The proposals are for:

- 2-[N-ethyl-4-[(5-nitrothiazol-2-yl)azo]-m-toluidino]ethyl acetate; C.I. Disperse Blue 124 (EC 239-203-6, CAS 15141-18-1);
- theophylline; 1,3-dimethyl-3,7-dihydro-1H-purine-2,6-dione (EC 200-385-7, CAS 58-55-9); and
- barium diboron tetraoxide (EC 237-222-4, CAS 13701-59-2).

The deadline for comments is 13 December 2019. Further information is available at: [Give comments](#)

ECHA, 16 October 2019

<http://echa.europa.eu>

### New proposals to harmonise classification and labelling

2019-10-17

The European Chemicals Agency (ECHA) has published new proposals to harmonise classification and labelling. The proposals have been submitted for:

- Reaction mass of 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]diphenol and benzyl(diethylamino)diphenylphosphonium 4-[1,1,1,3,3,3-hexafluoro-2-(4-hydroxyphenyl)propan-2-yl]phenolate (1:1) (EC 943-265-6, CAS -);
- Reaction mass of 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]diphenol and benzyltriphenylphosphonium, salt with 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis[phenol] (1:1) (EC 947-368-7, CAS -);
- Phosphorus(1+), (N-ethylethanaminato)diphenyl(phenylmethyl)-, (T-4)-, salt with 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis[phenol] (1:1) (EC 479-100-5, CAS 577705-90-9);
- Benzyltriphenylphosphonium, salt with 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis[phenol] (1:1) (EC 278-305-5, CAS 75768-65-9);
- zinc ammoniate ethylenebis(dithiocarbamate)-poly[ethylenebis(thiuramdisulfide)]; metiram (EC 618-430-8, CAS 9006-42-2);

The European Chemicals Agency (ECHA) is seeking comments on the 3 new harmonised classification and labelling proposals.

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- 5-methyl-2-(prop-1-en-2-yl)hex-4-en-1-yl 3-methylbut-2-enoate; lavandulyl senecioate (EC 805-422-6, CAS 23960-07-8); and
- N-Didecyl-N-dipolyethoxyammonium borate/ Didecylpolyoxethylammonium borate (Polymeric betaine) (EC 695-923-4, CAS 214710-34-6).
- Registry of CLH intentions

ECHA News, 16 October 2019

<http://echa.europa.eu>

### Updated advice on biocidal product families

2019-10-17

To help companies build up biocidal product families which are consistent and manageable to assess, the European Commission has published an updated note for guidance. The document clarifies the issue of 'similarity' regarding composition, uses, levels of risk and efficacy. It also gives best practice paths for pre-submission meetings with the competent authority and on how to deal with ongoing product family applications which need to be split into separate families. The note for guidance was agreed at the biocides competent authorities meeting in July 2019. Further information is available at: [More](#)

ECHA, 16 October 2019

<http://echa.europa.eu>

**To help companies build up biocidal product families which are consistent and manageable to assess, the European Commission has published an updated note for guidance.**

## Janet's Corner

CHEMWATCH

### No-Deforestation

2019-10-13



## Hazard Alert

CHEMWATCH

### Sulfuric acid

2019-10-06

Sulfuric acid is a highly corrosive strong mineral acid with the molecular formula  $H_2SO_4$ . It is a colourless to slightly yellow viscous liquid which is soluble in water at all concentrations. Sometimes, it may be dark brown as dyed during industrial production process in order to alert people's awareness to its hazards. Sulfuric acid is a diprotic acid which may show different properties depending upon its concentration. Its corrosiveness on metals, stones, skin, eyes and flesh or other materials can be mainly ascribed to its strong acidic nature and, if concentrated, strong dehydrating and oxidising properties. [1]

### USES [2]

The main use of sulfuric acid is in the production of phosphate fertilisers. It is also used to manufacture explosives, other acids, dyes, glue, wood preservatives, and automobile batteries. It is used in the purification of petroleum, the pickling of metal, copper smelting, electroplating, metal work, and the production of rayon and film.

### IN THE ENVIRONMENT [2,3]

Sulfuric acid will exist as particles or droplets in the air if released to the atmosphere. It dissolves when mixed with water. It has moderate acute (short-term) toxicity on aquatic life. Sulfuric acid is very corrosive and would badly burn any plants, birds or land animals exposed to it. It has moderate chronic (long-term) toxicity to aquatic life. Chronic effects on plants, birds or land animals have not been determined. Small quantities of sulfuric acid will be neutralised by the natural alkalinity in aquatic systems. Larger quantities may lower the pH for extended periods of time. Sulfuric acid is removed from the air in rain and contributes to the formation of acid rain.

### SOURCES AND ROUTES OF EXPOSURE [2,4]

#### Sources of Exposure

The primary sources of sulfuric acid emissions are the industries that manufacture it or use it in production. Some of the industries that use it in production are the metal smelters, phosphate fertiliser producers, oil refiners, the chemical industry, battery manufacturers, manufacturers or fabricated metal products, manufacturers of electronic components, and

## Hazard Alert

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manufacturers of measuring and controlling devices. These are emissions to the air unless there is a spill to water or land. Sulfuric acid spilt to land or water may result in emissions of the acid to air. Other possible emitters of sulfuric acid are home and larger pool treatment, the disposal of automobile batteries, electroplating facilities, electronics, semiconductor and circuit board production, potato growers, and water and waste water treatment. These emissions may be to the soil, water, or air. Sulfuric acid may be also produced as a result of sulphur dioxide reacting with other chemicals in the air.

### Routes of Exposure

The major routes of exposure to sulfuric acid are via inhalation of contaminated air, dermal or ocular exposure and ingestion. While it is not absorbed through the skin, contact of the skin and eyes with strong concentrations may cause serious burns.

### HEALTH EFFECTS [2,4,5]

#### Acute Effects

Sulfuric acid causes irritation to the eyes, skin, nose, throat; pulmonary oedema, bronchitis; emphysema; conjunctivitis; stomatis; dental erosion; eye, skin burns; dermatitis. The substance is very corrosive to the eyes, the skin, and the respiratory tract and attacks the enamel of the teeth. Inhalation may result in a burning sensation, sore throat, cough, laboured breathing, shortness of breath and lung oedema. Symptoms may be delayed. Skin contact may result in redness, pain, blisters, serious skin burns. Eye contact may result in redness, pain and severe deep burns. Corrosive on ingestion and may result in abdominal pain, burning sensation, shock or collapse.

#### Chronic Effects

Lungs may be affected by repeated or prolonged exposure to an aerosol of sulfuric acid. There is a risk of tooth erosion upon repeated or prolonged exposure to an aerosol of this substance.

#### Carcinogenicity

The International Agency for Research on Cancer has classified 'occupational exposures to strong-inorganic-acid mists containing sulfuric acid' as carcinogenic to humans.



## Hazard Alert

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### SAFETY [6]

#### First Aid Measures

##### Ingestion:

- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Avoid giving milk or oils.
- Avoid giving alcohol.
- If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

##### Eye Contact:

- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.

##### Dermal Contact:

- Immediately remove all contaminated clothing, including footwear.
- Flush skin and hair with running water (and soap if available).

##### Inhalation:

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.

#### Exposure Controls and Personal Protection

##### Engineering Controls

For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant.

##### Respirator

Type AENO-P Filter of sufficient capacity should be used

## Hazard Alert

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### Personal Protective Equipment

- Eyes: Safety glasses with side shields and chemical goggles.
- Hands: Chemical protective gloves, such as PVC should be worn. Suitability and durability of glove type is dependent on usage. Factors such as frequency and duration of contact and chemical resistance of glove material should be considered.
- Feet: Safety footwear or safety gumboots should be worn.
- Other safety equipment advised include overalls and PVC Apron.
- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

### REGULATION

#### United States [7]

Exposure Limit	Limit Values	HE Code	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL) - General Industry See <a href="#">29 CFR 1910.1000 Table Z-1</a>	1 mg/m <sup>3</sup> TWA	HE10	Lung changes
		HE11	Cough
OSHA PEL - Construction Industry See <a href="#">29 CFR 1926.55 Appendix A</a>	1 mg/m <sup>3</sup> TWA	HE10	Lung changes
		HE11	Cough
OSHA PEL - Shipyard Employment See <a href="#">29 CFR 1915.1000 Table Z-Shipyards</a>	1 mg/m <sup>3</sup> TWA	HE10	Lung changes
		HE11	Cough

## Hazard Alert

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Exposure Limit	Limit Values	HE Code	Health Factors and Target Organs
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	1 mg/m <sup>3</sup> TWA	HE3	Dental erosion
		HE10	Pulmonary fibrosis, bronchiectasis, and emphysema
		HE11	Pulmonary oedema
		HE14	Respiratory irritation, cough
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2004)	0.2 mg/m <sup>3</sup> TWA (thoracic particulate mass) A2 (when contained in strong inorganic acid mists)	HE3	Dental erosion
		HE10	Pulmonary fibrosis, bronchiectasis, and emphysema
		HE14	Marked eye, nose, throat, bronchial, and skin irritation
CAL/OSHA PELs	0.1 mg/m <sup>3</sup> TWA 3 mg/m <sup>3</sup> STEL		Irritation of the upper and lower respiratory tract

### Australia [2]

Safe Work Australia: Safe Work Australia has set an eight-hour time weighted average (TWA) exposure limit of 1 mg/m<sup>3</sup>, with a short term exposure limit (STEL) of 3 mg/m<sup>3</sup>.

### REFERENCES

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### Engineers produce water-saving crop irrigation sensor

2019-10-09

A team of University of Connecticut researchers engineered a soil moisture sensor that is more cost effective than anything currently available and responds to the global need to regulate water consumption in agriculture. Designed and tested on the university's farm, the sensors are small enough to insert into the soil with ease and less expensive to manufacture than current technology, the researchers write in the *Journal of Sensors and Actuators*. "Advances in hydrological science are hampered by the lack of onsite soil moisture data," said Guiling Wang, study author and professor of civil and environmental engineering at UConn. "It's really hard to monitor and measure things underground. The challenge is that the existing sensors are very expensive and the installation process is very labour intensive." The sensors developed by the team of UConn engineers -- environmental, mechanical, and chemical -- are expected to save nearly 35% of water consumption and cost far less than what exists. Current sensors that are used in a similar way range from \$100 to \$1,000 each, while the one developed at UConn cost \$2, according to the researchers. An alternate monitoring option, soil moisture data collected from remote sensing technology such as radars and radiometers on board satellites, have suffered from low resolution. But the new technology developed by UConn Professor Baikun Li's group can provide high spatio-temporal resolution data needed for hydrology model development in Wang's group. In the UConn prototype, wires are connected from the sensors to an instrument that logs data. Researchers conducted field tests of the sensors -- performing side-by-side tests with commercial sensors under various environmental conditions throughout a 10-month period. The effects of the environmental variations on soil moisture throughout the period were clearly reflected. Critically, the small sensors can also be easily sent around the world given the fact that soil moisture plays a fundamental role in agricultural decision-making globally. Accurate soil moisture sensing is essential to ensure a water level that produces the most robust crops while not wasting the natural resource. In some states in the U.S. -- Florida and California, for example -- irrigation water usage has become tightly restricted. The UConn researchers are also working on a nitrogen sensor that is the same model of the water sensors. These would help provide farmers with information on when fields need fertilising. Currently, nitrogen sensors are not available using this type of technology. "This is really an exciting start to a much larger scope of

**New technology responds to the global need to regulate water consumption in agriculture**

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things we have in mind," says Li, a study author and professor of civil and environmental engineering.

Science Daily, 26 September 2019

<http://www.sciencedaily.com>

### Development of highly sensitive diode, converts microwaves to electricity

2019-10-09

The Japan Science and Technology Agency (JST), Fujitsu Limited, and the Tokyo Metropolitan University announced that they developed a highly sensitive rectifying element in the form of a nanowire backward diode, which can convert low-power microwaves into electricity. Through JST's Strategic Basic Research Programs, the technology was developed by researchers led by Kenichi Kawaguchi of Fujitsu Limited and Professor Michihiko Suhara of the Tokyo Metropolitan University. The new technology is expected to play a role in harvesting energy from radio waves in the environment, in which electricity is generated from ambient radio waves, such as those emitted from mobile phone base stations.

#### Research Background and Circumstances

In preparation for the commencement of the true IoT era, energy harvesting technologies, which transform the minute sources of energy in the surrounding environment into electricity, have come under the spotlight in recent years as means for creating sensor networks that function without batteries. One such example reuses as electricity the low-power radio waves (microwaves), ubiquitous in open space, that are emitted from mobile phone base stations, for use in communications. Equipment used in generating electricity from ambient radio waves consists of a radio wave power generating element, which includes an antenna for collecting radio waves and a rectifying element (diode) that rectifies the radio waves. The responsiveness (sensitivity) of a diode to microwaves largely depends on the steepness of rectification characteristics and on diode size (capacity). Generally, Schottky\*1 barrier diodes, which utilise the rectification occurring at the junction formed between a metal and a semiconductor, are used as the diodes for power conversion. Due to rectification characteristics becoming slow at extremely low voltages and the size of elements being larger than several micrometres ( $\mu\text{m}$ ), however, sensitivity to low-power microwaves weaker than microwatts ( $\mu\text{W}$ ) was insufficient, and it was difficult to convert

**A group of researchers developed a highly sensitive rectifying element in the form of a nanowire backward diode, which can convert low-power microwaves into electricity.**

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ambient radio waves into electricity. This led to a demand for diodes with increased sensitivity.

#### Research Details

The researchers carried out development to create a diode with higher sensitivity. Specifically, they shrunk the capacity of and miniaturised a backward diode<sup>2</sup> that is capable of steep rectification operations with zero bias<sup>3</sup>, as rectification occurs by joining two different types of semiconductors and current flows with a different principle (tunnel effect) than conventional Schottky barrier diodes. Conventional backward diodes were formed by processing the thin film of a layered compound semiconductor into a disk shape via etching. Nonetheless, because the materials are prone to damage under processing, it was difficult to finely process diodes to a submicron size and operate them. By adjusting the ratio (composition) of the constituent elements of the connected semiconductor materials and, at a minute level, the density of the added impurities, the researchers succeeded in growing crystals in nanocrystals with a diameter of 150nm comprised of n-type indium arsenide (n-InAs) and p-type gallium arsenide antimonide (p-GaAsSb) for a tunnel junction structure necessary for the characteristics of the backward diode. Moreover, in the process for implanting insulating material around the nanowire<sup>4</sup> and the process for forming electrode film with metal on both end of the wire, a new technology was used for mounting that does not damage the nanowire. As a result, they were able to form a sub-micron sized diode, which was difficult to do with conventional miniaturisation process technology for compound semiconductors, and thereby succeeded, for the first time in the world, in developing a nanowire backward diode with over 10 times the sensitivity of conventional Schottky barrier diodes. In testing the new technology in the microwave frequency of 2.4GHz, which is currently used in the 4G LTE and Wi-Fi communication line standards for mobile phones, the sensitivity was 700kV/W, roughly 11 times that of the conventional Schottky barrier diode (with a sensitivity of 60KV/W). Therefore, the technology can efficiently convert 100nW-class low-power radio waves into electricity, enabling the conversion of microwaves emitted into the environment from mobile phone base stations in an area that is over 10 times greater than was previously possible (corresponding to 10% of the area in which mobile phone communications are possible). This has led to expectations that it can be used as a source of power for sensors. With this technology, microwaves with a power level of 100 nanowatts (nW) can be converted to electricity. Going forward, as the research group optimise the design

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of the diode and the radio wave-collecting antenna while adding power control for constant voltage, there are high expectations for the realisation of energy harvesting from environmental radio waves.

### Notes

1. Schottky barrier diode: Diodes that use the energy known as a Schottky barrier, which is produced through a junction of a semiconductor and metal, for rectification.
2. Backward diode: In contrast to conventional Schottky barrier diodes, these diodes operate by using the phenomenon of tunnelling. They enable excellent rectification operations even within small voltage ranges in which conventional diodes are unable to achieve sufficient rectification.
3. Zero bias: A condition in which there is zero voltage. With the harvesting of energy from environmental radio waves, zero bias operations are needed because power cannot be consumed for the adjustment of the operating voltage.
4. Nanowire: Wire-shaped semiconductors so thin that their width is measured in nanometres (nm). Rather than through top-down processing such as etching, they can be built bottom up through crystal formation.

Science Daily, 26 September 2019

<http://www.sciencedaily.com>

### **Lipid produced by organism helps control blood sugar**

2019-10-09

Researchers based in Brazil, the United States and Germany have discovered that 12-HEPE, a lipid produced in response to cold by brown adipose tissue in the human body, helps reduce blood sugar. The results of their experiments with mice pave the way for new treatments for diabetes. The group also observed that a drug used to treat urinary dysfunction increases the amount of 12-HEPE released into the bloodstream in human patients. The study is published in *Cell Metabolism*. Its first author is Luiz Osório Leiria, a researcher at the University of Campinas's Biology Institute (IB-UNICAMP) in São Paulo State, Brazil. The research was conducted as part of his postdoctoral fellowship at the same university's School of Medical Sciences (FCM-UNICAMP) during a research internship at Dr. Yu-Hua Tseng Lab at Joslin Diabetes Centre, an independent institution affiliated with Harvard Medical School in the US, with support from São Paulo Research Foundation—FAPESP and the American Diabetes

**Researchers based in Brazil, the United States and Germany have discovered that 12-HEPE, a lipid produced in response to cold by brown adipose tissue in the human body, helps reduce blood sugar.**

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Association. Currently, Leiria has a research grant from the FAPESP Young Investigator Grants (YIG) program. White adipose tissue, one of the two types of adipose tissue in mammals, including humans, stores excess energy as fat. The other kind is brown adipose tissue, which converts energy from food into heat and contributes to thermal regulation. Brown adipose tissue produces several kinds of lipids in response to cold. One of these lipids is 12-HEPE, whose function was unknown until the group discovered that blood sugar was reduced more efficiently in obese mice treated with 12-HEPE than in untreated mice after they were injected with a concentrated glucose solution. According to a published paper, the beneficial effect of 12-HEPE on glucose tolerance in obese mice was due to its promotion of glucose uptake into both skeletal muscle and brown adipose tissue. Studies conducted with patients pointed to a possible physiological role for 12-HEPE. The volunteers were divided into three groups: lean and healthy, overweight, and obese. An analysis of blood samples showed that the lean group had more 12-HEPE in their blood than the overweight group and much more than the obese group. The explanation may be that the proportion of brown fat mass is lower in obese individuals than in lean individuals. Moreover, the lack of brown fat in obese individuals may account for their obesity and even for their increased risk of diabetes. In vitro assays with human cells showed that 12-HEPE increased glucose uptake by adipose cells, suggesting that 12-HEPE contributes to the process of adaptation to cold as well as the possibility that a drastic reduction in the levels of the lipid in the bloodstream of obese individuals may account, at least partly, for their increased blood sugar. The discovery lays a foundation for the development of new drugs to combat diabetes and possible new treatments with currently available drugs. During the study, another group of healthy lean volunteers received doses of mirabegron, a drug that is normally prescribed as a medication to treat a urinary syndrome known as overactive bladder but can also activate brown adipose tissue. The control group was given only a placebo. The patients who received the drug were found to have increased plasma levels of 12-HEPE. This suggests that the drug could be prescribed as a treatment for diabetes in the future. "Mirabegron has several effects, some of which are undesirable. It activates the release of various other lipids and does not specifically target glucose reduction. An omega-3 lipid such as 12-HEPE would have a far more desirable toxicological profile," Leiria said. US researchers are currently conducting tests to measure the effects of relatively low doses of the drug on blood sugar levels. The next step is to determine which receptor 12-HEPE bonds to in order to promote glucose



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## CHEMWATCH

uptake, enabling scientists to develop novel molecules that stimulate the receptor in question.

Phys.org, 30 September 2019

<http://phys.org>

### **A new concept could make more environmentally friendly batteries possible**

2019-10-09

A new concept for an aluminium battery has twice the energy density as previous versions, is made of abundant materials, and could lead to reduced production costs and environmental impact. The idea has potential for large-scale applications, including storage of solar and wind energy. Researchers from Chalmers University of Technology, Sweden, and the National Institute of Chemistry, Slovenia, are behind the idea. Using aluminium battery technology could offer several advantages, including a high theoretical energy density, and the fact that there already exists an established industry for manufacturing and recycling. Compared with today's lithium-ion batteries, the researchers' new concept could result in markedly lower production costs. "The material costs and environmental impacts that we envisage from our new concept are much lower than what we see today, making them feasible for large-scale usage, such as solar cell parks, or storage of wind energy, for example," says Patrik Johansson, professor at the Department of Physics at Chalmers. "Additionally, our new battery concept has twice the energy density compared with the aluminium batteries that are state-of-the-art today." Previous designs for aluminium batteries have used the aluminium as the anode (the negative electrode) and graphite as the cathode (the positive electrode). But graphite provides too low an energy content to create battery cells with enough performance to be useful. But in the new concept, presented by Patrik Johansson and Chalmers, together with a research group in Ljubljana led by Robert Dominko, the graphite has been replaced by an organic, nanostructured cathode, made of the carbon-based molecule anthraquinone. The anthraquinone cathode has been extensively developed by Jan Bitenc, previously a guest researcher at Chalmers from the group at the National Institute of Chemistry in Slovenia. The advantage of this organic molecule in the cathode material is that it enables storage of positive charge-carriers from the electrolyte, the solution in which ions move between the electrodes, which make possible higher energy density in the battery. "Because the new cathode material makes it possible to use a more appropriate charge-carrier, the batteries

**A new concept for an aluminium battery has twice the energy density as previous versions, is made of abundant materials, and could lead to reduced production costs and environmental impact.**

## Gossip

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can make better usage of aluminium's potential. Now, we are continuing the work by looking for an even better electrolyte. The current version contains chlorine—we want to get rid of that," says Chalmers researcher Niklas Lindahl, who studies the internal mechanisms which govern energy storage. So far, there are no commercially available aluminium batteries, and even in the research world they are relatively new. The question is if aluminium batteries could eventually replace lithium-ion batteries. "Of course, we hope that they can. But above all, they can be complementary, ensuring that lithium-ion batteries are only used where strictly necessary. So far, aluminium batteries are only half as energy dense as lithium-ion batteries, but our long-term goal is to achieve the same energy density. There remains work to do with the electrolyte, and with developing better charging mechanisms, but aluminium is in principle a significantly better charge carrier than lithium, since it is multivalent—which means every ion 'compensates' for several electrons. Furthermore, the batteries have the potential to be significantly less environmentally harmful," says Patrik Johansson. "Concept and electrochemical mechanism of an Al metal anode—organic cathode battery" is published in the journal Energy Storage Materials.

Tech Xplore, 30 September 2019

<https://techxplore.com/>

### **We Just Made a Breakthrough on a Genius Concept For Eco-Friendly Batteries**

2019-10-09

From smartphones to electric cars, we're going to continue to need plenty of batteries in the years to come. New research shows how an upgraded type of aluminium battery could offer several advantages over the traditional lithium-ion ones in use today. The battery has low production costs, and doesn't take the same environmental toll as the batteries we currently use, partly because it uses materials that are abundant and easy to find, reducing our reliance on ravaging the planet to power our electronics. This new battery concept is particularly suitable for large-scale power systems – sites where power from renewable energy needs to be stored until it's ready, for example. In contrast, not only is lithium scarce, but lithium-ion batteries often make use of cobalt too – and that's tricky and potentially dangerous to mine. The switch over to aluminium, if scientists can make it work, would have several benefits, not least by reducing our reliance on fossil fuels for battery production and recycling. "The material costs and environmental impacts that we envisage from

**From smartphones to electric cars, we're going to continue to need plenty of batteries in the years to come.**

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our new concept are much lower than what we see today, making them feasible for large-scale usage, such as solar cell parks, or storage of wind energy, for example," says physicist Patrik Johansson, from Chalmers University of Technology in Sweden. "Additionally, our new battery concept has twice the energy density compared with the aluminium batteries that are 'state of the art' today." Aluminium batteries aren't new, but in this case, researchers swapped out the graphite usually used as the cathode, replacing it with the carbon-based molecule anthraquinone (the cathode absorbs electrons as the battery is used). That helps achieve that higher energy density, making aluminium batteries a lot more practical, sustainable and commercially viable than they were before – though there's plenty of room for improvement yet in the internal chemical mix, particularly in the electrolyte that encourages ions to travel between the anode and cathode. "There remains work to do with the electrolyte, and with developing better charging mechanisms, but aluminium is in principle a significantly better charge carrier than lithium, since it is multivalent – which means every ion 'compensates' for several electrons," says Johansson. For now, this is only a proof of concept, and plenty more work needs to be done before we're running our homes on aluminium batteries. This study shows that the idea can work though, and if we're able to wean our electronics and power systems off lithium-ion, the benefits could be substantial. The researchers suggest that aluminium batteries could soon be running alongside lithium-ion batteries in certain scenarios, with systems able to switch between the two depending on energy demands and specific use cases. "Because the new cathode material makes it possible to use a more appropriate charge-carrier, the batteries can make better usage of aluminium's potential," says physicist Niklas Lindahl, from Chalmers University of Technology. "Now, we are continuing the work by looking for an even better electrolyte." The research has been published in *Energy Storage Materials*.

Science Alert, 3 October 2019

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

## T cells Are More Active At Different Times Of The Day

2019-10-09

Our biological clock may influence the efficiency of our immune response, according to new research in mice. CD8 T cells, which are essential to fight infections and cancers, function very differently according to the time of day, researchers report. We know that circadian rhythms come from "clock genes", which influence most organs and cells—including those of

**Our biological clock may influence the efficiency of our immune response, according to new research in mice.**

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the immune system, whose function varies according to the time of day. Circadian rhythms are involved in various aspects of physiology, including sleep, nutrition, hormonal activity, and body temperature. These daily rhythms help the body adapt to cyclical changes in the environment, such as seasons and the day and night cycle. In earlier research, the team had demonstrated that T cells react more or less strongly to a foreign body according to the time of day, but the role of the biological clock in this phenomenon remained unknown. "Using a mouse vaccine model, we observed that after vaccination, the strength of the CD8 T cell response varied according to the time of day. Conversely, in mice whose CD8 T cells were deficient for the clock gene, this circadian rhythm was abolished, and response to the vaccine was diminished in the daytime," explains Nicolas Cermakian, a professor in the psychiatry department at McGill University. "Our study shows that T cells are more prone to be activated at certain times of the day. Identifying the mechanisms through which the biological clock modulates the T cell response will help us better understand the processes that regulate optimal T cell responses," says Nathalie Labrecque, professor at the medicine and microbiology, infectious diseases, and immunology departments at Université de Montréal. "This knowledge will contribute to improving vaccination strategies and cancer immune therapies," she says. The researcher appears in the Proceedings of the National Academy of Sciences. Grants from the Canadian Institutes of Health Research funded the research.

Futurity, 2 October 2019

<http://www.futurity.org>

## A filament fit for space: Silk is proven to thrive in outer space temperatures

2019-10-09

Their initial discovery had seemed like a contradiction because most other polymer fibres embrittle in the cold. But after many years of working on the problem, the group of researchers have discovered that silk's cryogenic toughness is based on its nano-scale fibrils. Sub-microscopic order and hierarchy allows a silk to withstand temperatures of down to -200oC. And possibly even lower, which would make these classic natural luxury fibres ideal for applications in the depths of chilly outer-space. The interdisciplinary team examined the behaviour and function of several animal silks cooled down to liquid nitrogen temperature of -196 oC. The fibres included spider silks but the study focused on the thicker and much more commercial fibres of the wild silkworm *Antheraea pernyi*. In

**The scientists who discovered that natural silks get stronger the colder they get, have finally solved the puzzle of why.**

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an article published in *Materials Chemistry Frontiers*, the team was able to show not only 'that' but also 'how' silk increases its toughness under conditions where most materials would become very brittle. Indeed, silk seems to contradict the fundamental understanding of polymer science by not losing but gaining quality under really cold conditions by becoming both stronger and more stretchable. This study examines the 'how' and explains the 'why'. It turns out that the underlying processes rely on the many nano-sized fibrils that make up the core of a silk fibre. In line with traditional polymer theory, the study asserts that the individual fibrils do indeed become stiffer as they get colder. The novelty and importance of the study lies in the conclusion that this stiffening leads to increased friction between the fibrils. This friction in turn increases crack-energy diversion while also resisting fibril slippage. Changing temperature would also modulate attraction between individual silk protein molecules in turn affecting core properties of each fibril, which is made up from many thousand molecules. Importantly, the research is able to describe the toughening process on both the micron and nano-scale levels. The team concludes that any crack that tears through the material is diverted each time it hits a nano-fibril forcing it to lose ever more energy in the many detours it has to negotiate. And thus, a silk fibre only breaks when the hundreds or thousands of nano-fibrils have first stretched and then slipped and then all of them have individually snapped. The discovery is pushing boundaries because it studied a material in the conceptually difficult and technologically challenging area that not only spans the micron and nano-scales but also has to be studied at temperatures well below any deep-freezer. The size of scales studied range from the micron size of the fibre to the sub-micron size of a filament bundle to the nano-scale of the fibrils and last but not least to the level supra-molecular structures and single molecules. Against the backdrop of cutting-edge science and futuristic applications it is worth remembering that silk is not only 100% a biological fibre but also an agricultural product with millennia of R&D. It would appear that this study has far-reaching implications by suggesting a broad spectrum of novel applications for silks ranging from new materials for use in Earth's polar regions to novel composites for light-weight aeroplanes and kites flying in the strato- and meso-sphere to, perhaps, even giant webs spun by robot spiders to catch astro-junk in space. Professor Fritz Vollrath, from Oxford University's Department of Zoology, said: 'We envision that this study will lead to the design and fabrication of new families of tough structural filaments and composites using both natural and silk-inspired filaments for applications in extreme cold conditions such as space.' Prof Zhengzhong Shao, from the Macromolecular Science Department of Shanghai's Fudan University,

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said: 'We conclude that the exceptional mechanical toughness of silk fibre at cryogenic temperatures derives from its highly aligned and oriented, relatively independent and extensible nanofibrillar morphology.' Dr Juan Guan from Beihang University, in Beijing, said: 'This study provides novel insights into our understanding of the structure-property relationships of natural high-performance materials which we hope will lead to fabricating human-made polymers and composites for low temperature and high impact applications.' And Dr Chris Holland from Sheffield University, leader of a European-wide Research Consortium on novel, sustainable bio-fibres based on insights into natural silk spinning said: 'Natural silks continue to prove themselves as gold standard materials for fibre production. The work here identifies that it is not just the chemistry, but how silks are spun and in consequence are structured that is the secret to their success.' The next steps of the research will further test the amazing properties. A spin-out company, Spintex Ltd, from Oxford University, partly funded by an EU H2020 grant, is exploring spinning silk proteins the spider's way and focuses on copying the sub-micron structures of bundled fibrils.

### Silk

Natural silks are environmentally sustainable with the animal spin-extruding it from aqueous protein melts at ambient temperatures and low pressures. Many silks are bio-compatible, making them excellent materials for use in medical devices. Silks are light and tend to be very tough suggesting use in light-weight applications where much energy has to be taken up by the material. All silks are bio-disposable, consisting entirely of natural amino acid building blocks that easily integrate into the natural cycle of decay and rebuilding. Last but not least, there is a wealth of information hidden in silk on protein folding and on Nature's way of making exceptional polymer structures.

Science Daily, 3 October 2019

<http://www.sciencedaily.com>

### **Just add water: Chemists suggest a fix for insoluble drugs**

2019-10-09

Stable metal organic frameworks are prized for their ability to capture carbon dioxide or harvest atmospheric water, but U-M researchers have developed a use for unstable metal organic frameworks: as a system for drug delivery. Ninety percent of drugs in development don't dissolve well

**Stable metal organic frameworks are prized for their ability to capture carbon dioxide or harvest atmospheric water, but researchers have developed a use for unstable metal organic frameworks: as a system for drug delivery.**

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or at all in the body, according to a 2012 study. Metal organic frameworks, or MOFs, are rigid, porous structures composed of metal linked by organic ligands. While researching unstable MOFs, U-M chemist Adam Matzger realised they may work as a delivery system for these kinds of drugs. "It struck us that while everyone was shooting for stable MOFs, we could use what we had learned about instability of MOFs to get a degradable substance that would rapidly release drugs. It was a really unexpected finding," said Matzger, the Charles G. Overberger Collegiate Professor of Chemistry and a professor of macromolecular science and engineering. The MOF delivery system takes advantage of one strategy of delivering insoluble drugs, Matzger says. The strategy is to deliver them in an amorphous form, meaning that the drugs are kept from crystallising. Once the drug compounds crystallize, they become less soluble -- and therefore less bioavailable, which means less of the drug crosses into the bloodstream. MOFs are able to keep these drugs in an amorphous state because of their porous structure. MOF-5 in particular looks like a set of cubes stacked on top of each other: picture an endlessly repeating 3D grid. When the researchers load a drug into this grid, the pores in the MOF compartmentalise the drug molecules, holding the compound in the desired amorphous state. Researchers have previously used polymers to hold drug compounds in an amorphous state, but drug molecules could still migrate and crystallise in the polymer, which affects solubility and therefore how much of a drug is bioavailable. Because MOF rigidly holds drug molecules apart but quickly decomposes, drug dosage is easily controlled, Matzger says. The compound itself crosses into the bloodstream, while the MOF decomposes in the body. The researchers, who include postdoctoral fellow Kuthuru Suresh, decided to use MOF-5 for a few reasons. First, its metal component is zinc, a metal with low toxicity used in many supplements, and the organic component is an acid called terephthalic acid. Second, MOF-5 is relatively unstable, which the researchers demonstrated in separate work that examined the stability of different MOFs. "What we do here is we increase the solubility while guaranteeing dosage stability," Matzger said. "This approach is relatively universal. We show it for three drugs, but the fact that the pores are too small to allow a crystal to form is going to be true for all drugs."

Science Daily, 3 October 2019

<http://www.sciencedaily.com>

### A safer way to make azides for use in click chemistry

2019-10-09

A team of researchers at the Chinese Academy of Sciences has found a safer way to synthesize azides for use in click chemistry reactions. In their paper published in the journal *Nature*, the group describes how they discovered a safer way to transform primary amines into azides. In the same journal issue, Joseph Topczewski and En-Chih Liu with the University of Minnesota have published a News & Views piece outlining the work by the team in China. Click chemistry combines two reactive compounds that assemble in ways that reliably produce results with no by-products. The most popular click reaction is called CuAAC and it is used in a wide variety of applications. But synthesizing an azide for use in the process is problematic—it takes a very long time, and produces toxic emissions. Also, the reagents pose an explosion risk when stored. In this new effort, the researchers report that they have found a new way to synthesize azides that eliminates both problems. The researchers report that they were actually working on something else when they discovered that fluorosulfonyl azide (FSO<sub>2</sub>N<sub>3</sub>) could convert primary amines into azides—and instead of it taking hours, it took just a few minutes. Further testing showed that FSO<sub>2</sub>N<sub>3</sub> would react with almost any primary amine, and that it almost always resulted in a 100 percent yield. The researchers note that there is no need to purify FSO<sub>2</sub>N<sub>3</sub> before use, making it an inexpensive option. They further note that there is no need to store it because it can be produced when needed—by mixing imidazolium fluorosulfonyl triflate salt with a sodium azide. They also note that the initiating salt is not toxic—at least to test rodents that were exposed to it. Topczewski and Liu suggest the work by the team in China could open the door to very efficient and generalized two-step methods for converting primary amines into triazoles. They further note that the work also represents another step toward the ultimate goal of click chemistry—developing just a few reactions that can be used to create precursors for a wide number of applications.

Phys.org, 3 October 2019

<http://phys.org>

**A team of researchers at the Chinese Academy of Sciences has found a safer way to synthesize azides for use in click chemistry reactions.**



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### **A blue pigment found to be a high-performance ammonia adsorbent**

2019-10-09

Akira Takahashi and institutional collaborators have discovered that the blue pigment Prussian blue has a higher adsorption capacity than common ammonia adsorbents, and controlled the structure of Prussian blue to synthesise Prussian blue analogues with higher ammonia adsorption capacity. Prussian blue is a pigment used since early times. In the present study, the researchers found that Prussian blue adsorbs more ammonia than common adsorbents such as zeolite and activated carbon. In analogues with the metal ions included in Prussian blue replaced by other metal ions and more defects, the amount of absorbed ammonia increased. Furthermore, while common ammonia adsorbents have low adsorption capacity for low concentration ammonia, Prussian blue was able to adsorb low concentration ammonia in the air at "odourless levels." It was also confirmed that the Prussian blue analogues can release ammonia once adsorbed, making them reusable. This technology is expected to be used as an ammonia odour countermeasure in care homes, a technology for suppression of PM 2.5 generation, and a technology to remove ammonia in hydrogen fuel. Details of this technology will be published in an American chemistry journal, Journal of the American Chemical Society. Ammonia is the most produced chemical substance in the world, with its primary uses as a raw material for chemical products such as fertilizers and fibres. Yet, ammonia is also a malodorous substance, and urine, for example, decomposes to ammonia and causes malodour. Also, ammonia in the atmosphere is a causative substance of the fine particulate matter PM 2.5, believed to mainly originate from ammonia dissipating from agriculture and the livestock industry. Therefore, a technology to remove dilute ammonia contained in the atmosphere is required. In addition, if ammonia is contained in hydrogen supplied to a fuel cell, it has an adverse effect on power generation capacity of the fuel cell, so international standards on hydrogen for fuel cell vehicles require ammonia concentration of less than 0.1 ppm. Particularly in Japan, the government is advancing the development of technology to make hydrogen from ammonia, so a technology to remove ammonia from hydrogen fuel is crucial. Currently, activated carbon, zeolite, and ion-exchange resins are used as common ammonia adsorbents. However, these adsorbents have issues such as difficulty in reuse, low adsorption capacity for low concentration ammonia, and high prices. So, there has been demand for low-price and reusable ammonia adsorbents that demonstrate high adsorption capacity even for low concentration

**Akira Takahashi and institutional collaborators have discovered that the blue pigment Prussian blue has a higher adsorption capacity than common ammonia adsorbents, and controlled the structure of Prussian blue to synthesise Prussian blue analogues with higher ammonia adsorption capacity.**

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ammonia. Recently, porous coordination polymers composed of metal ions and small molecules, with fine spatial networks inside, have gained attention as new materials for gas adsorption and recovery. AIST has conducted research and development of harmful substance removal using porous coordination polymers. In particular, AIST has advanced development using porous coordination polymers, i.e. Prussian blue-type complexes, to adsorb radioactive caesium with high efficiency, and use them in a volume reduction technology for plant-based contamination. In the present study, the researchers used the structure of Prussian blue and Prussian blue analogues to develop an ammonia gas removal technology, while also pursuing improvement of ammonia adsorption capacity by structural control at an atomic level. In the present study, the researchers focused on the fact that exposed metal ions in these defects (vacancy sites) easily form coordination bonds with molecules, and investigated whether insoluble Prussian blue with defects are capable of high-density adsorption of ammonia or not. In order to increase vacancy sites as much as possible, a method was devised to increase the numbers of defects, while reducing the content of alkali metal ions that are likely to induce the interstitial sites. The researchers thereby created a cobalt-substituted Prussian blue analogue ( $\text{Co}[\text{Co}(\text{CN})_6]_{0.60}$ , CoHCC) and a copper-substituted Prussian blue analogue ( $\text{Cu}[\text{Fe}(\text{CN})_6]_{0.50}$ , CuHCF) and evaluated their ammonia adsorption capacity along with Prussian blue. First, the researchers evaluated the adsorption amount in pure ammonia as the basic performance of adsorbents. The ammonia adsorption amount of Prussian blue was 12.4 mol (211 g)/kg at 1 atm, a higher value than common adsorbents. This corresponds to adsorption of 11 ammonia molecules per unit cell of Prussian blue with a volume of approximately 1 nm<sup>3</sup>. Furthermore, the analogues CoHCC and CuHCF showed high adsorption amounts of 21.9 mol (373 g)/kg and 20.6 mol (351 g)/kg respectively. CoHCC in particular had an ammonia adsorption amount of 16.2 molecules per unit cell, adsorbing 93 percent of the estimated maximum adsorption amount of 17.6 molecules. Next, the researchers placed a film of Prussian blue in a usual laboratory showing ammonia concentration of 0.015 ppm, and examined the adsorption behaviour of dilute ammonia. As a result, the ammonia adsorption amount of the Prussian blue film increased with time, showing an adsorption amount of 0.3 mol (5.1 g)/kg. This means that dilute concentration ammonia contained in the atmosphere was adsorbed and trapped in the fine space of Prussian blue that corresponds to 1 part in 700,000,000 by volume conversion. It is thought that Prussian blue can adsorb such dilute ammonia because adsorbed ammonia (NH<sub>3</sub>) reacts with water in Prussian blue to form an ammonium ion (NH<sub>4</sub><sup>+</sup>), is stabilised, and is

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trapped inside Prussian blue without being rereleased into the air. The ammonia adsorption capacity of the ion-exchange resin (Amberlyst) and zeolite in a room, where ammonia of the same concentration is contained. Zeolite adsorbed almost no ammonia at all. The ion-exchange resin showed similar adsorption capacity to that of Prussian blue, but it is extremely expensive. These facts indicated the superiority of Prussian blue. Furthermore, in order to check that ammonia is adsorbed by Prussian blue quickly enough, the researchers filled a thin tube with Prussian blue, and let air containing approximately 1 ppm of ammonia pass through at a speed so that the Prussian blue and air were in contact for 2 milliseconds only. After air with an ammonia concentration of 0.86 ppm passed through the tube, it decreased to 0.036 ppm, adsorbing and removing 96 percent of ammonia. In addition, in the tests conducted in the same way, both CuHCF and CoHCC adsorbed and removed over 90 percent of ammonia. Finally, the researchers checked whether the newly fabricated analogues could be used repeatedly as adsorbents. As a result, in applications that removed dilute ammonia from the atmosphere, the adsorbed ammonia was desorbed by rinsing CuHCF with a dilute acid, and CuHCF was found to be reusable as an adsorbent. Also, in applications to store pure ammonia, CoHCC was capable of repeated use. The Prussian blue analogues used in this study are similar to materials used as radioactive caesium adsorbents so far, and there are a variety of forming techniques for the radioactive caesium adsorbents, such as granules and non-woven fabrics supporting an adsorbent. AIST will continue development so that Prussian blue and its analogues can be used as ammonia adsorbents, such as developing non-woven fabrics supporting Prussian blue to install them on ventilators in facilities which have potential for ammonia to dissipate, including in pig houses and compost buildings, and remove ammonia that can cause malodours and PM 2.5, and developing gas vent pipes coated with Prussian blue on their inner surface that can be installed in hydrogen stations to remove ammonia. In addition, AIST plans to search companies for joint research and technology transfer, and aims at practical use of ammonia removal and ammonia storage.

Phys.org, 2 October 2019

<http://phys.org>

### **A new way to corrosion-proof thin atomic sheets**

2019-10-09

A variety of two-dimensional materials that have promising properties for optical, electronic, or optoelectronic applications have been held

**A team of researchers at MIT and elsewhere has developed an ultrathin coating that is inexpensive, simple to apply, and can be removed by applying certain acids.**

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back by the fact that they quickly degrade when exposed to oxygen and water vapor. The protective coatings developed thus far have proven to be expensive and toxic, and cannot be taken off. Now, a team of researchers at MIT and elsewhere has developed an ultrathin coating that is inexpensive, simple to apply, and can be removed by applying certain acids. The new coating could open up a wide variety of potential applications for these “fascinating” 2-D materials, the researchers say. Their findings are reported this week in the journal PNAS, in a paper by MIT graduate student Cong Su; professors Ju Li, Jing Kong, Mircea Dinca, and Juejun Hu; and 13 others at MIT and in Australia, China, Denmark, Japan, and the U.K. Research on 2-D materials, which form thin sheets just one or a few atoms thick, is “a very active field,” Li says. Because of their unusual electronic and optical properties, these materials have promising applications, such as highly sensitive light detectors. But many of them, including black phosphorus and a whole category of materials known as transition metal dichalcogenides (TMDs), corrode when exposed to humid air or to various chemicals. Many of them degrade significantly in just hours, precluding their usefulness for real-world applications. “It’s a key issue” for the development of such materials, Li says. “If you cannot stabilize them in air, their processability and usefulness is limited.” One reason silicon has become such a ubiquitous material for electronic devices, he says, is because it naturally forms a protective layer of silicon dioxide on its surface when exposed to air, preventing further degradation of the surface. But that’s more difficult with these atomically thin materials, whose total thickness could be even less than the silicon dioxide protective layer. There have been attempts to coat various 2-D materials with a protective barrier, but so far, they have had serious limitations. Most coatings are much thicker than the 2-D materials themselves. Most are also very brittle, easily forming cracks that let through the corroding liquid or vapor, and many are also quite toxic, creating problems with handling and disposal. The new coating, based on a family of compounds known as linear alkylamines, improves on these drawbacks, the researchers say. The material can be applied in ultrathin layers, as little as 1 nanometre (a billionth of a meter) thick, and further heating of the material after application heals tiny cracks to form a contiguous barrier. The coating is not only impervious to a variety of liquids and solvents but also significantly blocks the penetration of oxygen. And, it can be removed later if needed by certain organic acids. “This is a unique approach” to protecting thin atomic sheets, Li says, that produces an extra layer just a single molecule thick, known as a monolayer, that provides remarkably durable protection. “This gives the material a factor of 100 longer lifetime,” he says, extending the

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processability and usability of some of these materials from a few hours up to months. And the coating compound is “very cheap and easy to apply,” he adds. In addition to theoretical modelling of the molecular behaviour of these coatings, the team made a working photodetector from flakes of TMD material protected with the new coating, as a proof of concept. The coating material is hydrophobic, meaning that it strongly repels water, which otherwise would diffuse into the coating and dissolve away a naturally formed protective oxide layer within the coating, leading to rapid corrosion. The application of the coating is a very simple process, Su explains. The 2-D material is simply placed into bath of liquid hexylamine, a form of the linear alkylamine, which builds up the protective coating after about 20 minutes, at a temperature of 130 degrees Celsius at normal pressure. Then, to produce a smooth, crack-free surface, the material is immersed for another 20 minutes in vapor of the same hexylamine. “You just put the wafer into this liquid chemical and let it be heated,” Su says. “Basically, that’s it.” The coating “is pretty stable, but it can be removed by certain very specific organic acids.” The use of such coatings could open up new areas of research on promising 2-D materials, including the TMDs and black phosphorous, but potentially also silicene, stanine, and other related materials. Since black phosphorous is the most vulnerable and easily degraded of all these materials, that’s what the team used for their initial proof of concept. The new coating could provide a way of overcoming “the first hurdle to using these fascinating 2-D materials,” Su says. “Practically speaking, you need to deal with the degradation during processing before you can use these for any applications,” and that step has now been accomplished, he says.

Phys.org, 4 October 2019

<http://phys.org>

### Researchers discover a link between two important products of nitric oxide

2019-10-09

Ever since three United States-based researchers working independently unveiled the role of nitric oxide in mediating blood vessel dilation, endothelial cell contraction and smooth muscle relaxation, their discoveries have served as a basis for novel treatments for high blood pressure and erectile dysfunction, among other conditions. The Nobel Prize in Physiology or Medicine in 1998 was awarded jointly to Robert F. Furchgott, Louis J. Ignarro and Ferid Murad for ground-breaking research of nitric oxide conducted during the 1970s and 1980s. Their work paved

**Oxide plays a key role in cardiovascular and neurodegenerative diseases as well as cancer; experiments reveal a hitherto unknown mechanism underlying the formation of nitroso thiols**

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the way for the development of redox biochemistry, an entirely new research field. Nitric oxide is a free radical that has been shown to play a key role in the body's defences against tumours and bacteria, as well as in inflammatory and wound healing processes. Like any biological molecule, nitric oxide is modified in organisms, and the resulting products also act on the body. Understanding how these products are formed in cells is important to the development of new medications designed to increase or decrease the effects of nitric oxide, depending on the condition that is to be treated. In contrast with the prevailing belief before the discoveries made by Furchgott, Ignarro and Murad, free radicals such as nitric oxide are not necessarily toxic to cells. They are vital for the molecular signalling that maintains cellular homeostasis and are hazardous only at high concentrations. In an article published in the journal *Chemical Communications*, scientists have revealed a hitherto unknown mechanism underlying the formation of nitroso thiols, which are important reaction products of nitric oxide. The group - comprising two researchers affiliated with the University of São Paulo Chemistry Institute (IQ-USP) in Brazil and a colleague at the University of California Santa Barbara (UCSB) in the US - found that this process occurs during the formation of dinitrosyl iron complexes (DNICs), which are also products of nitric oxide. In previous research, whenever nitroso thiols and DNICs appeared together in experiments in cells, DNICs were thought to donate nitric oxide to thiols to convert them into nitroso thiols. The group showed that the mechanism whereby DNICs are formed gives rise to thiyl radicals. Because these are also free radicals, they react with nitric oxide, and this reaction produces nitroso thiols. "DNICs have been tested for several functions because they promote similar actions to nitric oxide. The issue is that DNICs are currently tested by trial and error, due to the lack of sufficient information to select those best suited for each desired biological action. Our research involves studying the characteristics of the different DNICs to determine which are most reactive, so that we can then model a specific complex, for example, as the basis for developing a vasodilatory or wound healing drug," said Daniela Ramos Truzzi, a professor at IQ-USP and the first author of the article. The study was part of her postdoctoral research at IQ-USP and her research internship at UCSB, both of which were supported by São Paulo Research Foundation - FAPESP. The research was conducted under the aegis of the Centre for Research on Redox Processes in Biomedicine (REDOXOME) - one of the Research, Innovation and Dissemination Centres (RIDCs) supported by FAPESP - for which the principal investigator is Ohara Augusto, who is a Full Professor at IQ-USP and a co-author of the study. Peter C. Ford at UCSB acted as a supervisor abroad.

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### DNICs

Many different complexes that are derived from nitric oxide are produced in cells, but DNICs are the most abundant. Their physiological roles include protein S-nitrosation (or nitrosylation), which is a post-translational modification during which nitric oxide attacks specific cysteine residues in proteins, forming S-nitroso thiol groups. S-nitrosation is a key mechanism for the regulation of various protein classes and influences many physiological processes. The researchers could not determine exactly which compounds are derived from which reactions because of the intensity of intracellular activity, so they chose experimental parameters that were as close as possible to physiological conditions, while knowing in advance which elements were present. They used electron paramagnetic resonance (EPR) to observe the reaction between iron II (ferrous) oxide, nitric oxide, and the low-molecular-weight thiols cysteine and glutathione. All are abundant in mammalian cells. "The final compounds, in this case the DNICs, appeared after only a second. They form very rapidly," Truzzi explained. "We then started to study how these molecules bind and managed to determine the mechanisms of formation. To our surprise, we found that thiyl radicals were also produced along with DNICs." Radicals often react with each other, and thiyl radicals naturally react with nitric oxide. This reaction produced nitroso thiols. "Nitroso thiols may be involved in cell signalling," he said. "In addition, high levels of nitroso thiols have been found to be correlated with the development of neurodegenerative diseases and cancer." New studies will be performed with other thiols to see if the effect recurs and to confirm the discovery. "REDOXOME focuses on metabolic and cardiovascular diseases, but it is important to understand the mechanistic details in order to be able to intervene in the processes of interest, and that is our main research aim in this instance," Augusto said.

EurekAlert, 4 October 2019

<http://www.eurekalert.org>

### **Graphene turns 15 on track to deliver on its promises**

2019-10-09

Graphene is light, flexible, conductive, and one of the strongest materials in the world. And it is right on track to deliver on its promises - the Graphene Flagship is confident many applications will be unveiled in the next decade. In a special Nature Nanotechnology issue, celebrating 15 years since the Nobel Prize-winning "ground-breaking experiments

**The Graphene Flagship analyses the current graphene landscape and market forecast for graphene over the following decade**

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on graphene," the Graphene Flagship analysed the current graphene landscape and market forecast for graphene over the following decade. In a world dominated by the immediacy of social media and digital technologies, it is hard to take a step back and think about how long materials take to develop. The silicon transistor, at the heart of all our beloved gadgets, was engineered in 1958. However, scientists had known of silicon for over 120 years - it was discovered in 1824. Although expecting broad market penetration for graphene today would not be realistic, the truth is that one can already find graphene-enabled products on the market. A number of these commercial applications have been enabled by the Graphene Flagship; a project funded by the European Commission that kicked off in 2013. Bringing together nearly 150 partners from 23 countries, it created the perfect breeding ground for innovation, which could not emerge without an intricate web of collaborations between academics, researchers, and industries. The Graphene Flagship also acted as inspiration for many programs on graphene and related layered materials in many other countries. The Graphene Flagship expects short-term applications in the materials sector, with graphene-enabled inks, composites, and coatings, for applications ranging from food packaging to textiles and sports goods. In the mid-term, graphene could be crucial for the energy sector, and market analyses agree on a high potential for graphene-enabled batteries and supercapacitors. With the first graphene-enabled solar farm to be installed in Crete next year, the Graphene Flagship will showcase how graphene can enable more sustainable energy generation, in line with Europe's commitment to renewable energies. A host of applications for graphene are expected to hit the market 10 to 15 years from now. These are related to (opto)electronics, where graphene can deliver performances orders of magnitude higher than current technologies. The developments in this area could trigger the next-generation of (opto)electronic devices, bringing the 'more-than-Moore' devices to reality. To secure its most valuable strength - bridging the gap between basic and applied research - the Graphene Flagship has also announced the creation of the first graphene foundry. With a budget of almost €20 million over four years, this experimental pilot line will pave the way towards commercially competitive graphene products, such as transceivers, photodetectors, and sensors. The Graphene Flagship foundry will also develop a process design kit: a set of 'instructions' to support product tape-out and guarantee that the finalised designs are high-quality and consistent. The foundry will be accessible by academia and industry stakeholders worldwide. Kari Hjelt, Graphene Flagship Head of Innovation stated: "We are now seeing the first wave of graphene-enabled products on the market. The



commercialisation activities of graphene are moving from materials development towards components and system level integration. In the future we will see a growing number of high-value add products for various application domains." Thomas Reiss, Graphene Flagship Work Package Leader for Industrialisation, adds: "Key factors facilitating the further commercialisation of graphene comprise establishing innovation ecosystems and providing holistic innovation support. This includes elaborating innovation roadmaps and creating trust and confidence in graphene among industry by trusted validation and standardization services." Andrea C. Ferrari, Graphene Flagship Science and Technology Officer and Chair of its Management Panel, concludes: "Graphene and related materials are progressing towards commercialization at the expected pace. The Graphene Flagship is not about hype, but about concrete and tangible results and progress. The Flagship Foundry will strengthen the EU position as world leader and pioneer in graphene technology and facilitate incorporation of graphene devices in various industries."

EurekAlert, 4 October 2019

<http://www.eurekalert.org>

### **New 3D printing technique for biomaterials**

2019-10-09

A new way of 3D printing soft materials such as gels and collagens, offers a major step forward in the manufacture of artificial medical implants. Developed by researchers at the University of Birmingham, the technique could be used to print soft biomaterials that could be used to repair defects in the body. Printing soft materials using additive manufacturing has been a big challenge for scientists because if they are not supported, they sag and lose their shape. The new technique, called Suspended Layer Additive Manufacturing (SLAM), uses a polymer-based hydrogel in which the particles have been manipulated to create a self-healing gel. Liquids or gels can be injected directly into this medium and built up in layers to create a 3D shape. The method offers an alternative to existing techniques which use gels that have been minced to form a slurry bath into which the printed material is injected. Called Freeform Reversible Embedding of Suspended Hydrogels (FRESH), these offer many advantages, but frictions within the gel medium can distort the printing. In a study published in *Advanced Functional Materials*, a team led by Professor Liam Grover, in the School of Chemical Engineering, show how particles in the gel they have developed can be sheared, or twisted so they separate, but still retain

**A new way of 3D printing soft materials such as gels and collagens, offers a major step forward in the manufacture of artificial medical implants.**

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some connection between them. This interaction creates the self-healing effect, enabling the gel to support the printed material so objects can be built with precise detail, without leaking or sagging. "The hydrogel we have designed has some really intriguing properties that allow us to print soft materials in really fine detail," explains Professor Grover. "It has huge potential for making replacement biomaterials such as heart valves or blood vessels, or for producing biocompatible plugs, that can be used to treat bone and cartilage damage." SLAM can also be used to create objects made from two or more different materials so could be used to make even more complex soft tissue types, or drug delivery devices, where different rates of release are required.

EurekAlert, 4 October 2019

<http://www.eurekalert.org>

### Printed electronics open way for electrified tattoos and personalised biosensors

2019-10-09

Electrical engineers at Duke University have devised a fully print-in-place technique for electronics that is gentle enough to work on delicate surfaces including paper and human skin. The advance could enable technologies such as high-adhesion, embedded electronic tattoos and bandages tricked out with patient-specific biosensors. The techniques are described in a series of papers published online July 9 in the journal *Nanoscale* and on October 3 in the journal *ACS Nano*. "When people hear the term 'printed electronics,' the expectation is that a person loads a substrate and the designs for an electronic circuit into a printer and, some reasonable time later, removes a fully functional electronic circuit," said Aaron Franklin, the James L. and Elizabeth M. Vincent Associate Professor of Electrical and Computer Engineering at Duke. "Over the years there have been a slew of research papers promising these kinds of 'fully printed electronics,' but the reality is that the process actually involves taking the sample out multiple times to bake it, wash it or spin-coat materials onto it," Franklin said. "Ours is the first where the reality matches the public perception." The concept of so-called electronic tattoos were first developed in the late 2000s at the University of Illinois by John A. Rogers, who is now the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering at Northwestern University. Rather than a true tattoo that is injected permanently into the skin, Rogers's electronic tattoos are thin, flexible patches of rubber that contain equally flexible electrical components. The thin film sticks to skin much like a

**Electrical engineers have devised a fully print-in-place technique for printable electronics that is gentle enough to work on delicate surfaces ranging from paper to human skin.**

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temporary tattoo, and early versions of the flexible electronics were made to contain heart and brain activity monitors and muscle stimulators. While these types of devices are on their way to commercialisation and large-scale manufacturing, there are some arenas in which they're not well suited, such as when direct modification of a surface by adding custom electronics is needed. "For direct or additive printing to ever really be useful, you're going to need to be able to print the entirety of whatever you're printing in one step," said Franklin. "Some of the more exotic applications include intimately connected electronic tattoos that could be used for biological tagging or unique detection mechanisms, rapid prototyping for on-the-fly custom electronics, and paper-based diagnostics that could be integrated readily into customised bandages." In the July paper, Franklin's lab and the laboratory of Benjamin Wiley, professor of chemistry at Duke, developed a novel ink containing silver nanowires that can be printed onto any substrate at low temperatures with an aerosol printer. It yields a thin film that maintains its conductivity without any further processing. After being printed, the ink is dry in less than two minutes and retains its high electrical performance even after enduring a 50 percent bending strain more than a thousand times. In a video accompanying the first paper, graduate student Nick Williams prints two electronically active leads along the underside of his pinky finger. Toward the end of his finger, he connects the leads to a small LED light. He then applies a voltage to the bottom of the two printed leads, causing the LED to stay lit even as he bends and moves the finger. In the second paper, Franklin and graduate student Shiheng Lu take the conductive ink a step further and combine it with two other printable components to create functional transistors. The printer first puts down a semiconducting strip of carbon nanotubes. Once it dries, and without removing the plastic or paper substrate from the printer, two silver nanowire leads that extend several centimetres from either side are printed. A non-conducting dielectric layer of a two-dimensional material, hexagonal boron nitride, is then printed on top of the original semiconductor strip, followed by a final silver nanowire gate electrode. With today's technologies, at least one of these steps would require the substrate to be removed for additional processing, such as a chemical bath to rinse away unwanted material, a hardening process to ensure layers don't mix, or an extended bake to remove traces of organic material that can interfere with electric fields. But Franklin's print-in-place requires none of these steps and, despite the need for each layer to dry completely to avoid mixing materials, can be completed at the lowest overall processing temperature reported to date. "Nobody thought the aerosolized ink, especially for boron nitride, would deliver the properties needed to make functional electronics

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without being baked for at least an hour and a half," said Franklin. "But not only did we get it to work, we showed that baking it for two hours after printing doesn't improve its performance. It was as good as it could get just using our fully print-in-place process." Franklin doesn't see his printing method replacing large-scale manufacturing processes for wearable electronics. But he does see a potential value for applications such as rapid prototyping or situations where one size doesn't fit all. "Think about creating bespoke bandages that contain electronics like biosensors, where a nurse could just walk over to a work station and punch in what features were needed for a specific patient," said Franklin. "This is the type of print-on-demand capability that could help drive that." This work was supported by the Department of Defence Congressionally Directed Medical Research Program (W81XWH-17-2-0045), the National Institutes of Health (1R21HL141028) and the National Science Foundation (ECCS-1542015).

Science Daily, 3 October 2019

<http://www.sciencedaily.com>

### **Hard as ceramic, tough as steel: Newly discovered connection could help design of nextgen alloys**

2019-10-09

A new way to calculate the interaction between a metal and its alloying material could speed the hunt for a new material that combines the hardness of ceramic with the resilience of metal. The discovery, made by engineers at the University of Michigan, identifies two aspects of this interaction that can accurately predict how a particular alloy will behave -- and with fewer demanding, from-scratch quantum mechanical calculations. "Our findings may enable the use of machine learning algorithms for alloy design, potentially accelerating the search for better alloys that could be used in turbine engines and nuclear reactors," said Liang Qi, assistant professor of materials science and engineering who led the research. Today's jet engines and nuclear reactors can't get too hot or else the metal of the engine's turbine or the reactor's internal components would soften. However, jet engines could operate more efficiently and nuclear reactors could be safer if they could sustain higher temperatures, Qi said. The search is on for a material that is very hard even at high temperatures but also resistant to cracking. Materials scientists approach this problem through alloys -- mixing a metal with one or more other elements. A metal is mainly composed of a crystal lattice, with the atoms packed together in an orderly way. However, it is the defects -- or the locations where the lattice is disrupted -- that have the most influence

**A new way to calculate the interaction between a metal and its alloying material could speed the hunt for a new material that combines the hardness of ceramic with the resilience of metal.**

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over how a material will behave, Qi said. "The properties of defects decide mechanical, thermal and irradiation performances of metals because atoms at defects usually have fewer constraints to move around compared with those at perfect positions," he said. Some defects are points of weakness, such as breaks in the lattice that cover large areas -- known as grain boundaries. But small defects, such as dislocations of several rows of atoms, can improve a metal's performance by enabling it to bend, for example. Alloying elements combine with defects to create a network of disruptions in the lattice of the host metal, but it's hard to predict how that network will affect the metal's performance. The team limited their study to metals with just one alloying element at defects -- still a considerable design space with hundreds of material combinations and millions of defect structures. Electrons are responsible for linking the atoms of the lattice together, so the team looked for a connection between the way electrons are structured in an ordinary lattice atom and an atom at a defect -- and how this changes the way that the lattice interacts with an alloying element. A high interaction energy between the metal and alloying element at the defect usually makes the metal less flexible, for example, while a lower energy means they aren't so tightly knit. The team identified two measures, which they call "descriptors," that represent how the structure of the electrons changes at the defect in the pure metal. Using these, they could figure out how an alloying element would interact with the defect. "We were amazed to find that the predictive power held for different types of defects and sites, given a particular metal crystal and alloying element," said Yong-Jie Hu, a postdoctoral researcher in materials science and engineering and first author on the paper in *Nature Communications*. The team found that they could predict how atoms of the alloying element concentrated at various kinds of defects -- including complex types such as high angle grain boundaries, where the lattice is majorly misaligned. The identification of these descriptors is a significant step toward being able to harness machine learning effectively for alloy design, using algorithms to trawl through the results of highly accurate but computationally intensive quantum mechanical simulations. However, the researchers note that more descriptors must be discovered for predictions of how more complex alloys will behave, for instance those with two or more alloying elements at defects. And while these descriptors may feed into machine learning, humans will probably identify them. "The discovery was made through 'human learning' from classical electronic models," Qi said. "It indicates that, in the age of big data and artificial intelligence, human intelligence still provides reliable resources for scientific discoveries." The research, published in the journal *Nature*

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Communications, was funded by the National Science Foundation and the University of Michigan.

Science Daily, 2 October 2019

<http://www.sciencedaily.com>

### **Just add water: Simple step boosts polymer's ability to filter carbon dioxide from mixed gases**

2019-10-09

An international team of researchers has found it can significantly boost an existing polymer's ability to selectively remove carbon dioxide (CO<sub>2</sub>) out of gas mixtures by first submerging the material in liquid water. "Normally, improving the permeability of a gas through a material impairs the material's selectivity," says Rich Spontak, co-corresponding author of a paper on the work and Distinguished Professor of Chemical and Biomolecular Engineering and Professor of Materials Science and Engineering at North Carolina State University. "To explain this using CO<sub>2</sub> as an example, the more easily gases can pass through a material, the less able the material usually is to remove CO<sub>2</sub> from a gas mixture. It lets through the CO<sub>2</sub>, but it lets through other gases as well. There's a real trade-off when engineering polymers for use as gas-separation membranes. "What's remarkable about our finding is that we were able to drastically improve the polymer's CO<sub>2</sub> permeability while also slightly improving its CO<sub>2</sub> selectivity. And the process that led to this substantial improvement was related to transforming the microstructure of the membrane in low-cost and nontoxic fashion—we submerged the material in water." Polymer membranes that can filter out CO<sub>2</sub> are desirable for use in a variety of applications, such as removing CO<sub>2</sub> from natural gas and sequestering CO<sub>2</sub> in order to limit emissions from industrial facilities. The polymer at issue here is a thermoplastic elastomer that is recyclable, relatively tough, and has been shown to have desirable properties for a wide range of contemporary technologies. For this work, the researchers set out to see how the morphology of the material—how the molecular sequences comprising the polymer molecules are arranged relative to each other—affects its performance as a CO<sub>2</sub>-selective membrane. The permeability of gases through polymers is frequently measured in Barrer units. When dry, the permeability of CO<sub>2</sub> through the polymer examined in the paper is less than 30 Barrer. Previous work reported by members of the team had shown that inclusion of water vapor in the feed could improve CO<sub>2</sub> permeability, boosting it to as high as 100-190 Barrer at relative humidity levels above 85%. "With these new results, we've shown

**An international team of researchers has found it can significantly boost an existing polymer's ability to selectively remove carbon dioxide (CO<sub>2</sub>) out of gas mixtures by first submerging the material in liquid water.**

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we can reach a permeability of almost 500 Barrer at 90% humidity," says Liyuan Deng, Professor of Chemical Engineering at the Norwegian University of Science and Technology and co-corresponding author of the paper. "At the same time, the selectivity of CO<sub>2</sub> relative to nitrogen (N<sub>2</sub>) increases to as high as ~60. For comparison, the best commercial polymer membranes that could be used for CO<sub>2</sub> capture possess a permeability up to ~200 Barrer and a CO<sub>2</sub>/N<sub>2</sub> selectivity up to ~50. It's very important that both of these performance metrics are considered simultaneously to achieve competitive membranes. "This work demonstrates the polymer's potential for use in industrial gas separation and carbon capture technologies, with benefits for both manufacturing efficiency and efforts to mitigate global climate change. It also provides a previously unexplored and facile route by which to transform the morphology of a polymer membrane and achieve tremendous improvement in gas transport properties." The paper, "Highly CO<sub>2</sub>-permeable membranes derived from a midblock-sulfonated multiblock polymer after submersion in water," is published in the journal NPG Asia Materials.

Phys.org, 1 October 2019

<http://phys.org>

## Curiosities

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### **Avoiding red or processed meat doesn't seem to give health benefits**

2019-10-10

There are no health reasons to cut down on eating red or processed meat, according to a new review of the evidence. The claims, which contradict most existing dietary advice, come from a review of existing studies led by the Spanish and Polish Cochrane Centres, part of a global collaboration for assessing medical research. Numerous health bodies have said for decades that we should limit our intake of red meat because it is high in saturated fat, thought to raise cholesterol levels and cause heart attacks. More recently, both red and processed meat have been linked with cancer. In the latest review, though, the authors came to a different conclusion because they considered separately the two main kinds of research. The best evidence comes from randomised trials. In these, some participants are helped to change their diet in a certain way, such as eating less meat, and the rest aren't. At the end, the health of the people in the two groups is compared. But such trials are costly and hard to do. According to one estimate, only about 5 per cent of nutrition studies are large, good-quality randomised trials. It is much more common to do research that just observes what people choose to eat undirected. Known as observational studies, these are notoriously open to bias and can give misleading results. Bradley Johnston of Dalhousie University in Halifax, Canada, and his colleagues first reviewed all previous observational studies looking at the health impact of eating red or processed meat. These pointed to a "very small" adverse effect on deaths, heart disease and cancer. Then they separately reviewed the 12 randomised trials that have been done in this area, and found that there was little or no health benefit for people who cut down on eating these meats. Based on these findings, the authors conclude that people should "continue to eat their current levels of red and processed meat unless they felt inclined to change them themselves". However, they added that some might want to change their diet because of animal welfare or environmental reasons. "It may be time to stop producing observational research in this area," Tiffany Doherty from Indiana University's Paediatric and Adolescent Comparative Effectiveness Research team wrote in an accompanying editorial. Duane Mellor, a spokesperson for the British Dietetic Association, says people shouldn't take the advice as a green light to eat more red meat. "What it doesn't say

**There are no health reasons to cut down on eating red or processed meat, according to a new review of the evidence.**



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is that we can tear up the guidelines and start eating twice as much meat. But red meat three times a week is not a problem.”

New Scientist, 30 September 2019

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

### Occupational pesticide exposure may raise heart risk

2019-10-10

On-the-job exposure to high levels of pesticides might raise the risk of developing heart disease or having a stroke, according to a long-term study in Hawaii. Farm and agricultural workers need to wear personal protective equipment and, even after they retire should continue to have their health monitored for cardiovascular complications, the authors conclude in the *Journal of the American Heart Association*. “Pesticides have a long half-life and exist in the body for a long time, so side effects may appear even 10-20 years later,” said lead author Zara Berg of Fort Peck Community College in Peck, Montana. “Many workers may not think that exposure during their younger or middle years is crucial, but it actually is,” said Berg, who worked on the study as part of her doctoral research at the University of Hawaii at Manoa in Honolulu. For the analysis, Berg’s team used data from the Kuakini Honolulu Heart Program, established in 1965 to study heart disease in middle-aged Japanese-American men living on the island of Oahu. Participants were born between 1900 and 1919 in Japan or Hawaii and were between ages 45 and 68 at the beginning of the study. Data was updated through 1999, which allowed for up to 34 years of follow-up with surviving participants. Berg and colleagues focused on 7,557 men who had provided information on their work history and had no heart disease at the beginning of the study period. To gauge pesticide exposures, the research team used the Occupational Safety Health Administration exposure scale, which estimates typical pesticide amounts encountered during an eight-hour workday and 40-hour workweek based on a participant’s job, age and years worked in that industry, particularly for industrial, factory and agricultural workers. Berg’s team then looked at medical records to assess who developed cardiovascular disease, which they defined as coronary heart disease or a cerebrovascular incident such as a stroke. Overall, just 451 men had high exposure to pesticides and 410 men had low-moderate exposure, while the rest had none.

Reuters Health, 1 October 2019

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

**On-the-job exposure to high levels of pesticides might raise the risk of developing heart disease or having a stroke, according to a long-term study in Hawaii.**

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#### **Type 2 Diabetes Can Be Reversed Even Without Intensive Weight Loss, Study Shows**

2019-10-10

Across the world, some 400 million people experience type 2 diabetes: a chronic health condition that can affect several major organs in your body, and eventually lead to heart disease, kidney damage, blindness, and more. The good news is type 2 diabetes can often be avoided through managing your weight, exercising regularly, and eating a balanced diet – but even if you do develop the condition, it's not necessarily permanent. In recent years, research has shown that it's possible to reverse a type 2 diabetes diagnosis and send the disease into remission, and now a new study demonstrates that recovering from the disease could be a lot easier than you think. "We've known for some time now that it's possible to send diabetes into remission using fairly drastic measures such as intensive weight loss programs and extreme calorie restriction," says epidemiologist Hajira Dambha-Miller from the University of Cambridge. "These interventions can be very challenging to individuals and difficult to achieve." Difficult is true. In one 2017 clinical trial, patients had to adopt an extreme "total diet replacement" that saw them subsist on low-calorie shakes for up to five months, before slowly being reintroduced to food. These kinds of extreme interventions get results – as do other intensive approaches involving combinations of medications, insulin, and lifestyle adjustments. But according to Dambha-Miller, people with type 2 diabetes may not need to go quite so extreme to increase their chances of reversing the condition. "Our results suggest that it may be possible to get rid of diabetes, for at least five years, with a more modest weight loss of 10 percent," Dambha-Miller says. In the new study, the researchers examined a cohort of 867 people aged between 40 and 69 years who were newly diagnosed with type 2 diabetes. All of the participants were from the east of England, and were monitored for five years in the experiment, during which some people received an intervention treatment (involving additional medical consultations and resources being provided) or a control group who received routine medical care. Ultimately, at the end of five years of follow-ups, 257 of the participants (about 30 percent of the whole cohort) were in remission. Compared with people who maintained the same weight throughout the study, people who lost 10 percent of their body weight or better than doubled their chances of achieving remission and reversing their type 2 diabetes diagnosis – and all without being encouraged to make extreme diet and lifestyle adjustments. The authors of the study note that previous clinical experiments advocating significant weight loss of 15 percent or greater may be disincentivising

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patients who find it hard to physically or emotionally reach such ambitious targets. "This may provide some rationale for motivating people with newly diagnosed type 2 diabetes to lose weight rather than focusing on specific and potentially unachievable weight targets," the researchers explain. "Previous studies have shown that, when attempting to lose weight, people often set unrealistically high weight loss goals that could be detrimental to success." The findings are reported in *Diabetic Medicine*.

Science Alert, 1 October 2019

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

### Scientists Engineered a Bacterium That Poops Out Huge Amounts of Psilocybin

2019-10-10

Scientists have found a new way to harvest psilocybin, the psychedelic compound typically found in mushrooms. They've engineered bacteria to produce psilocybin in their cells and poop it out, in gram-scale concentrations that are higher than any other bioengineered organism to date. It is, the researchers say, a significant step towards demonstrating the feasibility of industrial-scale production of the drug. Psilocybin is found in over 200 fungus species, and has long enjoyed a reputation for its psychedelic and hallucinogenic properties. In recent years, however, it has become increasingly evident that psychedelic drugs also have serious potential for treating conditions such as treatment-resistant depression. But mass-producing the compound from mushrooms would require a lot of time, and a lot of space to grow the fungi. So, a team of biochemists led by Andrew Jones and Alexandra Adams of Miami University decided to try something else - metabolic engineering. This is a biosynthesis process that relies on changing cells so they will produce compounds they don't naturally produce, or in quantities they don't naturally produce; one example of this is bioethanol, which can be used as biofuel. A popular bacterium for this purpose is *Escherichia coli*, since it is easy to engineer, prolific, well understood and has a large and versatile array of genetic tools available for engineering. So, this is what the team used as their host. They introduced psilocybin-producing genes from the quintessential 'magic mushroom' *Psilocybe cubensis* into the bacterium, to see if that would induce the microbes to produce psilocybin. It worked, with varying levels of success. "We are taking the DNA from the mushroom that encodes its ability to make this product and putting it in *E. coli*," Jones said. "It's similar to the way you make beer, through a fermentation process. We are effectively taking the technology that allows for scale and speed

**Scientists have found a new way to harvest psilocybin, the psychedelic compound typically found in mushrooms.**

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of production and applying it to our psilocybin producing *E. coli*." The researchers identified the bacterium strain that produced the greatest concentration of psilocybin, greatest reliability, and low build-up of intermediate products. Dubbing this strain pSil16, they then worked to optimise its production, through a series of experiments to provide the best fermentation conditions. This provided the best base media, the best temperature and the best nutrient mix for producing psilocybin. Finally, the team was able to scale their production up into large bioreactors, fine-tuning the process to eventually produce a concentration of 1.16 grams of psilocybin per litre - the first demonstration of psilocybin in a prokaryotic host, and the highest concentration of psilocybin produced by any recombinant organism to date. (The concentration of psilocybin in *P. cubensis* itself varies, but it's between 0.37 and 1.30 percent of the dry weight of the entire mushroom.) "What's exciting is the speed at which we were able to achieve our high production," Jones said. "Over the course of this study we improved production from only a few milligrams per litre to over a gram per litre, a near 500-fold increase." Clinical trials for psilocybin as a treatment for depression are currently ongoing. Meanwhile, Jones and his team are investigating ways to make *E. coli* an even better host for the psilocybin genes. The research has been published in *Metabolic Engineering*.

Science Alert, 1 October 2019

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

### **A Common Medication Has Been Linked to Double The Risk of Stomach Cancer**

2019-10-10

A class of drugs commonly used to treat acid reflux and heartburn has been linked to a greater-than-doubled risk of developing stomach cancer, a study has found. Proton pump inhibitors (PPIs) are used to suppress acid production in the stomach and are among the most widely sold drugs in the world, but a 2017 study revealed that long-term use of the medicine can increase stomach cancer risks by almost 250 percent. The risks are associated with a bacterium called *Helicobacter pylori*, carried by more than half of the world's population – most often harmlessly, but in a small percentage of people, the bug has been tied to the development of stomach cancer. Previous research found that people with an ongoing *Helicobacter pylori* infection taking a PPI stood a greater chance of developing a precursor to stomach cancer, called atrophic gastritis. While the mechanism for this was unclear, it's long been considered

**A class of drugs commonly used to treat acid reflux and heartburn has been linked to a greater-than-doubled risk of developing stomach cancer, a study has found.**

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that eliminating the infection prior to taking PPIs – which have been linked to various adverse effects – might reduce the prospects of getting cancer. But the recent research shows that might not be the case. “Proton pump inhibitors (PPIs) are an important treatment of *Helicobacter pylori* infection and have good safety records for short-term use,” said researcher Ian Wong from University College London. “However, unnecessary long-term use should be avoided.” Wong and fellow researchers analysed a health database of Hong Kong residents, identifying 63,397 adults treated with a triple-therapy combination to kill the *Helicobacter pylori* infection – using a PPI and two antibiotics. Once the infection was eradicated, the subjects were monitored for an average of 7.5 years, during which 3,271 continued to take PPIs (for an average of nearly three years), while 21,729 others used an alternative drug, H2 blockers. Of the 63,397 people who took the triple-therapy treatment originally, 153 ended up developing stomach cancer – but patients who took PPIs were 2.44 times more likely to get cancer, while those on H2 blockers didn’t show any heightened risk. What’s more, greater frequency of PPI usage and longer-term treatment with the medication appeared to up the likelihood of developing cancer further. Daily PPI use was associated with a 4.55 times greater risk of cancer than baseline, and became as high as an 8-fold greater risk if the drugs were taken for more than three years. The researchers acknowledged that this is only an observational study, so we can’t assume from the data that PPIs are the cause here – but nonetheless, it’s an alarming finding that shows there’s more going on than scientists previously realised. “Interestingly, the authors found no such correlation between gastric cancer risk and long-term treatment with other anti-suppressive drugs... suggesting that acid-suppression is not the sole factor,” said gastrointestinal infection researcher Richard Ferrero from the Hudson Institute of Medical Research in Australia, who wasn’t involved with the study. “The work has important clinical implications as PPIs, which are among the top 10 selling generic drugs in the US, are commonly prescribed to treat heartburn.” Of course, as significant as the increased risk is, we should also bear in mind that the overall risk factor is still low. Per the study, long-term use of PPIs was only associated with about four additional cases of stomach cancer per 10,000 people per year, which is worth keeping in perspective. It’ll take more research into PPIs’ long-term effects to better understand why this association is showing up the way it does, but in the meantime, it adds further evidence to suggest that PPIs could be problematic for patients who use them beyond the short term. “Many observational studies have found adverse effects associated with PPIs,” said pharmacoepidemiologist Stephen Evans from the London School of Hygiene & Tropical Medicine, who wasn’t part of the research.

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"The most plausible explanation for the totality of evidence on this is that those who are given PPIs, and especially those who continue on them long-term, tend to be sicker in a variety of ways than those for whom they are not prescribed." The findings were reported in Gut.

Science Alert, 29 September 2019

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

### Ditch the delicate wash cycle to help save our seas

2019-10-10

New research led by Newcastle University has shown that it is the volume of water used during the wash cycle, rather than the spinning action of the washing machine, which is the key factor in the release of plastic microfibres from clothes. Millions of plastic microfibres are shed every time we wash clothes that contain materials such as nylon, polyester and acrylic. Because these fibres are so small, they drain out of our washing machines and can ultimately enter the marine environment. Once in the ocean, they are ingested by the animals living there and two years ago Newcastle University scientists showed for the first time these fibres have now reached the deepest parts of our ocean. Working with Procter & Gamble in Newcastle, the team measured the release of plastic microfibres from polyester clothing for a range of cycles and water volumes. Counting the fibres released, the team found the higher the volume of water the more fibres released, regardless of the speed and abrasive forces of the washing machine. In fact, they found that on average, 800,000 more fibres were released in a delicate wash than a standard cycle. Publishing their findings today in the academic journal Environmental Science and Technology, PhD student Max Kelly, who led the research, explained: "Counterintuitively, we discovered that 'delicate' cycles release more plastic microfibres into the water, and then the environment, than standard cycles. "Previous research has suggested the speed the drum spins at, the number of times it changes spinning direction during a cycle and the length of pauses in the cycle -- all known as the machine agitation -- is the most important factor in the amount of microfibre released. "But we have shown here that even at reduced levels of agitation, microfibre release is still greatest with higher water-volume-to-fabric ratios. "This is because the high volume of water used in a delicate cycle which is supposed to protect sensitive clothing from damage actually 'plucks' away more fibres from the material."

**Delicate wash cycles in washing machines found to release more plastic microfibres than other cycles.**

[Plastic pollution in our oceans](#)

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Plastic pollution is one of the biggest challenges facing society today and understanding the key sources is an important process to help reduce our impact on the environment. Laundry has been recognised as a major contributor of microplastics but until now, precisely measuring the release of these fibres has been difficult due to the fact that it's almost impossible to accurately simulate the reality of what happens in people's machines in a lab setting. Using a tergotometer -- a benchtop device comprising of eight (1000 mL) washing vessels that simulate full-scale domestic washing, the team were able to carry out tests under different conditions, making changes to water volume, spin speed, temperature and time. A DigiEye camera -- digital colour imaging system -- was then used to accurately calculate the amount of microfibrils released. To test whether the observations made using the tergotometers were reflective of full-size domestic washing machines, the team then tested the fabrics on a delicate wash cycle using identical washing machines in the test centre at Procter and Gamble (P&G). The team showed that previous recommendations by groups to move towards high water volumes and low levels of agitation as a way of reducing the amount of microfibre released was actually making the problem worse. Neil Lant, Research Fellow at P&G and co-author on the study, said: "The appliance industry has started to introduce microfibre filters in some new washing machines and the textile industry is looking to reduce the fibre shedding levels of new clothing." "We hope that the issue will ultimately be solved by such actions, and our work on the mechanistic causes will help in the development of these solutions." Max Kelly adds: "Reducing the amount of plastic pollution is everyone's responsibility and often it's the small changes that make a huge difference." "By avoiding high water-volume-to-fabric washes such as the delicate cycles and ensuring full wash loads then we can all do our bit to help reduce the amount of these synthetic fibres being released into the environment." "Hopefully, these findings may also be used by manufacturers to influence the design of future washing machines and reduce our plastic footprint. Over time these changes could also see a global reduction in the amount of energy and water required to wash our clothes."

Science Daily, 28 September 2019

<http://www.sciencedaily.com>

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### **Biologists track the invasion of herbicide-resistant weeds into southwestern Ontario**

2019-10-10

A team including evolutionary biologists from the University of Toronto (U of T) have identified the ways in which herbicide-resistant strains of an invasive weed named common waterhemp have emerged in fields of soy and corn in southwestern Ontario. They found that the resistance—which was first detected in Ontario in 2010—has spread thanks to two mechanisms: first, pollen and seeds of resistant plants are physically dispersed by wind, water and other means; second, resistance has appeared through the spontaneous emergence of resistance mutations that then spread. The researchers found evidence of both mechanisms by comparing the genomes of herbicide-resistant waterhemp plants from Midwestern U.S. farms with the genomes of plants from Southern Ontario. “We used modern methods of genome analysis to look at the genetic similarity of different populations of these plants,” explains Julia Kreiner, a Ph.D. candidate in the Department of Ecology & Evolutionary Biology (EEB) in U of T’s Faculty of Arts & Science and lead author of a study published today in Proceedings of the National Academy of Sciences. “To our surprise, we found that the genomes of some resistant plants in Ontario were nearly identical to those in very distant U.S. plants. This was evidence that the Ontario plants were very closely related to the U.S. plants and suggests that the former came from seeds that were just picked up from one field and dropped in another.” While Kreiner and her collaborators did not determine exactly how the seeds were physically transported, this propagation—known as gene flow—is typically accomplished in different ways. Seeds can be carried by water, or in the digestive tracts of animals, or from field to field by way of farm equipment. And especially with a wind-pollinated plant like common waterhemp, genes can also be spread via wind-borne pollen. The same DNA analysis identified some resistant plants that did not genetically match any other plants suggesting they appeared through the independent emergence of a genetic mutation conveying resistance. The researchers were surprised to discover both mechanisms at play. “We have two regions, Walpole Island and Essex County in southwestern Ontario, where waterhemp populations evolved resistance,” says Stephen Wright, a professor in ecology & evolutionary biology at U of T and a co-author of the study. “Because of their proximity, our expectation was that they would have shared the same origin of resistance. But our results suggest different origins—from the movement of seed from a source population in the U.S. as well as independent evolution of resistance in a local population.” According to John Stinchcombe, also

**A team including evolutionary biologists from the University of Toronto (U of T) have identified the ways in which herbicide-resistant strains of an invasive weed named common waterhemp have emerged in fields of soy and corn in southwestern Ontario.**



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a professor in ecology & evolutionary biology at U of T and a co-author, “One of the most striking findings is that we see both ways that weeds could become resistant happening on really short time scales. Evolution is happening very quickly, and using multiple mechanisms.” Detlef Weigel, a co-author from the Max Planck Institute in Germany added, “Because herbicide-resistant waterhemp had appeared in the U.S. long before such plants were found in Canada, we were convinced that evolution of herbicide resistance is very rare and had occurred only once. Now that we know that it can occur repeatedly, the next question is whether one can slow down the evolution of new genetic variants that make waterhemp herbicide resistance.” In addition to the U of T cohort, co-authors included weed scientists from the University of Illinois and the University of Guelph Ridgetown Campus; and genome and developmental geneticists at the Max Planck Institute for Developmental Biology in Germany. The researchers studied strains of the common waterhemp—aka *Amaranthus tuberculatus*—that are resistant to glyphosate, one of the most widely used herbicides in the world, commonly known by its trade name Roundup. “Waterhemp is one of the most problematic agricultural weeds in North America,” explains Kreiner. “In the U.S., common waterhemp and the closely related *Amaranthus palmeri* are causing all kinds of havoc in terms of crop productivity and crop yields.” “Waterhemp first appeared in one county in Ontario in the early 2000s. And as of this year, we’ve found them in seven different counties in the province. So, it’s spreading.” Kreiner suggests that the findings underline the importance of strictly following agricultural practices designed to minimize gene flow and staunch resistant strains as they arise. “The fact that we’re seeing a spread involving all of these mechanisms shows that managing the problem is a real challenge and that it will require integrating management approaches across different scales,” explains Kreiner. For example, it illustrates the importance of thoroughly cleaning agricultural residue from rented farm equipment—which is used on multiple farms in a season—in order to minimize the transport of seeds from field to field. “It also shows the importance of practices like rotating herbicides from season to season,” says Kreiner. “And rotating crops between corn, soy and wheat. It’s practices like these that will minimize the emergence of resistance and limit seed movement.” At the same time, Kreiner warns that the occurrence of herbicide resistance is an inevitable evolutionary process and that the challenge requires further study. “Management practices still don’t treat the underlying cause, which is that herbicide resistance is evolving repeatedly,” she says. “And so, with these new genomic resources and approaches, I’m now trying to understand what makes a weed a weed. What are the factors that might make these weeds more likely to evolve

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resistance and be more problematic than others? "At this point, we're running out of herbicides. These plants have evolved resistance to pretty much every herbicide we've come up with. And it doesn't seem like there's ever going to be a herbicide that a weed can't eventually evolve resistance to." "There may be other strategies for controlling these weeds—like weed-control technologies based on robotics and machine learning," she suggests. "But even then, the weed has a way to evolve around that, so it's a really difficult challenge."

Phys.org, 1 October 2019

<http://phys.org>

### Tests show bootleg marijuana vapes tainted with hydrogen cyanide

2019-10-10

Fabian Castillo was suffering from crippling anxiety when his uncle handed him a marijuana vape pen one day last December. "It will help calm you down," Castillo said his uncle told him. Over the next several months, the vape worked as advertised. Castillo, who had just graduated high school in southern California, found himself more mellow and more productive. He had no idea at the time that he was using, what he now believes, was a bootleg vape pen filled with a toxic mix of chemicals. But on 2 August, Castillo's breathing grew laboured. His mother brought him to the emergency room where, she says, an X-ray revealed severe damage to his lungs. "I couldn't breathe. I couldn't talk. I literally couldn't even move my hands," Castillo, 19, said. He spent the next nine days in a medically induced coma. Eight weeks later, he still struggles to breathe deeply. The soaring popularity of vaping products — both legal and knock-offs — is fuelling a public health crisis that has vexed the medical community. Some 12 people have died from mysterious lung illnesses linked to vape pens, and 805 others have been hospitalised in 46 states, according to federal health officials. "We are dealing with a new epidemic," said Dr. Melodi Pirzada, a paediatric pulmonologist at NYU Winthrop Hospital in Mineola, New York, on Long Island. The Centres for Disease Control and Prevention says most of the patients reported using vapes containing THC, the psychoactive ingredient in marijuana. Some state health officials have indicated that Vitamin E acetate, a solvent used to "cut" cannabis for use in vape pens, may be responsible for the outbreak. But no single substance or product has yet been linked to all of the cases of vaping-related lung disease, the CDC says, leaving the medical community grappling with an exploding health crisis with an unknown cause. At the same time, the

**NBC News commissioned laboratory tests of knock-off marijuana vapes that found a pesticide linked to hydrogen cyanide in 10 out of 10 products.**

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FDA is struggling to police what has rapidly grown into a billion-dollar industry with a booming black market, experts say. The result: Americans have access to an astonishing assortment of THC vape pens without having any way of knowing what's actually in them. Seeking answers, NBC News commissioned one of the nation's leading cannabis testing facilities to test a sampling of THC cartridges — 18 in all — obtained from legal dispensaries and unlicensed dealers. The findings were deeply troubling. Of the three purchased from legal dispensaries in California, the CannaSafe testing company found no heavy metals, pesticides or residual solvents like Vitamin E. But 13 out of the other 15 samples from black market THC cartridges were found to contain Vitamin E. CannaSafe also tested 10 of the unregulated cartridges for pesticides. All 10 tested positive. The products all contained myclobutanil, a fungicide that can transform into hydrogen cyanide when burned. "You certainly don't want to be smoking cyanide," said Antonio Frazier, the vice president of operations at CannaSafe. "I don't think anyone would buy a cart that was labelled hydrogen cyanide on it." Pirzada described the existence of myclobutanil as "very disturbing," adding that "it's going to cause a very toxic effect on the lungs." The New York pulmonologist also expressed alarm about the presence of Vitamin E, which is also known to cause significant lung damage when inhaled, in the THC mixtures. "It should not be inhaled into your lungs," she said. Pirzada has treated four patients, all teenagers, suffering from vaping-related lung damage. She said testing conducted on the same vaping mixture used by one of her patients detected the presence of Vitamin E. The 18-year-old boy arrived at the hospital with pneumonia-like symptoms. But within 48 hours, Pirzada said, his condition deteriorated rapidly and he was placed on a ventilator. He spent five days on life support before he was able to breathe on his own and recover with the help of steroids. "He required very high levels of support to keep him alive," Pirzada said.

Such patients have been pouring into hospitals around the country. Over the summer, an 18-year-old girl arrived at UCLA Health with a bad cough, fevers, nausea and laboured breathing. Within 48 hours, her lung function deteriorated to the point that doctors sent her to the ICU and hooked her up to a respirator. The teenager, who reported having vaped tobacco and pot products every day for the past two years, ultimately improved and was released from the hospital. "She got very sick, very fast," said Dr. Kathryn Melamed, the pulmonologist who saved the teenage girl's life. Less than 15 miles from UCLA Health lies a 12-block area of downtown Los Angeles filled with vape shops. The stores sell empty cartridges and packaging, making it easy for anyone with access to THC and a solvent like

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Vitamin E to produce their own bootleg vape products. California legalised recreational marijuana for adults over the age of 21 in 2016. David Downs, the California bureau chief for Leafly, an online publication devoted to the cannabis industry, said downtown Los Angeles acts as the final destination for a supply chain that originates in China. "This all starts in China where you can get the empty cartridges both for the THC market and the nicotine market, as well as the additives, flavourings, and thickeners that are being put into these cartridges alongside the THC oil," Downs said. "It's a very deep, mature, and advanced industry that starts in China and ends in our own backyard." Downs said anyone who buys bootleg vapes is putting themselves at risk. "I've been saying, 'Look, if you buy a fake Gucci purse, it's not going to give you a lung injury, but if you buy a fake vape cartridge, it just might.'" Downs said. Acting FDA Commissioner Ned Sharpless, speaking to a congressional committee on Wednesday, said investigators are working to identify the toxic products and "follow the supply chain to the source." "FDA is not pursuing any actions associated with personal use of any vaping products, our interest is in the suppliers," Sharpless told the House Energy and Commerce subcommittee, which has oversight authority over the FDA. "But to be clear, if we determine that someone is manufacturing or distributing illicit, adulterated vaping products that caused illness and death for personal profit, we would consider that to be a criminal act." The American Vaping Association insists the outbreak is linked to THC oils and knock-offs. One of the shops visited by NBC News in Los Angeles sold packaging for Dank Vapes Gorilla Glue, the same brand of vape that Castillo was using before he landed in the hospital ICU. The product is not in any way associated with Gorilla Glue, the company that produces super glue and other adhesives. An aspiring singer, Castillo hasn't yet returned to full health. Any time he tries to take a deep breath, he feels like he just ran down a flight of stairs. Castillo is also dealing with an odd sensation that leaves him feeling like he's falling and results in a body twitch. He said he's speaking out to deter others from putting their lives at risk by using vapes. "Everything was put on pause because I decided to vape," Castillo said. "I thought it was safe."

NBC News, 27 September 2019

<http://www.nbc.com>

### Vaping Illnesses Top 1,000, C.D.C. Says

2019-10-10

Illnesses and deaths linked to vaping continue to increase around the country, now totalling 1,080 cases and 19 deaths, health officials said. The

**The number of cases has risen weekly. So far, 19 deaths have been confirmed, and health officials say more are being investigated.**

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Centres for Disease Control and Prevention said that cases had occurred in 48 states and the United States Virgin Islands. This week, Nebraska, Alabama, Delaware, Connecticut, Virginia and New Jersey reported deaths, which brought the total to 19 in 16 states. The new case count reflects an increase of 275 in just the past week. About half of the 275 were hospitalised in the past two weeks, and the rest were older cases whose link to vaping was just recognized, Dr. Anne Schuchat, principal deputy director of the C.D.C., said during a news briefing. She described the outbreak as “continuing at a brisk pace,” emphasised that the illnesses were serious and life-threatening and called the proportion of patients hospitalized and in intensive care “just terrible.” “We know that additional deaths are under investigation,” Dr. Schuchat said. About 70 percent of the patients were male, 80 percent under 35 years old and 16 percent younger than 18, she said. Among the patients who died, the median age was about 50, and the proportion of women was higher than in the overall group of patients. In response to the outbreak of illnesses as well as the increasing rate of teenage vaping, several states have ordered bans on flavoured e-cigarettes. The Trump administration has said that it would draft a ban on flavoured e-cigarettes, too. But recently, a New York appeals court ordered a temporary stay of a state-wide flavour ban that was to take effect on Friday. Vaping groups had filed suit against the ban, contending that it would hurt retailers and adults who use the products. The vaping industry is also battling a more extensive ban of all vaping products in Massachusetts. Dr. Howard Zucker, the New York state health commissioner, called the outbreak a “public health emergency,” adding: “It is undeniable that the vaping industry is using flavoured e-cigarettes to get young people hooked on potentially dangerous and deadly products. While the court’s ruling temporarily delays our scheduled enforcement of this ban, it will not deter us from using every tool at our disposal to address this crisis.” Symptoms of the illness include coughing and breathing trouble that can become severe enough to require that patients be attached to ventilators. Some also have nausea, vomiting and fever. Many have vaped THC, the psychoactive ingredient in marijuana; some have vaped both THC products and nicotine. Some say they have vaped only nicotine. It is not yet possible to tell whether the illness comes on quickly or is the cumulative effect of long-time vaping. The exact cause of the illness is still not known, although C.D.C. officials have been referring to “chemical exposure.” The culprit could be one or more ingredients in the vaping fluids, or a toxin released from the materials used to make vaping devices, which contain heated coils that vaporize fluids or other substances. Many of the ingredients in the products are unknown. “I wish we had more answers regarding the specific harmful products or

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components that are causing these illnesses,” Dr. Schuchat said. She added: “I think we have the feeling right now that there may be a lot of different nasty things in e-cigarettes or vaping products, and they may cause different harms in the lungs.” In some cases, the injury to the lung tissue looks like a chemical burn, the same kind of damage that occurs from industrial accidents where chemicals spill and people inhale poisonous fumes, experts in lung pathology from the Mayo Clinic reported. Their findings were based on studying samples of lung tissue from 17 patients, ages 19 to 67, who became ill after vaping. Most reported vaping THC. Medical investigators are scrambling to find the cause of the illnesses, a task made more difficult by the booming market in vaping products, some legal and many not, from sources unknown. Some are concocted at home by users themselves. All the products are a stew of chemicals, often including flavourings, oils and solvents that may react with one another when heated, to produce still more molecules that have yet to be identified. The Food and Drug Administration is testing vaping products, and has obtained more than 440 samples from 18 states, Judy McMeekin, the agency’s deputy associate commissioner for regulatory affairs said at the briefing on Thursday. So far, she said, no single product or substance has been identified as the source of the trouble. She said that the agency was particularly concerned about black-market sources, but that it was too soon to rule out other products. During the briefing, Dr. Schuchat was asked if THC vaping products could be considered safe if purchased from dispensaries in states that license them. She replied: “With all the data I’ve been seeing, I don’t know what safe is now.”

New York Times, 3 October 2019

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

## Potential dioxin emissions from Rouen chemical plant fire raises concerns

2019-10-10

It is “possible” that a major industrial fire in Rouen last week produced dioxin emissions, the head of a French environmental agency said. Amid pollution fears after the Lubrizol blaze, there are calls for more testing to be made public. A week after the massive fire at the Lubrizol chemical plant in Normandy, the massive plume of smoke that spiralled into the air last Thursday is causing intense concern among area residents. The plant, which makes industrial lubricants and fuel additives and is owned by the American billionaire Warren Buffet, is located just kilometres from the city of Rouen, population 110,000. But smoke from the blaze cut a

**It is “possible” that a major industrial fire in Rouen last week produced dioxin emissions, the head of a French environmental agency said.**

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broad black swath across the sky, spreading some 22 kilometres beyond the site. More than 1,800 farmers saw their fields tainted by an oily soot from the fire. Authorities have told them to destroy any exposed produce. The government has pledged to compensate their losses promptly. On Wednesday, Raymond Cointe, who heads the National Institute for Industrial Environment and Risks (Ineris) charged with analysing samples collected in the wake of the inferno, announced that “it is possible that the fire led to the emission of dioxins”, while adding that current analyses “suggest that most of” the plant’s products have a “low likelihood of releasing dioxins”. “Further results are necessary in order to elaborate on and confirm this data, keeping in mind that as far as dioxins are concerned, the principal and potential source of contamination is from ingestion,” Cointe said. French Prime Minister Édouard Philippe was prudent earlier Wednesday, declaring before the Senate: “We don’t know everything right now because the tests are ongoing and because they will need to continue and be pursued for a long time.” Chemist and legal expert Frédéric Poitou told FRANCE 24 that, after Cointe’s remarks on dioxins, “the floodgates are open”. “He is someone who is very competent and who is considered an authority in the profession saying this,” Poitou explained. “I hope it will spur our politicians to adopt a stance.” Former environment minister Corinne Lepage struck a similar note. Lepage has for days been warning of the risks of dioxin emissions from the Lubrizol fire. “What the State is saying wasn’t biased. It was accurate, but it was incomplete,” she told FRANCE 24. “The dioxin emissions result has seemed evident to me from the start.” Have authorities known of dioxin emissions since the night of the explosion? Dioxins are chemical compounds that linger in the environment and enter the food chain, principally in meat, dairy products, fish and seafood, according to the World Health Organisation. The WHO underscores that some of these pollutants are potentially carcinogenic. “There are about 200 existing dioxins – including 10 that are very toxic and two that are deadly – but not all of them are dangerous,” Poitou explained. As for knowing which dioxins were “possibly” emitted in Rouen, the chemist says he doesn’t know which of the compounds were stored at the Lubrizol site. “We will know soon. Private analyses are under way,” he said. Poitou believes the possible release of dioxins has been known to authorities “since the night of the explosion thanks to a CBRN [chemical, biological, radiological and nuclear] truck” put to use in Rouen to detect such emissions. Lepage shares that reasoning. She is calling for CBRN trucks’ analyses “to be made public”. “There were several on site to my knowledge,” she says. “They are extremely sophisticated trucks inside which analyses, notably of dioxins, take only a few hours.” Lepage adds, “The problem isn’t the quality of the air today; everything that went up

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in smoke a week ago has settled on the ground and in the water. Dioxins need to be looked for in [local] milk and eggs." Contacted by FRANCE 24 for comment on Cointe's dioxin remarks and on the presence of CBRN trucks on site at Lubrizol on the night of the fire, the Seine-Maritime department's police prefecture had yet to respond at the time of writing.

France24, 3 October 2019

<http://www.france24.com/en/>

### **Australia to fund research on medicinal cannabis as demand grows**

2019-10-10

Australia will provide A\$3 million for research on the use of cannabis to help cancer patients, its health minister said, as the demand for medicinal cannabis products grows rapidly. While legal in most of Australia, such products are allowed only to patients on the prescription of a doctor, and a license is required to grow and make medicinal cannabis. On Sunday, Health Minister Greg Hunt said access had been permitted to more than 11,000 patients, with most approvals this year. "There have only been a limited number of well-designed clinical studies on medicinal cannabis, and we need to increase the evidence base to support medical professionals," a ministry statement cited him as saying. Health ministry data shows 78 companies now licensed to grow and harvest medicinal cannabis, up from one in March 2017. Hunt was speaking at a fundraising walk led by Olivia Newton-John, the English-born Australian singer and actress who became an ardent advocate of medical cannabis after being diagnosed with cancer. "I'm a great proponent of it, for general health, for pain, for sleep, for anxiety," Newton-John told Nine News television last week. "I really believe it is important in my journey." Newton-John's experience and efforts had helped shine a light on the benefits associated with medicinal cannabis, Hunt said, adding that the government would work to ensure access for Australian patients. "But only when it is prescribed by a medical professional," he added. The government looks unlikely to change its stance on the recreational use of cannabis, however. Federal law prohibits such use, although late in September, the Australian Capital Territory (ACT) became the first of the country's six states and two main territories to legalize cannabis for personal use. Attorney-General Christian Porter is awaiting a copy of the final version of the ACT bill before deciding whether the federal government should override the territory legislation, the Weekend Australian newspaper said on Saturday. The ACT

**Australia will provide A\$3 million for research on the use of cannabis to help cancer patients, its health minister said, as the demand for medicinal cannabis products grows rapidly.**



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law, due to take effect from January 31, conflicts with national drug laws that ban possession of marijuana.

Reuters Health, 6 October 2019

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

### Eating nuts might help limit weight gain

2019-10-10

Despite their high calorie counts, daily doses of nuts might help people keep off excess weight, especially when nuts are substituted for less healthy foods, a recent study suggests. Researchers followed 126,190 healthy middle-aged adults for 20 to 24 years. At the start, participants were typically at a healthy weight or slightly overweight. By the end of the study, about 17% of participants had become obese. People who increased their total nut consumption by a half-serving a day (14 grams, or about half an ounce) were 3% less likely to become obese, researchers report in *The BMJ*. Boosting daily walnut consumption by a similar amount was associated with a 15% lower obesity risk, while adding tree nuts like cashews and almonds was tied to an 11% lower obesity risk. Increasing nuts in the diet may help maintain a healthy body weight in several ways, said senior study author Deirdre Tobias of Brigham and Women's Hospital and Harvard Medical School in Boston. "Their high healthy-fat and fibre content are more filling for longer compared with processed carbs and other more easily digested foods," Tobias said by email. "This may also benefit the overall quality of the diet by making less room for less-healthy snack foods," Tobias added. "So, even though nuts are considered calorie-dense, their intake likely displaces other calories in the diet to improve long-term weight." To get the most health benefit from eating more nuts, people should avoid nuts coated with salt and sugar, Tobias advised. Each year during the study, participants gained an average of 0.32 kilograms (0.71 pounds). But each half-serving of nuts added to a daily diet was associated with less weight gain. With an added half-serving of nuts in general, people gained an average of 0.19 kg (0.42 lb) less every four years than those who didn't add nuts to their diet, while adding a similar amount of walnuts was tied to 0.37 kg (0.82 lb) less weight gain and tree nuts were associated with 0.15 kg (0.33 lb) less weight gain. The study also found that adding nuts to the diet was associated with a 4% lower risk of gaining more than 2 kg (4.4 lb) or more than 5 kg (11 lb) every four years. The study wasn't a controlled experiment designed to prove whether or how changes in nut consumption might directly impact weight gain over time. Another limitation is that researchers relied on participants

**Despite their high calorie counts, daily doses of nuts might help people keep off excess weight, especially when nuts are substituted for less healthy foods, a recent study suggests.**

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to accurately recall and report on their eating habits once every several years, and it's possible this might not reflect what they actually ate, the study team notes. Even so, the results suggest that adding a handful of nuts to a varied diet could help people avoid packing on the pounds as they age, said Gang Liu, a nutrition and public health researcher at Tongji Medical College, Huazhong University of Science and Technology in China. "Replacing a half serving a day of less healthful foods with nuts may be a simple strategy to help prevent gradual long-term weight gain and obesity," Liu, who wasn't involved in the study, said by email.

Reuters Health, 5 October 2019

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

### Scientists find toxic fungus near Australia's Great Barrier Reef

2019-10-10

A highly poisonous fungus, with toxins that can be absorbed through the skin, has been identified for the first time in the rain forest near the Great Barrier Reef, Australian scientists said. The Fire Coral fungus, which is better known in South Korea and Japan as being among the world's most poisonous mushrooms, was found near Cairns in the northern state of Queensland, scientists from James Cook University said. "If found, the fungus should not be touched, and definitely not eaten," said Matt Barrett, an expert on fungi at the university's Australian Tropical Herbarium. "Of the hundred or so toxic mushrooms that are known to researchers, this is the only one in which the toxins can be absorbed through the skin." If eaten, the distinctive red fungus causes a horrifying array of symptoms: stomach pain, vomiting, diarrhoea, fever and numbness are followed over hours or days by the skin peeling off the hands and feet, and the shrinking of the brain, he added. It was most likely that the fungus occurred naturally in Cairns, although instances have also been reported from Indonesia and Papua New Guinea, Barrett said in a statement. "The fact that we can find such a distinctive and medically important fungus like Poison Fire Coral right in our backyard shows we have much to learn about fungi in northern Australia," he added.

Reuters Health, 3 October 2019

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

**A highly poisonous fungus, with toxins that can be absorbed through the skin, has been identified for the first time in the rain forest near the Great Barrier Reef, Australian scientists said.**

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### **This Could Be Why It's So Hard to Maintain Eye Contact While Having a Conversation**

2019-10-10

Research suggests there could be a good scientific reason why some of us struggle to look someone in the eye and hold a conversation with them. It turns out we're not just awkward, our brains actually can't handle the tasks of thinking of the right words and focussing on a face at the same time. The effect becomes more noticeable when someone is trying to come up with less familiar words, which is thought to use the same mental resources as sustaining eye contact. Scientists from Kyoto University in Japan put this to the test in 2016 by having 26 volunteers play word association games while staring at computer-generated faces. When making eye contact, the participants found it harder to come up with links between words. "Although eye contact and verbal processing appear independent, people frequently avert their eyes from interlocutors during conversation," wrote the researchers. "This suggests that there is interference between these processes." The volunteers were tested while looking at both animations of faces making eye contact and animations of faces looking away. They were also asked to think of links between easily associated words and words where there are a lot of competing associations. For example, thinking of a verb for 'knife' is relatively easy, because you can't do much more than cut or stab with one. Coming up with an associated verb for 'folder' is harder, considering you could open, close, or fill them. The volunteers took longer to think of words when they were making eye contact, but only when difficult word associations were involved. The researchers suspect the hesitation indicates the brain is handling too much information at once. So, while making eye contact and holding a conversation is certainly possible, this is evidence that they can both draw on the same pool of cognitive resources, and sometimes that pool starts to run a little dry. The sample size used was small, so we need to take it with a grain of salt. But it's an interesting hypothesis - and it's also not the only study to suggest the brain gets slightly freaked out by eye contact. In 2015, Italian psychologist Giovanni Caputo demonstrated that staring into someone else's eyes for just 10 minutes induced an altered state of consciousness. Participants saw hallucinations of monsters, their relatives, and even their own faces. It seems that a process called neural adaptation is the cause, where our brains gradually alter their response to a stimulus that doesn't change - so when you put your hand on a table, you immediately feel it, but that feeling lessens as you keep your hand there. The volunteers making eye contact and associating words may also be experiencing some kind of neural adaptation, but for now the Kyoto

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University researchers are calling for further study into the links between verbal and non-verbal communication. And in the meantime, if someone looks away while they're talking to you, they might not be being rude – they could just have an overloaded cognitive system. The findings were published in the journal *Cognition*.

Science Alert, 5 October 2019

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

### That Great Pacific Garbage Patch Cleaning Device Is Finally Working Properly

2019-10-10

It's been six years since Boyan Slat began developing a system to rid the world's oceans of harmful plastic. In 2013, the entrepreneur founded The Ocean Cleanup, a non-profit that aims to remove plastic from the Great Pacific Garbage Patch, a trash-filled vortex in the Pacific Ocean that's more than twice the size of Texas. The group designed a device that passively collects plastic in its fold like a giant arm. But the system has hit several snags, including a design and manufacturing flaw that caused the plastic to spill back into the ocean. More recently, plastic began flowing over the top of a cork line that helps stabilise the system. But recently, The Ocean Cleanup announced that it had fixed that problem and that the device is now capturing and retaining plastic debris in the Great Pacific Garbage Patch. So far, the team has collected large fishing nets, plastic objects like cartons and crates, and microplastics as small as 1 millimetre in length, it said. The system's ability to trap microplastics came as a surprise, the organisation said in a press release. The Ocean Cleanup's previous research had suggested that microplastics rain down like ash toward the bottom of the ocean and so should be less likely to stay floating close to the surface. Because of that, the organisation has focused on removing larger pieces of plastic from the Great Pacific Garbage Patch. Laurent Lebreton, one of the organisation's researchers, previously told *Business Insider* that a lot of the debris the device was catching "is really weathered and broken down, and some of it looks really old." He added: "We don't really find any plastic bags or straws, but we find really thick, hard plastic fragments." The team has now demonstrated that the device can retain various types of plastic, thanks to a new parachute system that debuted in June. The Ocean Cleanup's U-shaped plastic-catching system is engineered to passively collect trash from the garbage patch using the ocean's current. It essentially creates a coastline in deep water. The most visible portion of the device is a 2,000-foot (600 metre) pipe made of

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high-density polyethylene plastic. The pipe is connected to a screen that extends about 10 feet (3 metres) below the surface and is responsible for catching plastic debris. In the first version of the device, the screen was attached to the bottom of the pipe like a skirt. But the team found that this configuration created too much stress at the point where the pipe and screen joined. In late 2018, a crack at the bottom of the pipe widened into a fracture, causing a 59-foot (18 metre) end section to detach from the array. To address this issue, The Ocean Cleanup moved the screen in front of the pipe and connected it with slings. The team also installed a cork line (similar to the ones that separate the lanes of a swimming pool) behind the screen to keep it taut. In June, The Ocean Cleanup launched a new version of the device, known as System 001/B. Once it was set up in the Pacific Garbage Patch, researchers did a series of tests. They wanted to know whether the device had to travel at a consistent speed – either faster or slower than the plastic in the water. So, they tried a parachute anchor that decelerated the system, and they experimented with turning the device in the opposite direction and attaching inflatable bags to tow it faster than the plastic. The parachute anchor proved to be the “winning concept,” Slat wrote on his blog. But the new design still wasn’t quite right: In August, the group’s researchers found that plastic was spilling over the cork line, which sat about 10 centimetres (4 inches) above the water. So, they built a much taller cork line to prevent this “overtopping.” The organisation said that there was only “minimal overtopping,” a sign the tweak was successful. “This now gives us sufficient confidence in the general concept,” Slat said in a press conference. Slat told Business Insider in September that he planned to build a larger version of the system next year that could capture more plastic, though his team was still trying to determine what the precise size should be. For now, he said in the press conference, “there are still quite a few hurdles ahead of us before we are actually ready to scale.” One of those hurdles is demonstrating that the system can retain plastic for more than a year – something the existing model isn’t designed to do. In particular, the organisation wants to make sure the device can hold up in harsh winter weather. After that, Slat said, the organisation hopes to construct a fleet of these plastic-cleaning devices. The group thinks a ship could visit the garbage patch every few months and tow the debris that the array catches to shore. But right now, The Ocean Cleanup’s staff removes the plastic the device catches from the water by hand, using nets. So, to achieve its ultimate goal of capturing up to 15,000 tons of plastic per year, the organisation would have to consider more advanced ways to transfer plastic to a ship. Once the system is scaled up, Slat said, he’ll likely visit the Great Pacific Garbage Patch to observe it in action. For now, though, he stays on land, since he tends to get seasick.

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"I'd like to go at some point, but only once the whole fleet is out there," he said. "I think it will be kind of epic to see."

Science Alert, 3 October 2019

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

### How the monarch butterfly evolved its resistance to toxic milkweed

2019-10-10

The beloved black and orange wings of the monarch butterfly are more than just beautiful. They warn potential predators that this insect is poisonous to eat—a trait acquired from the butterfly feeding on the toxic milkweed plant. Now, two research teams have independently discovered how this iconic insect became immune to its poisonous diet, and they have shown how three genetic mutations are key—by making those same changes in a fruit fly. "They are impressive pieces of research," says Marcus Kronforst, an evolutionary biologist at the University of Chicago in Illinois who was not involved with either group. He notes that these studies are rare examples where researchers verified the mutations responsible for a trait by making them in another species. Milkweed plants produce compounds called cardiac glycosides, which disrupt molecular pumps that control the proper flow of ions in and out of cells. Monarch butterflies and other consumers of the plant, however, have evolved versions of these pumps that leave the animals unaffected. To find what changes these milkweed eaters had in common, Noah Whiteman, an evolutionary biologist at the University of California, Berkeley, and his colleagues recently matched up the gene for this molecular pump in 21 insects, including monarchs, that tolerate the plant to varying degrees. They found three mutations that changed three amino acids in the protein pump. By looking at the distribution of these changes across the insect family tree, Whiteman and colleagues were able to predict which ones came first—and it turned out that the order in which they evolved mattered. They then tried to replay the tape of evolution by making combinations of those changes in fruit flies using the gene-editing tool CRISPR. A single mutation predicted to have arisen in the monarch's ancestor made the fruit fly only a little resistant to the toxins in milkweed. But when that change was combined with a second one, the fruit fly was far better protected, Whiteman and his colleagues report in *Nature*. And when they added the third mutation, the fruit fly thrived on milkweed as well as monarchs. The flies even retained some of the toxin in their bodies—as monarchs do to make themselves toxic to predators. "It's

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just mind-blowing that the amazing ability of the butterfly to survive on these harsh chemicals comes down to just those three amino acids in the protein," Kronforst says. The findings confirm what evolutionary geneticist Peter Andolfatto of Columbia University and his colleagues reported 27 August in *eLife* when they engineered fruit flies with a different editing approach, sometimes making mutations in both copies of the pump's gene and sometimes making them in only one copy. The order in which the mutations were introduced was also critical, Andolfatto notes. In one sequence, the mutations produced healthy, milkweed-tolerant insects. In others, the flies had neurological defects, he and his colleagues reported. His team also studied what happened when the fruit fly had just a single copy of the ion pump gene with either one, two, or three mutations. The team found that just a single copy with the initial mutation confers some glycoside resistance, a property that may have enabled the change to persist long enough for other, more beneficial mutations to occur. "Hopefully [this work] will serve as a reminder that the genomic context in which a mutation occurs is important," says Hopi Hoekstra, an evolutionary biologist at Harvard University who was not involved with the work. All in all, "It's just a beautifully complete story," she adds.

Science, 2 October 2019

<http://sciencemag.org/>

### **Our tastes change with adulthood, pregnancy, medication and more. Here's why**

2019-10-10

Did you hate the bitter taste of coffee as a kid, scrunching up your face after sneaking a sip of an adult's brew, but then wake up one morning as a teenager and suddenly fancy a latte? Or maybe you hated the earthy flavour of mushrooms, and now you can't get enough of that umami taste. It might seem like it was a sudden change of heart (or stomach), but how our food preferences change over time is a complex combination of exposure, genetics and physiology, according to taste researcher and consultant John Prescott. "Food preference is to do with learning," Dr Prescott said, who is a visiting professor at the University of Florence. "Genetic factors are important, and there's also some individual variability in terms of physiology." It's certainly more complicated than subconsciously deciding you're ready to eat blue cheese one day. To understand why our preferences for foods might change in different circumstances, we have to go back to what our body uses taste for in the first place.

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### Taste screens for nutrition

In nature, taste is what drives our body to consume different nutrients, and what deters our body from consuming potentially dangerous things. Taste has a number of qualities — sweet, sour, salty, bitter and umami — which are all detected by taste buds on the tongue and some parts of the mouth, said Dr Prescott. (And there are murmurings of a sixth taste — fat.) “If something is sweet [in nature] it’s almost certainly going to be good because it provides calories,” he said. However, we’re naturally wary of bitter things because bitterness can indicate something is poisonous, and there’s little wiggle room when it comes to bitter taste preferences because it’s highly regulated by our genes. We also tend to reject sour foods because it can suggest underripeness, overripeness, or fermentation. “As for salty, you have to take in salt or you simply die,” Dr Prescott said. “So, there’s a specific nutritional link to each taste quality.” Your taste perception can change in response to you needing more or less of a nutrient, according to nutrition scientist Andrew Constanzo from Deakin University. “If your ability to perceive taste is reduced, it can drive you to consume more food, more nutrients,” Dr Constanzo said. But there is more to food preference than taste alone — which only accounts for those qualities of sweet, sour, salty, bitter and umami. It’s flavour that coffee roasters and wine growers harness to create complex experiences in your mouth. “Flavour comes from our sense of smell,” Dr Prescott said. It’s the volatile compounds from food — chemical compounds in vapour form — that we breathe through our nose that, combined with taste, give food its flavour. These compounds can also be detected through the back of the nose — so when the food is already in your mouth, you’re still “smelling” it. “If you hold your nose and drink coffee, it’s just a bitter liquid,” Dr Prescott said. “But normally when you put coffee in your mouth, the volatiles reach the receptors in the back of the nose.” So, if you hold your nose, you take flavour out of the equation and are left just with taste. A classic test for this is to eat a lolly without looking at its colour, and while holding your nose, and see if you can identify what flavour it is. With your nose blocked, you’ll probably only be able to detect that what you’re eating is sweet, but not what specific flavour the lolly is. And in fact, the whole experience of tasting food is also affected by food texture, temperature, chewing and saliva production.

### Illness can muck with your tastes

Often, having a cold means a partially or completely blocked nose, which means eating your favourite foods might seem different. “When you’ve got a cold a lot of people think that they can’t taste things as well, but



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that's not really the case," Dr Constanzo said. "Because your nasal passages are blocked, you're not getting those smells coming through so you can't perceive flavour. "But you can still perceive taste just as good as you could when you weren't sick." And because your flavour perception is dampened, you might find yourself craving a spicy bowl of laksa or a bucket of salty hot chips to inject some life back into you. The way you feel about food will likely change in response to a range of illnesses, and medications too, said Dr Prescott. "A lot of illnesses change your appetite, and that's different from changing your perception of the smells or the taste of food," he said. "There's also a whole raft of drugs that could alter, sometimes permanently, the sense of taste or sense of smell." The experience of eating food can be completely changed by chemotherapy treatment, for example. The tastebuds themselves can be damaged by the treatment, and as the cells regenerate, they might communicate differently with the brain — so flavours are not experienced the same way they were before. Some medications can get into your saliva, producing a bitter taste, while others can make your mouth dry, which also affects how you perceive taste and food.

#### A lifetime of smells and tastes

Taking medication in old age can compound the natural decline most people experience in their senses of smell and taste. Just as people's hearing and eyesight might decline as they get older, the senses of smell and taste can become weaker too. "A lot of people over 70 or 75 will be taking a medication that could impact on taste or smell," Dr Prescott said. "But also having a chronic illness can mean you're not enjoying your food as much to begin with, if your quality of life is poor." Our food experiences and preferences are developing and changing throughout our entire life — even before we are born. "The foetus receives the mother's bloodstream which is full of flavour compounds from whatever the mother eats," Dr Prescott said. So, babies are born with some built-in likes and dislikes from day one, thanks to mum. "It's just a function of being a mammal that newborns like sweet tastes, and dislike bitter tastes," he said. And whether it's pickles or ice-cream, pregnant women experience changes to their food preferences (or cravings) too. "In general, when you're pregnant all your taste sensitivities become reduced or dampened," Dr Constanzo said. "It's because you've got a baby growing so you want to consume more nutrients in order to help that baby grow." If you can't taste salt as much as you normally can, then your body might be trying to get you to consume more salt in your diet. "Generally speaking, the less you can taste the more you want to consume," Dr Constanzo said.

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#### Maturing palettes need time and influence

Our natural rejection of bitter-tasting foods extends well in to childhood — just watch a kid take a sip of a coffee. But that dislike for bitterness is tempered with time and exposure, said Dr Constanzo. “It’s probably a learned effect. As we become exposed more and more to certain flavours, we get used to them,” he said. It may seem like you just woke up one day in high school and decided it was time to transition from hot chocolate to coffee — but the change had probably been brewing away for a while. The coffee example is useful for illustrating how our preferences can change, but if you grow up somewhere where coffee isn’t common, you’d probably be even more repulsed by it when tasting it for the first time. Culture and social influences play a big role in determining what foods we like and dislike. Teenagers experiment in a lot of different ways and trying different foods is certainly part of that, if through choice, or through a desire to conform to what others are doing, Dr Prescott said. “There’s no specific changes in adolescence except a broadening of experience,” he said. In terms of conforming to food norms, the same probably goes for adults. Do you really like oysters — or do you just order them to seem fancy and fit in?

ABC News, 6 October 2019

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

## Technical Notes

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

### ENVIRONMENTAL RESEARCH

[Distribution of microbial communities in metal-contaminated nearshore sediment from Eastern Guangdong, China](#)

[Mode of action \(MOA\) classifications in the EnviroTox database: Development and implementation of a consensus MOA classification](#)

[Effect of Individual and Combined Treatments of Pesticide, Fertiliser, and Salt on Growth and Corticosterone Levels of Larval Southern Leopard Frogs \(\*Lithobates sphenoccephala\*\)](#)

[Chemical mixtures and fluorescence in situ hybridization analysis of natural microbial community in the Tiber river](#)

[Dissolution and aggregation kinetics of zero valent copper nanoparticles in \(simulated\) natural surface waters: Simultaneous effects of pH, NOM and ionic strength](#)

### MEDICAL RESEARCH

[Effect of environmental and pharmaceutical exposures on foetal testis development and function: a systematic review of human experimental data](#)

[An assessment of the impact of multi-route co-exposures on human variability in toxicokinetics: A case study with binary and quaternary mixtures of volatile drinking water contaminants](#)

[Molecular interactions of chlorpyrifos and its environmental degradation products with human sex hormone-binding globulin: an in-silico study.](#)

[Exposure to indoor endocrine-disrupting chemicals and childhood asthma and obesity](#)

[Angiotensin-converting enzyme inhibitors/angiotensin receptor blockers,  \$\beta\$ -blockers or both in incident end-stage renal disease patients without cardiovascular disease: a propensity-matched longitudinal cohort study](#)

### OCCUPATIONAL RESEARCH

[Hair as a matrix to evaluate cumulative and aggregate exposure to pesticides in winegrowers](#)

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Fixed night workers and failed smoking cessation

Senior managers' awareness of sun protection policy predicts implementation of worksite sun safety in a randomised trial

Current Review of Pneumoconiosis Among US Coal Miners

Effects of occupational exposure to dust on chest radiograph, pulmonary function, blood pressure and electrocardiogram among coal miners in an eastern province, China

### **PUBLIC HEALTH RESEARCH**

Formaldehyde in "Nontoxic" Nail Polish

Identifying Compounds with Genotoxicity Potential Using Tox21 High-Throughput Screening Assays

Evaluation of hazard distances related to toxic releases in a gas refinery: comparison of chemical exposure index and consequence modelling approaches

Determination of nine preservatives in processed foods using a modified QuEChERS extraction and quantified by HPLC-PDA

Organochlorine pesticides in the soils from Benevento provincial territory, southern Italy: Spatial distribution, air-soil exchange, and implications for environmental health