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

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ASIA PACIFIC

Reforms update — change to exempted introductions category due to Industrial Chemicals Bill amendment

2019-03-01

The amended Industrial Chemicals Bill 2017 (IC Bill) requires introducers to tell the Australian Industrial Chemical Introduction Scheme (AICIS) about chemicals introduced under the exempted category. This is a new requirement, consisting of a once-off declaration at the end of the registration year in which each chemical is first introduced in this category. The amended IC Bill allows for the details of these declarations to be set out in the Rules. The Rules will describe the information to be included in the declarations, as well as the exempted introductions that will not require this once-off declaration. These details are yet to be developed and we will consult with stakeholders before they become part of the Rules.

NICNAS, 25 February 2019

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

Independent review finds model Work Health and Safety (WHS) laws are operating as intended

2019-03-01

Safe Work Australia has announced the review of the model WHS laws is complete and the report is available on the Safe Work Australia website. "I commend the review report to WHS ministers for their consideration. On behalf of Safe Work Australia, I extend my thanks to Marie Boland for undertaking this important work and engaging widely with the community to understand how the model WHS laws are working in practice" said Safe Work Australia Chair Ms Diane Smith-Gander. "Safe Work Australia is committed to ensuring the model WHS laws are as effective as possible to keep Australian workers healthy and safe and will continue to conduct regular reviews" said Ms Smith-Gander. The report includes 34 recommendations to enhance the WHS framework. Key recommendations relate to the model WHS Regulations and Codes of Practice, including making regulations on psychological health, higher penalties and other measures to strengthen the compliance and enforcement framework and enhance deterrence, and clarifying requirements for meaningful WHS consultation, representation and participation to improve safety outcomes. The review report is with WHS ministers for consideration. More

The amended Industrial Chemicals Bill 2017 (IC Bill) requires introducers to tell the Australian Industrial Chemical Introduction Scheme (AICIS) about chemicals introduced under the exempted category.

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information about the review, including the consultation summary, can be found on the [Safe Work Australia website](#).

Safe Work Australia, 25 February 2019

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

Amendments to the APVMA MRL Standard

2019-03-01

The Australian Pesticides and Veterinary Medicines Authority (APVMA) approves maximum residue limits (MRLs) of agricultural and veterinary chemicals in agricultural produce, particularly produce entering the food chain. The MRLs approved by the APVMA are associated with a regulatory decision to register a product, grant a permit approval, or as an outcome from a review decision and are set out in the Agricultural and Veterinary Chemicals Code Instrument No. 4 (MRL Standard) 2012. The MRL Standard lists MRLs of substances that may arise from the approved use of agricultural and veterinary chemical products containing those substances on commodities used for human consumption as well as livestock feeds. The MRL Standard also provides the relevant residue definitions to which these MRLs apply. There may be situations where the residue definition for monitoring and enforcement is different to the definition used for dietary risk assessment purposes. MRLs are set at levels which are not likely to be exceeded if the agricultural or veterinary chemicals are used in accordance with approved label instructions. In considering MRLs and variation to MRLs, the APVMA takes into account studies on chemistry, metabolism, analytical methodology, residues, toxicology, good agricultural practice and dietary exposure. In approving MRLs, the APVMA is satisfied, from dietary exposure assessment, that the levels set are not an undue hazard to human health. The APVMA has amended the MRL Standard and the changes will have affect the day after the instrument is registered. Details of the amendment can be found in the Agricultural and Veterinary Chemicals Code Instrument No. 4 (MRL Standard) Amendment Instrument 2019 (No. 2). The amendments will be incorporated into the compilation of the [Agricultural and Veterinary Chemicals Code Instrument No. 4 \(MRL Standard\) 2012](#).

APVMA Gazette, 26 February 2019

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

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EPA proposes tightened rules on paraquat use

2019-03-01

Public submissions are open on a reassessment proposal by New Zealand's Environmental Protection Authority (EPA) for the herbicide paraquat and its associated formulations. The herbicide is included in the EPA's priority chemical list that was unveiled in October 2018 as part of the Authority's revamped reassessments program. Dr Fiona Thomson-Carter, the General Manager of Hazardous Substances and New Organisms at the EPA says: "Paraquat is a particularly harsh and hazardous chemical, and its sale and use is tightly controlled in New Zealand." Based on our review, we propose further tightening the controls for two paraquat-containing substances currently used in agriculture, which we believe can be used safely as long as risk mitigation measures are strictly followed. "We propose revoking approvals for sale and use in New Zealand of two substances which have mutagenic, carcinogenic or reproductive toxicant classifications and pose unnecessary risk, regardless of controls." We also propose revoking the approvals for two substances which we can find no evidence are being used in this country." The tighter controls being proposed involve restricting use to agriculture only, and imposing downwind buffer zones, and restrictions on application rates, frequencies, and intervals. Manufacturers who continue to sell paraquat would need to provide a product stewardship programme for all users. This would include details on how to safely handle the substance through its lifecycle, from storage to disposal. WorkSafe New Zealand is considering setting stricter rules around the use of paraquat if any approvals are retained. It is anticipated that if there is a decision to revoke any approvals, it will come into effect immediately. The public have until 12 April 2019 to submit on the consultation. Further information is available at: [Find out more or make a submission](#)

NZ EPA, 28 February 2019

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

China MEM Publishes Hazardous Chemicals Supervision and Control Schedule

2019-03-01

On 14 February 2019, China MEM (Ministry of Emergency Management) published the key work arrangement on hazardous chemicals supervision and control in 2019. The work arrangement focuses on oil-gas pipeline and fireworks safety supervision and non-pharmaceutical precursor chemicals

Public submissions are open on a reassessment proposal by New Zealand's Environmental Protection Authority (EPA) for the herbicide paraquat and its associated formulations.

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supervision & control. The main missions in the 2019 work arrangement consist of 6 parts:

- Reinforce the major risk control and prevent major accidents;
- Conduct comprehensive hazardous chemical safety management and special chemical industries and firework safety reform;
- Improve supervision and law enforcement and encourage stakeholders to self-regulate;
- Accelerate the formulation of regulations/standards;
- Vigorously promote science and technology progress, talent cultivation and social co-governance;
- Promote grassroots supervisory capacity.

Interpretation on key missions

1. Reinforce risk control and prevent major accidents

It is required that key regions (not mentioned yet) should introduce inventories on banned, restricted and controlled hazardous chemicals. To comprehensively launch and carry out the 3-year expert guidance service for 53 counties, with the aim to improve supervisory and management capacities.

2. Conduct comprehensive hazardous chemical safety management and reform of special chemical industries and firework regulations

Chemical industry rectification: Improve the safety on chloro-Alkali industry and screen for flammable and explosive toxic gas risks, for instance, vinyl chloride.

3. Accelerate the formulation of regulations/standards

a. Accelerate the implementation of **Hazardous Chemical Safety Law** and *Firework Safety Management Regulation*.

b. Expedite the formulation of supervision rules/regulations, including:

- Regulations on supervision and management of hazardous chemicals enterprises safe production;
- Safety system on oil-gas pipeline high-impact area
- Guidance on hazardous chemicals enterprises safety infrastructure construction
- Management measures on fireworks new technology application safety

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- Regulations on the standardisation union of non-pharmaceutical precursor chemicals and the safe production of hazardous chemicals
- c. Accelerate the formulation of imperative standards, including:
 - Primary safety technology requirements for hazardous chemicals operation enterprises
 - Guidelines on chemical process safety management
 - Norms on safety facility design for oil and gas pipeline construction projects
 - Identification of major hazard installations for fireworks
 - Specifications on safety technology for fireworks retail outlets/stores
- d. Disseminate and promote information on published regulations/ standards, including:
 - Identification of major hazard installations for hazardous chemicals
 - Risk criteria for hazardous chemicals production unit and storage installations

Further information is available at:

- [MEM Notice on 2019 work arrangement on hazardous chemicals supervision and control](#)
- [MEM Notice on expert guidance service for key counties](#)
- [List of 53 counties](#)

[Chemlinked, 20 February 2019](#)

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

AMERICA

EPA Retains National Ambient Air Quality Standards for Sulfur Dioxide

2019-03-01

The United States Environmental Protection Agency (EPA) recently announced its final decision to retain without changes to the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO₂). This decision comes after carefully reviewing the most recent available scientific evidence and risk and exposure information and consulting with the agency's independent science advisors "The United States has made great strides in reducing SO₂ concentrations," said EPA Assistant Administrator for the Office of Air and Radiation Bill Wehrum. "Based on

The United States Environmental Protection Agency (EPA) recently announced its final decision to retain without changes to the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO₂).

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review of the scientific literature, recommendation from our independent science advisors, and public comment, we have concluded that the existing standard continues to provide adequate health protection to our most vulnerable populations." As a result of Clean Air Act programs and efforts by state, local and tribal governments as well as technological improvements, SO₂ concentrations in the U.S. fell by more than 85 percent between 1990 and 2017 and more than 60 percent since 2010. These data accompany similar long-term trends showing air quality improvements:

- Between 1970 and 2017, combined emissions of six common air pollutants declined by 73 percent, while the U.S. economy increased more than 260 percent.
- EPA's [latest report on power plant emissions](#) also shows that SO₂ emissions from power plants fell six percent between 2017 and 2018.
- Since 1990, annual emissions of SO₂ from power plants fell by 92 percent, and annual emissions of NO_x from power plants fell by 84 percent.

Background

The Clean Air Act requires EPA to set NAAQS for "criteria pollutants." Currently, SO₂ and five other major pollutants are listed as criteria pollutants. The law also requires EPA to periodically review the relevant scientific information and primary (health-based) standards. If appropriate, EPA revises the standards to ensure they provide requisite protection for public health, allowing for an adequate margin of safety. The EPA and its independent advisors on this topic, the Clean Air Scientific Advisory Committee (CASAC), agree that this existing standard continues to provide health protection and "that the current scientific literature does not support revision of the primary NAAQS for SO₂." More information about the rule can be found at <https://www.epa.gov/so2-pollution/primary-national-ambient-air-quality-standard-naaqs-sulfur-dioxide>.

U.S EPA, 26 February 2019

<http://www.epa.gov>

Amendment to Section 25705 No Significant Risk Level for Bromodichloroacetic Acid

2019-03-01

On 5 February 2019, the Office of Administrative Law approved the amendment of Title 27, California Code of Regulations, section 25705, to add a No Significant Risk Level for the chemical bromodichloroacetic

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acid. The regulation will be effective on 1 April 2019. This regulation establishes a No Significant Risk Level of 0.95 micrograms per day for bromodichloroacetic acid for purposes of Proposition 65. Further information is available at:

- [Notice of Proposed Rulemaking Title 27, California Code of Regulations Amendment to Section 25705](#)
- [Initial Statement of Reasons, Amendment to Section 25705 Regulatory Levels Posing No Significant Risk: Bromodichloroacetic Acid](#)
- [Final Statement of Reasons, Amendment to Section 25705 Regulatory Levels Posing No Significant Risk: Bromodichloroacetic Acid](#)
- [Regulatory Text for Amendment to Section 25705 Regulatory Levels Posing No Significant Risk: Bromodichloroacetic Acid](#)
- [Stamped 400 for Amendment to Section 25705 Regulatory Levels Posing No Significant Risk: Bromodichloroacetic Acid](#)

Chemical Reference

Bromodichloroacetic acid

OEHHA, 13 February 2019

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

FDA Adds Ten New Substances to its Inventory of Effective FCS Notifications

2019-03-01

The United States Food and Drug Administration (FDA) recently added ten new substances to its Inventory of Effective Food Contact Substances (FCS) Notifications. The newly listed substances and the manufacturers are listed below.

FCN No.	Food Contact Substance	Manufacturer/Supplier	Effective Date
<u>1941</u>	N,N,N',N'-tetrakis(2-hydroxyethyl)hexanediamide (CAS Reg. No. 6334-25-4).	SIR Industriale S.p.A.	Jan 9, 2019

The United States Food and Drug Administration (FDA) recently added ten new substances to its Inventory of Effective Food Contact Substances (FCS) Notifications.

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FCN No.	Food Contact Substance	Manufacturer/ Supplier	Effective Date
<u>1937</u>	Copolymer of vinyl acetate (CAS Reg No. 108-05-4), butyl acrylate (CAS Reg No 141-32-2), glycidyl methacrylate (CAS Reg. No. 106-91-2), itaconic acid (CAS Reg. No. 97-65-4), and sodium vinylsulfonate (CAS Reg. No. 3039-83-6).	BASF Corporation	Dec 26, 2018
<u>1936</u>	An aqueous mixture containing peroxyacetic acid (PAA; CAS Reg. No. 79-21-0), hydrogen peroxide (HP, CAS Reg. No. 7722-84-1), acetic acid (CAS Reg. No. 64-19-7), 1-hydroxyethylidene-1,1-diphosphonic acid (HEDP, CAS Reg. No. 2809-21-4), dipicolinic acid (DPA, CAS Reg. No. 499-83-2), and, optionally, sulfuric acid (CAS Reg. No. 7664-93-9).	Diversey Inc.	Dec 26, 2018
<u>1934</u>	Isononanoic and 2-ethylhexanoic acid esters with pentaerythritol	Performance Fluids, Ltd.	Dec 21, 2018
<u>1933</u>	Isononanoic acid esters with dipentaerythritol	Performance Fluids, Ltd.	Dec 21, 2018
<u>1928</u>	Fatty acids, C18-unsatd., dimers, polymers with caprolactam and hexamethylenediamine [Nylon 6/6.36] (CAS Reg. No 2068097-08-3).	BASF SE	Dec 5, 2018
<u>1922</u>	2-Propen-1-aminium, N,N-dimethyl-N-2-propen-1-yl-, chloride (1:1), polymer with ethanedial and 2-propenamide (CAS Reg. No. 32555-39-8).	SNF SAS SNF Inc.	Jan 23, 2019
<u>1919</u>	2,6-Pyridinedicarboxylic acid (dipicolinic acid) (CAS Reg. No. 499-83-2).	Enviro Tech Chemical Services, Inc.	Dec 28, 2018
<u>1914</u>	Tetrafluoroethylene-ethylene-3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene terpolymer (CAS Reg. No. 68258-85-5).	Asahi Glass Co., Ltd. AGC Chemicals Europe	Dec 13, 2018

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FCN No.	Food Contact Substance	Manufacturer/ Supplier	Effective Date
<u>1911</u>	An aqueous mixture of peroxyacetic acid (PAA) (CAS Reg. No. 79-21-0), hydrogen peroxide (HP) (CAS Reg. No. 7722-84-1), acetic acid (CAS Reg. No. 64-19-7), 1-hydroxyethane 1,1-diphosphonic acid (HEDP) (CAS Reg. No. 2809-21-4), and optionally, sulfuric acid (CAS Reg. No. 7664-93-9).	Xgenex, LLC	Dec 6, 2018

The Food and Drug Administration Modernization Act of 1997 amended the Federal Food, Drug, and Cosmetic Act to provide for the submission of food-contact notifications (FCNs). Under the FCN system, a manufacturer or supplier of a food-contact material may submit an FCN to FDA regarding the identity and use of a new food-contact substance (FCS), along with information supporting the conclusion that the substance is safe for the intended use. If FDA does not object in writing within 120 days to the substance's use based on safety grounds, the submitter and its customers may market the substance. Once the notification becomes effective, FDA will add it to its Inventory of Effective FCS Notifications.

National Law Review, 22 February 2019

<http://www.natlawreview.com>

Regulatory Developments: EPA Releases Updated TSCA Inventory

2019-03-01

On 19 February 2019, the United States Environmental Protection Agency (EPA) released an update of the Toxic Substances Control Act (TSCA) Chemical Inventory (TSCA Inventory), which lists chemicals that are "active" versus "inactive" in commerce in the U.S. EPA's News Release states that a "key result of the update is that less than half of the total number of chemicals on the current TSCA Inventory (47 percent or 40,655 of the 86,228 chemicals) are currently in commerce." According to EPA, more than 80 percent (32,898) of the chemicals in commerce have identities that are not Confidential Business Information (CBI), increasing public access to additional information about them. For the less than 20 percent of the chemicals in commerce that have confidential identities, EPA is

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developing a rule outlining how it will review and substantiate all CBI claims seeking to protect the specific chemical identities of substances on the confidential portion of the TSCA Inventory. [“EPA Issues Final TSCA Framework Rules,”](#) the [final TSCA Inventory notification \(active-inactive\) rule](#) (82 Fed. Reg. 37520 (Aug. 11, 2017)) established a retrospective electronic notification of chemical substances on the TSCA Inventory that were manufactured (including imported) for non-exempt commercial purposes during the ten-year time period ending on 21 June 2016, with provision to also allow notification by processors. From 11 August 2017, through 5 October 2018, chemical manufacturers and processors provided information on which chemicals were manufactured, imported, or processed in the U.S. over the past ten years. EPA states that it received more than 90,000 responses, representing “a significant reporting effort by manufacturers, importers and processors.” The updated TSCA Inventory includes an updated commercial activity status field designating which chemical substances are “active” in U.S. commerce, based on reporting to or in any of the following:

- 2012 and 2016 Chemical Data Reporting (CDR) cycles;
- Notices of Commencement (NOC) received since 21 June 2006; and
- Notice of Activity (NOA) Form A’s received through 5 October 2018, per the final TSCA Inventory notification (active-inactive) rule.

All substances not reported as “active” are identified as “inactive.”

Next Steps

On 13 March 2019, EPA will host a webinar to assist manufacturers (including importers) and processors with future reporting requirements. Under the final TSCA Inventory notification (active-inactive) rule, a substance is not designated as an “inactive substance” until 90 days after EPA publishes the initial version of the Inventory with all listings identified as active or inactive. EPA states that manufacturers and processors should be aware that if there is a substance that is listed as “inactive” that is currently being manufactured or processed, they have 90 days to file an NOA Form B so that they can continue their current activity. Manufacturers and processors that intend to manufacture or process an “inactive” substance in the future must submit an NOA Form B before they start their activity. The webinar is scheduled for 1:00 p.m. - 4:00 p.m. (EDT) on Wednesday, 13 March 2019. The webinar will include an overview of filing an NOA Form B, a demonstration of the electronic reporting application, and time for questions and answers. Registration for the webinar is not required. EPA will soon issue a “signed action” that the final rule stated

On 19 February 2019, the United States Environmental Protection Agency (EPA) released an update of the Toxic Substances Control Act (TSCA) Chemical Inventory (TSCA Inventory), which lists chemicals that are “active” versus “inactive” in commerce in the U.S.

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would accompany the first version of the active/inactive Inventory. According to the final rule preamble, EPA intends to publish this signed action in a web posting on EPA's Inventory web page (82 Fed. Reg. 37533). Ninety days from publication of the action, it will be impermissible to manufacture, import, or process a substance that is inactive without first submitting an NOA Form B. The ninety-day period is an opportunity for notification by submitters who have commenced activity on a substance that was not identified as active on one of the interim lists (e.g., if activity started after 22 June 2016). As noted above, EPA is developing a rule outlining how it will review and substantiate all CBI claims seeking to protect the specific chemical identities of substances on the confidential portion of the TSCA Inventory.

National Law Review, 22 February 2019

<http://www.natlawreview.com>

California proposes naming nail products containing toluene a priority product

2019-03-01

California's Department of Toxic Substances Control has proposed listing nail products containing toluene as its latest priority product under its Safer Consumer Products program. If adopted, the designation will prompt manufacturers either to phase out the substance's use in that application or to undertake an alternatives analysis if they want to continue serving the California market. Toluene is used as a solvent in a variety of nail products, including polishes, hardeners and thinners. But it has been linked with damage to the nervous system and respiratory tract, as well as developmental effects such as low birthweight. The DTSC said this presents concern for the state's more than 130,000 nail salon workers, many of whom are women of childbearing age. Meredith Williams, acting director of DTSC, said industry "has known for a long time that toluene is a problematic chemical in these products". "Responsible manufacturers have moved away from it. We want to make sure that others do the same," she added. As a first step, the DTSC has released a draft technical report outlining the scientific basis of the proposal. A comment period on the draft will be open until 15 March and the department will also host a public workshop to receive comments on 13 March. The technical report will then be updated, based on the comments, and submitted to an independent scientific review panel. Toluene is also the subject of recent state-level legislation in states like New Jersey and New York, which are considering banning its use in nail products, alongside dibutyl phthalate

Safer Consumer Products program identifies concern for salon workers exposed to solvent

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(DBP) and formaldehyde. In 2016, the DTSC sought feedback on this so-called “toxic trio” of substances. But in its technical report, it said that most nail product manufacturers have largely phased out formaldehyde and DBP, while some are continuing to use toluene.

Safer Consumer Products program

California’s Safer Consumer Products program identifies products that contain potentially harmful chemicals and has manufacturers look for potential replacements via alternatives analyses. The program took effect in 2013 as a consequence of California’s green chemistry laws, passed in 2008. Other products that have been adopted as SCP priorities include:

- paint or varnish paint strippers containing methylene chloride;
- spray polyurethane foam with unreacted MDI; and
- children’s foam-padded sleeping products with the flame retardants TDCPP or TCEP.

Aside from nail products containing toluene, other proposed priority products include:

- perfluoroalkyl and polyfluoroalkyl substances (PFASs) in carpets and rugs;
- laundry detergents containing the surfactants nonylphenol ethoxylates (NPEs); and
- paint and varnish strippers and graffiti removers containing N-methylpyrrolidone (NMP).

Further information is available at:

- Toluene technical report
- Safer Consumer Products program

Chemical Watch, 20 February 2019

<http://chemicalwatch.com>

EUROPE

UK companies consider REACH authorisation transfer ahead of Brexit

2019-03-01

Six UK-based companies that have applied for a REACH authorisation for a specific use of an SVHC are contemplating transferring their applications

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to EU entities ahead of Brexit, the European Chemicals Agency (ECHA) said. All REACH authorisations or registrations filed by manufacturers, importers or only representatives (OR) based in the UK will no longer be valid in the EU or European Economic Area if Britain leaves the single market on 29 March. The six have informed ECHA that they have “clear plans” for Britain’s departure and will decide “in the weeks to come” whether to move applications to a company operating in the EU27 so as to continue supplying the respective substances, the agency told Chemical Watch. They are the only upstream companies that have applied for, or have been granted, an authorisation. ECHA identified them following a request from the European Commission, and in January asked about their plans. The EU executive wants to ensure that there would be no market disruption if Brexit goes ahead, ECHA said.

The companies and the substances concerned are:

- Indestructible Paint – pentazinc chromate octahydroxide;
- Brenntag UK – potassium dichromate and sodium dichromate;
- Wesco Aircraft EMEA – sodium chromate and strontium chromate;
- PPG Central Industries UK – strontium chromate and potassium hydroxyoctaoxidizincatedichromate;
- Cytec Engineered Materials – strontium chromate; and
- Elementis Chromium – chromium trioxide.

In addition, ECHA said, there are some UK-based downstream companies with authorisation applications. However, these applications or authorisation decisions will not have an impact in the EU27 “as the authorisation concerns the use of the substance only” and not the articles the companies produce. A case in point is aircraft engine manufacturer Rolls Royce. The company has an authorisation in the UK, ECHA said, but the engines it sells in Europe are not affected.

Registration exodus?

A growing number of UK companies are also looking to move REACH registrations to the EU27, according to trade associations and ECHA. The agency’s helpdesk is receiving “an increasing number” of enquiries by companies seeking advice on undertaking such transfers. So far it has not yet detected “any substantial increases” in the number of registrations transferred. It added that it will know more when it opens its ‘Brexit window’ in the REACH-IT system from 12 to 29 March. This will enable companies to make changes and transfer their REACH registrations. The window was announced as part of comprehensive instructions on Brexit

Six applicants identified by ECHA told agency they have ‘clear’ plans

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issued to companies earlier this month. Under REACH, the mechanism for companies in the UK to transfer manufacture or import and the resulting registrations is through a 'legal entity change'. With the clock ticking down to Brexit and no agreement yet on the withdrawal terms, contingency planning by companies "has very firmly moved to contingency action", the Chemical Industries Association (CIA) said. "The longer we wait for any deal, the more this will happen." And the Chemical Business Association (CBA) said companies were already moving their registrations. It named Zanos – supplier of essential oils and aroma chemicals – among those that have done so. Some SMEs are setting up new EU subsidiaries or disposing of their businesses to EU27 ownership, the CBA added. Further information is available at: [Authorisation applications](#)

Chemical Watch, 21 February 2019

<http://chemicalwatch.com>

Public consultation: phthalates used in food contact materials

2019-03-01

The European Food Safety Authority (EFSA) is launching a public consultation on the draft update of its 2005 risk assessments of five phthalates which are authorised for use in plastic food contact materials. For the updated draft opinion, EFSA's Panel on Food Contact Materials, Enzymes and Processing Aids (CEP Panel) has established a group tolerable daily intake (TDI) of 50 µg/kg bw per day for four of the substances – di-butylphthalate (DBP), butylbenzylphthalate (BBP), bis(2-ethylhexyl)phthalate (DEHP), and di-isononylphthalate (DINP). The group TDI is based on a plausible common mode of action underlying the reproductive effects of these four phthalates. For DINP, liver – rather than reproductive – toxicity was nevertheless recognised as the most critical effect. For di-isodecylphthalate (DIDP), the fifth phthalate not included in the group TDI, an individual TDI of 150 µg/kg bw per day is proposed based on liver toxicity. Combined dietary exposure to DBP, BBP, DEHP and DINP is estimated to be less than one quarter of the group TDI for all European consumers, including the most sensitive population groups, even in the worst-case scenario. For DIDP, dietary exposure is approximately 1,500-fold below the individual TDI. EFSA carried out the work in close collaboration with the European Chemicals Agency (ECHA), which recently assessed some phthalates under the REACH framework. Interested parties are invited to submit comments on the draft opinion via the [dedicated consultation page](#). The deadline for comments is 14 April

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Regulatory Update

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2019. EFSA will hold a webinar on 15 March to present the CEP Panel's approach to the draft assessment and its outcomes. Participants will have the opportunity to ask questions directly to the presenters. More information available [here](#).

EFSA, 21 February 2019

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

Plant protection products Regulation list of approved active substances updated

2019-03-01

The approval of the following active substances under the Plant protection products Regulation (EC) No. 1107/2009 has been renewed as per Commission Implementing Regulation (EU) 2019/291 of 19 February 2019:

- [Azoxystrobin](#)
- [Imazalil](#)
- [Prohexadione](#)
- [Spiroxamine](#)
- [Kresoxim-methyl](#)
- [Fluroxypyr](#)
- [Tefluthrin](#)
- [Oxyfluorfen](#)
- [1-naphthylacetamide](#)
- [1-naphthylacetic acid](#)
- [Fluazifop P](#)
- [Terbutylazine](#)
- [Acrinathrin](#)
- [Prochloraz](#)

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

Yorda's Hive, 27 February 2019

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

New active substances were added to under the Plant protection products Regulation,

Regulatory Update

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Germany AwSV List of published WGK classifications updated

2019-03-01

On 20 February 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated. The following substances were newly assigned a WGK:

- Benzeneacetic acid, 4-[1-hydroxy-4-[4-(hydroxydiphenylmethyl)-1-piperidinyl]butyl]-alpha, alpha-dimethyl-, hydrochloride (1:1): WGK 1 (slightly hazardous to water)
- Disodium fluorophosphate: WGK 2 (obviously hazardous to water)
- Pentapotassium triphosphate: WGK 1 (slightly hazardous to water)
- L-Prolinamide, N-[(phenylmethoxy)carbonyl]-L-tryptophyl-L-seryl-L-tyrosyl-O-(1,1-dimethylethyl)-D-seryl-L-leucyl-L-arginyl-N-ethyl-: WGK 1 (slightly hazardous to water)

Yorda's Hive, 27 February 2019

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

On 20 February 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated.

REACH Update

CHEMWATCH

Authorisations granted for uses of 1,2-dichloroethane (EDC)

2019-03-01

The European Commission has granted authorisations for uses of 1,2-dichloroethane (EDC) (EC 203-458-1, CAS 107-06-2) to:

ORGAPHARM, for two uses (expiry date of review period: 22 November 2024), [more](#);

Akzo Nobel Chemicals SpA, for one use (expiry date of review period: 22 November 2026), [more](#); and

Microbeads AS, for one use (expiry date of review period: 29 January 2031), [more](#).

Further information is available at: [Adopted opinions on applications for authorisation](#)

ECHA News, 27 February 2019

<http://echa.europa.eu>

New proposals and intentions to harmonise classification and labelling

2019-03-01

The proposal to harmonise the classification and labelling of exo-1,7,7-trimethylbicyclo[2.2.1]hept-2-yl acrylate (EC 227-561-6, CAS 5888-33-5) has been submitted. Further information is available at: [Registry of CLH intentions](#)

ECHA News, 27 February 2019

<http://echa.europa.eu>

PACT updated with 1 new intention for RMOA

2019-03-01

On 26 February 2019, the European Chemicals Agency's (ECHA) Public Activities Coordination Tool (PACT) was updated with the following new intention for Risk Management Option Analysis (RMOA):

- 2-benzyl-2-dimethylamino-4'-morpholinobutyrophenone

The European Commission has granted authorisations for uses of 1,2-dichloroethane to a number of companies.

REACH Update

CHEMWATCH

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

Yorda's Hive, 28 February 2019

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

Five cobalt salts proposed for restriction

2019-03-01

In response to a request by the European Commission, the European Chemicals Agency (ECHA) submitted a restriction dossier in October 2018 concerning five cobalt salts. ECHA have taken a closer look at the [proposed restriction](#) in the February edition of the newsletter .

How are cobalt salts used?

The five cobalt salts [cobalt sulphate](#), [cobalt dichloride](#), [cobalt dinitrate](#), [cobalt carbonate](#) and [cobalt di\(acetate\)](#) are produced and widely used to manufacture chemicals, catalysts, batteries, feed grade materials and biogas. The salts are also used for surface treatments and in fermentation processes. Around 30 000 tonnes of the salts are used each year in the EU. They are used in the largest amounts as transported isolated intermediates to manufacture other chemicals. These would still be subject to the proposed restriction. Over the last decade, the volumes placed on the EU market have doubled, and the rise in demand is likely to continue, as there is expected to be an increased need for rechargeable batteries, biotechnology and health applications. It is estimated that around 35 000 workers are exposed to the cobalt salts at around 20 000 industrial sites within the EU.

Why are the cobalt salts a concern?

Each of the five cobalt salts is classified as a carcinogen and reproductive toxicant (category 1B) and as a skin and respiratory sensitiser under the CLP Regulation. ECHA identified them as substances of very high concern and added them to the [Candidate List](#) for authorisation back in 2010. In 2016, ECHA's Committee for Risk Assessment (RAC) agreed that they should be considered as genotoxic carcinogens for which no safe level of exposure exists. Therefore, RAC endorsed a dose-response relationship deriving a value above which humans should not be exposed in case of occupational exposure. Exceeding this value could result in a higher lifetime cancer risk. ECHA's examination also showed that the individual excess lifetime cancer risk levels could be higher in several industrial sectors and be related to various activities involving uses of the cobalt

In response to a request by the European Commission, the European Chemicals Agency (ECHA) submitted a restriction dossier in October 2018 concerning five cobalt salts.

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salts in solid forms such as powders and granules, and activities such as electroplating, where the use of electrical currents may give rise to aerosols.

What's being proposed?

ECHA has found that the risks arising from the manufacture and use of the cobalt salts are not adequately controlled, and suggests that this needs to be addressed at the Union level. This goes against the conclusions of the registrants' chemical safety reports, where it is assumed that the salts are threshold substances and that the uses are safe. As the most appropriate measure to address the identified risks, ECHA proposes to implement a reference exposure value. Registrants should use this in their chemical safety assessments to determine suitable operational conditions and risk management measures for their uses of the cobalt salts. The value should also be communicated to all actors in the supply chain through extended safety data sheets. Under the proposed restriction, manufacturers and downstream users will have to show that they are compliant with the reference value that has been set. The proposal gives flexibility to industry in identifying and implementing adequate measures to control the risks, but they will have to monitor how effective the measures are in reducing risk to the required level. The proposal assesses the following reference values:

- 10 µg Co/m³;
- 1 µg Co/m³;
- µg Co/m³; and
- µg Co/m³.

For each of these, the individual excess lifetime cancer risk varies from 1/100 to 1/10 000, resulting in different figures for workers affected and annual costs. The overall aim is to decrease the excess cancer risk levels and the number of cancer cases arising from occupational exposure to the cobalt salts through inhalation.

Industry response to the restriction

Based on responses received from the cobalt industry during the preparation of the dossier, there are no suitable alternatives available for the current uses of the five cobalt salts. However, taking into account differences in reference exposure values and in risk management measures by industry, the available information does not indicate that production sites would have to close down due to the proposed restriction. In the proposal, ECHA considers that some companies may

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have to move to using liquid forms of cobalt salts, instead of solid forms. However, the Agency expects that industry will not implement such a switch unless the proposed restriction is put in place.

Next steps

In December 2018, the dossier passed a conformity check and is now being assessed by ECHA's scientific committees. The final opinion is expected at the end of 2019.

Cobalt salts	EC	CAS
Cobalt sulphate	233-334-2	10124-43-3; 10026-24-1
Cobalt dinitrate	233-402-1	10141-05-6; 10026-22-9
Cobalt dichloride	231-589-4	7646-79-9; 7791-13-1
Cobalt carbonate	208-169-4	513-79-1
Cobalt di(acetate)	200-755-8	71-48-7; 6147-53-1

Further information is available at:

- [Commission's request to ECHA, 12 April 2017 \[PDF\]](#)
[Cobalt salts restriction proposal](#)
[Substance information](#)
[The restriction process explained](#)

ECHA Newsletter, 21 February 2019

<http://echa.europa.eu>

EU study demonstrates grouping and read-across for nanomaterials

2019-03-01

European Commission scientists have demonstrated the use of ECHA's recommendations on grouping and read-across for nanomaterials through a study of multi-walled carbon nanotubes. The group from the Commission's Joint Research Centre (JRC) followed guidance document Recommendations for Nanomaterials Applicable to the Guidance on QSARs and Grouping. In particular, they applied grouping and read-across methods to 19 types of nanotubes to fill data gaps on genotoxicity. They also applied chemoinformatics to complement these methods. The study was led by the JRC's Karin Aschberger and published in Computational Toxicology. The aim of the study was not hazard assessment, but nevertheless the data chosen for illustrative purposes suggested that the

JRC followed ECHA guidance for evaluation of MWCNTs in relation to genotoxicity

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nanotubes used in the study were not genotoxic, the scientists said in their paper. In particular, the study found no major differences between the nanotubes that could be attributed to differences in physicochemical properties such as length, diameter or rigidity. However, these properties might have an impact on other hazard endpoints, such as carcinogenicity, the scientists added. ECHA's Read-Across Assessment Framework (RAAF) was used to characterise the uncertainties in the results. In their paper, the scientists recommended some changes to the workflow in the guidance to enhance usability and simplify reporting.

Environmental release

A paper published in *Nanotoxicology* on 7 February outlined how data on environmental release and exposure for nano-forms might be incorporated into grouping and read-across techniques. Henning Wigger and Bernard Nowack from the Swiss Federal Laboratories for Materials Science and Technology (Empa) said that the incorporation of this data is required for "complete" risk assessments. "Our results suggest that grouping and read-across concepts should include both a nano-form release potential for estimating the environmental exposure and separately consider the nano-forms in environmental risk assessments." They demonstrated their approach with data on titanium dioxide nanoparticles, carbon nanotubes and aluminium oxide nanoparticles. They found variation in environmental concentration for nano-forms of the same nanomaterial, such as single- and multi-walled carbon nanotubes. The work was funded by the EU's CALIBRATE project. Further information is available at:

- [Aschberger et al \(open access\)](#)
- [Wigger and Nowack \(subscription required\)](#)

Chemical Watch, 21 February 2019

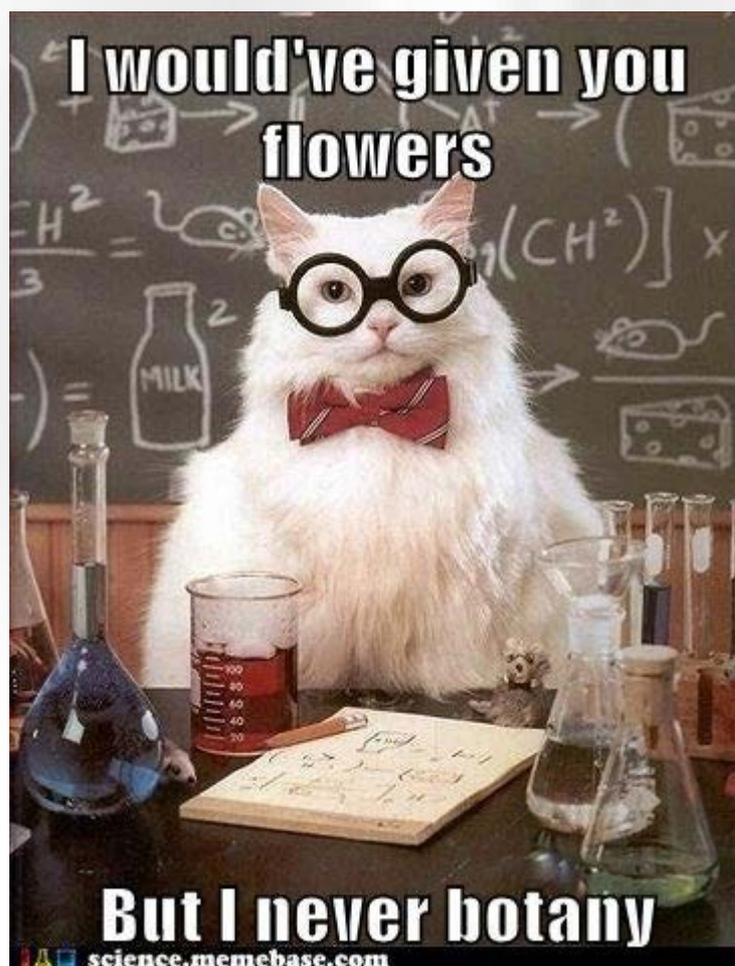
<http://chemicalwatch.com>

Janet's Corner

CHEMWATCH

Botany

2019-02-28



Hazard Alert

CHEMWATCH

Allyl Chloride

2019-02-12

Allyl chloride is the organic compound with the molecular formula C_3H_5Cl . [1] It is a colourless, light yellow or amber liquid with an unpleasant pungent odour. It is highly flammable. [2] Allyl chloride is slightly soluble in water and miscible with alcohol, chloroform, ether, and petroleum ether. In the United States, allyl chloride is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993. [3]

USES [3,4]

Allyl chloride is used as a chemical intermediate in the manufacture of pharmaceuticals, varnishes, epoxy resins, adhesives, plastics, glycerol, and insecticides. [3] Almost all of the allyl chloride produced is used to make epichlorohydrin and glycerin. In addition, it is used in the synthesis of allyl compounds such as allyl alcohol, allyl amines, allyl esters, and polyesters. [4]

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

- Possible sources of allyl chloride emissions to the ambient air are production and processing facilities.
- Occupational exposure exists for people working in the production of allyl chloride, epichlorohydrin, and synthetic glycerin.
- Individuals may be exposed to allyl chloride through breathing contaminated air or through skin contact.

Routes of Exposure [5]

The main routes of exposure to allyl chloride are:

- Inhalation;
- Skin absorption;
- Ingestion;
- Skin and/or eye contact

Allyl chloride is the organic compound with the molecular formula C_3H_5Cl .

Hazard Alert

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HEALTH EFFECTS [4]

Acute Effects

- Acute inhalation exposure to high levels of allyl chloride in humans has resulted in irritation of the eyes and respiratory passages and unconsciousness.
- Intense exposure also produces conjunctivitis, reddening of eyelids, and corneal burn.
- Acute animal tests in rats, mice, and guinea pigs, have shown allyl chloride to have moderate toxicity from oral and inhalation exposure.

Chronic Effects

- The major effects from chronic inhalation exposure to allyl chloride in humans are liver and kidney damage, which were reversible after the cessation or minimisation of exposure.
- Allyl chloride also affects the central nervous system (CNS), causing motor and sensory neurotoxic damage, and the heart and respiratory system, causing the onset of pulmonary oedema in humans.
- The Reference Concentration (RfC) for allyl chloride is 0.001 milligrams per cubic metre (mg/m^3) based on functional and histological peripheral neurotoxicity in rabbits.
- EPA has not established a Reference Dose (RfD) for allyl chloride.

Reproductive Effects/Developmental

- Limited human data were considered inadequate in providing evidence of reproductive or developmental effects in humans exposed to allyl chloride.
- One animal study involving the inhalation of allyl chloride in rabbits resulted in decreased maternal weight gain.
- Rats that were injected with allyl chloride had increased maternal heart, liver, spleen and kidney weights.

Cancer Risk

- No human cancer data were located for allyl chloride.
- Limited animal studies indicate that exposure to allyl chloride by gavage (placing the chemical experimentally in the stomachs of mice) caused an increase in the incidences of a rare forestomach tumour. Similar skin painting studies produced site specific tumours.
- Allyl chloride is an alkylating agent and structurally related to probable human carcinogens.

Hazard Alert

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- EPA considers allyl chloride to be a possible human carcinogen (cancer-causing agent) and has ranked it in EPA's Group C.
- EPA has not calculated an inhalation unit risk estimate for allyl chloride.
- The California Environmental Protection Agency (CalEPA) has established an inhalation unit risk estimate of $6.0 \times 10^{-6} (\mu\text{g}/\text{m}_3)^{-1}$ and an oral cancer slope factor of $2.1 \times 10^{-2} (\text{mg}/\text{kg}/\text{d})^{-1}$ for allyl chloride.

SAFETY [6]

First Aid Measures

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Fires & Exposure Information

- Allyl chloride is flammable.
- Auto-ignition Temperature is 485°C (905°F)

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- Closed cup flash point: -31.7°C (-25.1°F).
- Open cup flash point: -28.9°C (-20°F).
- Allyl chloride is highly flammable in presence of open flames and sparks, of heat.
- Flammable liquid, soluble or dispersed in water.
- Dry chemical powder should be used to extinguish small fires
- Alcohol foam, water spray or fog should be used to extinguish large fires

Exposure Controls & Personal Protection

Engineering Controls

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling allyl chloride:

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

Personal Protection in Case of a Large Spill:

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

Hazard Alert

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REGULATION [4,5,7]

United States

NIOSH: The National Institute for Occupational Safety & Health has established a Relative Exposure Limit (REL) for allyl chloride of:

- Time Weighted Average concentration of 1 ppm (3 mg/m³)
- Short term exposure concentration of 2 ppm (6 mg/m³)

OSHA: The Occupational Safety & Health Administration has set a Permissible Exposure Limit (PEL) for allyl chloride of: TWA 1 ppm (3 mg/m³)

ACGIH: the American Conference of Governmental Industrial Hygienists has set a time weighted average Threshold Limit Value (TLV) for allyl chloride of: 3mg/m³

Australia

Safe Work Australia: Safe Work Australia has established a time weighted average concentration of allyl chloride of:

- (3mg/m³) for an 8 hour work day
- 2ppm (6mg/m³) 15 minute short term exposure limit

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4. <http://www.epa.gov/ttn/atw/hlthef/allylchl.html>
5. <http://www.cdc.gov/niosh/npg/npgd0018.html>
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7. <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/772/Workplace-exposure-standards-airborne-contaminants.pdf>

Scientists exploit gel polymer electrolyte for high performance magnesium batteries

2019-02-13

Electronic products, electric vehicles and large-scale energy storage closely related to human life create an ever-growing demand for rechargeable batteries. Lithium-ion batteries, which are currently widely used, do not perform well in terms of energy density and safety. As for rechargeable magnesium (Mg) metal batteries developed later, the lack of Mg electrolytes capable of effectively plating/stripping Mg has impeded its practical development. Recently, a research team led by Prof. CUI Guanglei from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences exploited a novel rigid-flexible coupling gel polymer electrolyte (PTB@GF-GPE) that coupled with significantly improved overall performance. It was synthesised via an in-situ crosslinking reaction between magnesium borohydride and hydroxyl-terminated polytetrahydrofuran. Over the past few decades, although progress has been made in exploiting liquid Mg electrolytes capable of reversible Mg deposition, liquid electrolytes still pose the problem of being volatile and flammable. Compared with liquid electrolytes, polymer electrolytes have several advantages, including: no internal short circuit; no electrolyte leakage; ease of fabrication; and flexibility of structure. This gel polymer electrolyte exhibits reversible Mg plating/stripping performance, high Mg-ion conductivity, and a remarkable Mg-ion transfer number. The Mg batteries assembled with this gel polymer electrolyte not only work well at a wide temperature range (-20 to 60 °C) but also display unprecedented improvements in safety issues without suffering from internal short-circuit failure even after a cutting test. This in situ crosslinking approach toward exploiting the Mg-polymer electrolyte provides a promising strategy for achieving large-scale application of Mg-metal batteries.

Science Alert, 4 February 2019

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

Magnetic teeth hold promise for materials and energy

2019-02-13

A mollusc with teeth that can grind down rock may hold the key to making next generation abrasion-resistant materials and nanoscale materials for energy. The mollusc, called a gumboot chiton, scrapes algae off ocean rocks using a specialised set of teeth made from the magnetic mineral

Researchers have exploited a gel polymer electrolyte to create high performance magnesium batteries.

Gossip

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magnetite. The teeth have the maximum hardness and stiffness of any known biomineral. Although magnetite is a geologic mineral commonly found in the earth's crust, only a few animals are known to produce it, and little is known about how they make it. A better understanding of the biomineralisation process, combined with a thorough understanding of chiton tooth architecture and mechanics, could help scientists not only improve wear-resistant coatings and tooling, but also help grow nanoscale materials for energy and water-based applications. Now, for the first time, a team led by Michiko Nemoto, an assistant professor of agriculture at Okayama University and David Kisailus, a professor of materials science and chemical engineering in UC Riverside's Bourns College of Engineering, has discovered a piece of the genetic puzzle that allows the chiton to produce magnetite nanomaterials. Chitons have several dozen rows of teeth attached to a ribbon-like structure. Each tooth is composed of a mineralised cusp, or pointed area, and base supporting the mineralised cusp. Magnetite is deposited only in the cusp region. As teeth wear down, they are replaced by new teeth, so teeth in varying stages of formation are always present. Rather than looking for specific genes, the researchers examined the transcriptome, the set of all RNA molecules in the teeth, to see what substances the genes were actually expressing. DNA contains the blueprints, but RNA is what "transcribes" the blueprints and helps carry them out. They found that the 20 most abundant RNA transcripts in the developing teeth region contain ferritin, a protein that stores iron and releases it in a controlled fashion, while those in the mineralised teeth region include proteins of mitochondria that may provide the energy required to transform the raw materials into magnetite. On the fully mineralised cusp the researchers also identified 22 proteins that included a new protein they called "radular teeth matrix protein1." The new protein might interact with other substances present on the teeth to produce iron oxide. The findings could help scientists solve an urgent problem for next generation electronics-- nanoscale energy sources to power them. Knowing how to control the growth of biological magnetite, whose magnetic fields have electrical applications, could help scientists create nanoscale energy materials.

EurekaAlert, 1 February 2019

<http://www.eurekaalert.org>

Researchers report that they've engineered a capsule that, once ingested, pokes a tiny hole in the lining of the stomach to deliver insulin or other so-called biologic medicines that can't be taken by mouth.

Gossip

CHEMWATCH

Pills armed with tiny needles could inject insulin, other important meds directly into the stomach

2019-02-13

In 1922, a 14-year-old boy in Toronto, Canada, received the first injection of insulin to treat life-threatening diabetes. The same year, researchers began to test oral insulin formulations, hoping to relieve people with diabetes of daily shots. That effort failed, as have dozens of similar attempts. But realistic hope for oral insulin may finally be here. Researchers report in this issue of *Science* that they've engineered a capsule that, once ingested, pokes a tiny hole in the lining of the stomach to deliver insulin or other so-called biologic medicines that can't be taken by mouth. Other research groups and companies have also made recent progress in delivering once-injected medicines orally, raising hopes that for many patients, painful injections may become a thing of the past. "This field is really at an exciting stage," says Samir Mitragotri, a biomedical engineer at Harvard University. "I think it's going to completely transform how patients take drugs." Optimism has surged before. But the harsh environment of the stomach and intestine has thwarted many attempts to deliver complex, delicate drugs by mouth. "There are a lot of dead bodies in this space," says Mir Imran, CEO of Rani Therapeutics, a San Jose, California, company working to commercialise oral biologics. "People keep trying because it's such an important area." Unlike traditional pharmaceuticals, which are small molecules that the digestive tract easily absorbs, biologics are typically proteins: large, unwieldy molecules produced by microbes or other living cells. Biologics, which include seven of the 10 top selling drugs by sales in the United States, are more likely to hit a target molecule in the body without side effects because of their large size. But they're also more liable to degrade in the stomach or be blocked from entering the bloodstream by thick layers of mucus and tightly packed epithelial cells that line the stomach and gut. Getting past these defences "is honestly one of the biggest challenges and holy grails in drug development," says Carlo Giovanni Traverso, a gastroenterologist and bioengineer at Harvard Medical School in Boston and the Massachusetts Institute of Technology (MIT) in Cambridge. In recent years, pharmaceutical companies have encapsulated several small proteins, called peptides, in chemicals called permeation enhancers that promote absorption by the small intestine. But most permeation enhancers allow less than 1% of peptides to cross into the bloodstream. Mitragotri's team at Harvard is trying to improve on the approach. He and his colleagues reported in 2018 in the *Proceedings of the National Academy of Sciences* that they encapsulated insulin in a liquid that has the consistency of honey. When the capsule dissolves

Gossip

CHEMWATCH

in the small intestine, the viscous liquid gloms onto the lining and briefly disrupts the lipid membrane of the cells on the surface, allowing the insulin or other drugs to be absorbed. Recently, Mitragotri and his colleagues formed a biotech company to commercialise the technology. Similarly, Oramed Pharmaceuticals, a Jerusalem-based biotech company, is testing insulin capsules containing components that shield the protein from digestive acids and enzymes and promote its absorption in the small intestine. Traverso, with Robert Langer, a drug delivery expert at MIT, and their colleagues turned instead to engineering. They developed a hollow pill with one flattened end. The shape, along with the capsule's centre of mass near the flat end, ensures that the pill rights itself in the stomach, with its flat surface facing the stomach lining. Just inside the pill's flat end, which is made of sugar, sits a tiny tensed spring topped with a needle made from solid insulin. In the moist stomach, the sugar begins to dissolve, eventually allowing the spring to poke the insulin needle into the outer stomach layer, where it dissolves and enters the bloodstream. In rats and pigs, the pill could deliver essentially the same insulin levels into the blood as a subcutaneous injection. And histology studies showed no signs of lasting damage from daily internal needle punctures. "It's a very smart design," says Edith Mathiowitz, a biomedical engineer at Brown University. However, she adds, the team needs to ensure that creating even tiny perforations in the stomach doesn't pose long-term health problems for patients, and that undesirable proteins or bacteria can't wiggle their way in alongside the insulin. Rani Therapeutics is banking on similar ingenuity. Instead of a spring, Rani's pills use a chemical reaction set off by the small intestine's pH to generate carbon dioxide that inflates a tiny balloon. The balloon presses a needle packed with the drug through the intestinal lining. Although it has not published papers on its pills, Rani has completed more than 100 animal studies. In an initial safety study of pills without needles or drugs, people reported no awareness of the device's balloon as it inflated, Imran says. This year, he adds, the company plans its first clinical trials of pills loaded with octreotide, a biologic that treats acromegaly, a dangerous enlargement of the face, hands, and feet. It could take years for any of these technologies to complete safety and efficacy studies. But because the engineered pills are intended to work with existing drugs, they could spread rapidly if approved, realising a century-old goal—and the hopes of countless patients.

Science, 7 February 2019

<http://sciencemag.org/>

Researchers have scanned a chemical database containing some 170 million molecules—100 times larger than previous databases—to identify a handful of new compounds that could serve as starting points for novel antibiotics and antipsychotic medications.

Gossip

CHEMWATCH

Vast chemical library could yield trove of new medicines

2019-02-13

It's the drug discovery equivalent of looking for a book on Amazon versus at your local library. Researchers have scanned a chemical database containing some 170 million molecules—100 times larger than previous databases—to identify a handful of new compounds that could serve as starting points for novel antibiotics and antipsychotic medications. The resource is expected to grow to more than 1 billion molecules over the next year, making the technique increasingly powerful as time goes by. "For the [drug discovery] industry as a whole, this is a great thing," says Jeff Blaney, who directs computational chemistry research at the biotech company Genentech in South San Francisco, California, and was not involved in the work. Sampling a huge variety of molecules against particular disease targets means higher chances that one will prove to be a successful starting point for drug discovery, he says. "More shots on goal will help." To scan possible drug molecules, researchers use "virtual screening." The approach evaluates how well a potential molecule might bind to a protein or other biological target in the body. Scientists use software called molecular docking programs, among others, to probe thousands of orientations a molecule might take as it binds its target. The binders are then ranked, and the tightest ones synthesised so they can be tested experimentally. The problem is that the number of possible druglike molecules—10⁶³—is impossibly vast, similar to the number of atoms in the universe. Rather than focus on the majority of those molecules that will likely never be made, researchers have begun to team up with chemical supply companies that can make vast libraries of compounds on demand. One such company, Enamine, in Kyiv, for example, starts with 70,000 small chemical building blocks that they can connect to one another using 130 well-known chemical reactions. That's allowed the company to assemble a database of more than 700 million compounds that it can make to order in small amounts—a library that's already about 100 times the size of most libraries scanned by pharmaceutical companies. In 2016, researchers led by Brian Shoichet, a computational chemist at the University of California, San Francisco, scanned Enamine's database, which at the time included 3 million molecules. They pinpointed a potential opioid painkiller that likely would lack the addictive properties of today's opioid drugs. A biotech company called Epiodyne is now working to turn this lead, into a medicine. Now, Shoichet and his colleagues have screened 170 million of Enamine's compounds against two targets: a focal point of some antibiotics, known as AmpC β -lactamase, and the D4 dopamine receptor protein, a target for antipsychotic medications.

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Because of the sheer size of the database, Shoichet says, "We were terrified as to how we were going to find the interesting molecules, spotting the signal in the noise." So, the researchers decided to first test whether their software could spot the hundreds of already known inhibitors of these targets amid a library of 170 million molecules. Using a cluster of 2000 computer processors, they found that the top-scoring molecules included the known inhibitors and their structural cousins. Then, Enamine scientists synthesised hundreds of high-scoring compounds that hadn't previously been identified. Of these, 24% were found to bind tightly with the D4 receptor and 11% against AmpC β -lactamase, far higher hit rates than other virtual screening programs, the researchers report this week in *Nature*. The higher hit rates increase the odds that one will eventually lead to a medicine, Shoichet explains. The performance is likely due to the fact that the large database is sampling families of chemical structures that have never been scanned before. "I feel like a door has finally popped open," for the field of virtual screening, he says. In addition to aiding drug discovery, the ever-growing database will also help myriad basic biology researchers, says Laurie Nadler, a program officer for the National Institute of Mental Health in Bethesda, Maryland, which helped sponsor the research. As researchers discover novel protein targets in the body related to different diseases, they'll be able to scan the publicly available database for compounds that could hit those targets, she says. "The large size of the virtual library and the fact it is publicly available will have a large impact on pharmacology and drug discovery."

Science, 7 February 2019

<http://sciencemag.org/>

Acoustic waves can monitor stiffness of living cells

2019-02-13

MIT engineers have devised a new, non-invasive way to measure the stiffness of living cells using acoustic waves. Their technique allows them to monitor single cells over several generations and investigate how stiffness changes as cells go through the cell division cycle. This approach could also be used to study other biological phenomena such as programmed cell death or metastasis, the researchers say. "Non-invasive monitoring of single-cell mechanical properties could be useful for studying many different types of cellular processes," says Scott Manalis, the Andrew and Erna Viterbi Professor in the MIT departments of Biological Engineering and Mechanical Engineering, a member of MIT's Koch Institute for Integrative Cancer Research, and the senior author of

Technique sheds light on cells' health and development; may be useful for precision medicine

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the study. It could also be useful for analysing how patients' tumour cells respond to certain drugs, potentially helping doctors choose the best drugs for individual patients, the researchers say. Joon Ho Kang, an MIT graduate student, is the first author of the paper, which appears in the Feb. 11 issue of *Nature Methods*. Other authors include postdocs Teemu Miettinen and Georgios Katsikis, graduate student Lynna Chen, visiting scholar Selim Olcum, and professor of chemical engineering Patrick Doyle.

A unique measurement

The new measurement technique makes use of a technology that Manalis' lab previously developed to measure the mass of cells. This device, known as the suspended microchannel resonator (SMR), can measure the mass of cells as they flow through a tiny fluid-filled cantilever that vibrates inside a vacuum cavity. As cells flow through the channel, their mass slightly alters the cantilever's vibration frequency, and the mass of the cell can be calculated from that change in frequency. In the new study, the researchers discovered that they could also measure changes in stiffness to the cell -- specifically, a cell structure called the cortex that lies just below the cell membrane. The cortex, which helps to determine the shape of a cell, is composed mainly of actin filaments. Contraction and relaxation of these filaments often occurs during processes such as cell division, metastasis, and programmed cell death, leading to changes in the stiffness of the cortex. Over the past couple of years, Manalis and his students realised that the vibration of the cantilever also creates an acoustic wave that can be used to measure the stiffness of the particle or cell flowing through the device. As a particle flows through the channel, it interacts with the acoustic waves, changing the overall energy balance. This alters the vibration of the cantilever, by an amount that varies depending on stiffness of the cell or particle. This allows the researchers to calculate the stiffness of the cell by measuring how much the vibration changes. The researchers confirmed that their technique is accurate by measuring hydrogel particles of known stiffnesses, created in Doyle's lab, and measuring them as they flowed through the device. The acoustic waves used to generate these measurements disturb the cell by only about 15 nanometres, much less than the displacement produced by most existing techniques for measuring mechanical properties.

Cell division

The MIT team showed that they could use this technique to measure stiffness of a single cell repeatedly for over 20 hours as they flowed back and forth through the SMR device. During this time, they were able to

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monitor stiffness through two or more cell division cycles. They found that as cells enter mitosis, stiffness decreases, which the researchers believe is due to the swelling that occurs when the cells prepare to divide. By imaging the cells, they confirmed that the cell cortex becomes thinner as the cell swells. The researchers also found that cell stiffness dynamically changes just before it divides. Actin accumulates at the equatorial region, making the cell stiffer, while the polar regions become more relaxed as actins are temporarily depleted. "We can use our way of measuring stiffness to look at the dynamics of actin in a label-free, non-invasive way," Kang says. The researchers plan to start using this technique to measure the stiffness of even smaller particles, such as viruses, and to explore whether that measurement might be correlated with a virus's infectivity. "Measuring stiffness of submicron particles with meaningful throughput is currently not possible with existing approaches," Manalis says. Such a capability could help researchers who are working on developing weakened viruses that could be tested as possible vaccines. This kind of measurement could also be used to help characterise tiny particles such as those used for drug delivery. Another possible application is combining the stiffness measurement with the mass and growth rate measurements that Manalis' lab has been developing as a possible predictor of how individual cancer patients will respond to particular drugs. "When it comes to assays for precision medicine, measuring multiple functional properties from the same cell could help to make tests more predictive," Manalis says. The research was funded by the Koch Institute Support Grant from the National Cancer Institute (NCI), the Ludwig Centre for Molecular Oncology, the NCI Cancer Systems Biology Consortium, and the Institute for Collaborative Biotechnologies through the U.S. Army Research Office.

Science Daily, 11 February 2019

<http://www.sciencedaily.com>

Why glass recycling in the US is broken

2019-02-13

Glass can be recycled endlessly by crushing, blending, and melting it together with sand and other starting materials. Doing so benefits manufacturers, the environment, and consumers. Yet each year only one-third of the roughly 10 million metric tons of glass that Americans throw away is recycled. The rest ends up in landfills. In contrast, some European countries recycle more than 90% of their waste glass. US glass-industry trade groups are working with manufacturers and government agencies to boost the numbers. These efforts begin with a top-to-bottom

Americans turn old bottles into new ones at much lower rates than people in other countries. A recent analysis explains why

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analysis of glass recycling to identify areas for improvement. Americans dispose of some 10 million metric tons of glass annually. Most of it ends up in the trash. Only about one-third gets recycled. That's not because of some intrinsic materials or chemical property that makes glass difficult to recycle. "Glass is 100% recyclable," says Robert Weisenburger Lipetz, executive director of the Glass Manufacturing Industry Council (GMIC), a non-profit trade association. "It has an unlimited life and can be melted and recycled endlessly to make new glass products with no loss in quality," he adds. And the US's roughly 33% glass-recycling rate, which pales compared with the 90% recycling rate in Switzerland, Germany, and other European countries, is not the result of a lack of technical know-how. "Recycled glass is nearly always part of the recipe for making new glass," says Joseph J. Cattaneo, executive director of the Glass Packaging Institute (GPI), a trade association representing the North American glass-container industry. The glass industry regularly mixes cullet—a granular material made by crushing bottles and jars usually collected from recycling programs—with sand, limestone, and other raw materials to produce the molten glass needed to manufacture new bottles and jars. Manufacturers agree that using cullet benefits glassmakers, the environment, and consumers. And national surveys show that Americans overwhelmingly favour glass recycling and deem it to be important. Yet as the percentage of glass recycled in Spain and the UK, for example, has doubled and tripled in the past 25 years, respectively, the numbers in the US have barely budged. "There are many reasons why more glass isn't recycled in the US," says David Rue, an engineer at the Gas Technology Institute near Chicago who recently completed a yearlong study of US glass recycling as a consultant for GMIC. The US glass-recycling shortfall comes down to the interplay between the quality and availability of cullet and the economics of making glass, he explains. And, he says, the recycling rate discrepancies between the US and other countries result mainly from differences in government policy and consumer education and habits. By understanding these hurdles to glass recycling, GMIC, GPI, and other industry groups hope to boost the rate in the US.

Cullet's Many Benefits

When studying glass recycling, the first thing that becomes clear is that cullet is extremely useful. It provides many benefits to glass manufacturing. First, cullet allows glass manufacturers to reduce their need for raw materials. The key ingredients used in glassmaking are sand (mainly silica, SiO_2), sodium carbonate (also known as soda ash, Na_2CO_3), and limestone (CaCO_3). One kilogram of cullet replaces 1.2 kg of raw

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materials, according to James V. Nordmeyer, vice president of global sustainability at Owens-Illinois, a major manufacturer of glass bottles and containers. Cullet also helps manufacturers save on energy costs. For every 10% of cullet included in the glassmaking feed mixture, the energy needed to keep the furnace at temperatures high enough to generate molten glass falls by nearly 3%, Rue says. Running furnaces at lower temperatures extends furnace lives and reduces operating costs and, as a result, the price of the final glass products. According to Pennsylvania State University's John C. Mauro, adding cullet to the feed mixture also improves the quality of glass products. Mauro is a materials scientist and glass specialist who spent nearly 20 years at the glassmaker Corning. He explains that melting cullet doesn't release carbon dioxide or other gases that can form unwanted trapped bubbles in the glass. Also, using cullet limits the deposition of crystals of unmelted starting materials, as well as the formation of streaks and optical imperfections due to incomplete mixing of those materials. Finally, cullet has a significant environmental benefit. Adding the material to the mix reduces greenhouse gas emissions during manufacturing, Nordmeyer points out. When the carbonates from limestone melt with the other materials, they release CO₂. Using 10% cullet in the manufacturing feed lowers emissions of CO₂ by roughly 5%. Basically, for every 6 metric tons of cullet used in manufacturing, glassmakers can cut 1 metric ton of CO₂ emissions.

The Problems with US Recycling

Despite cullet's long list of benefits, glassmakers are limited by what recycled material is available to them at a manageable cost. Getting cullet in a clean, furnace-ready form generally requires a lot of processing. And depending on how the US recycles, that processing is done relatively inefficiently compared with what happens in Europe. US municipalities manage residential recycling primarily via single-stream curbside collection. Single-stream means residents use their recycling bins to comingle glass with aluminium and steel cans, various types of plastic, newsprint, junk mail, cardboard, and other paper products. People also tend to throw in a lot of things that shouldn't go in the bin, such as plastic bags, batteries, light bulbs, soiled food containers, used napkins, and what Nordmeyer and others call "wish-cycling" materials. One example is a popular single-serve coffee-brewing product that features a plastic cup and foil lid. Well-meaning people think since those components can be recycled, they're justified in tossing the whole thing—dirty filter, wet coffee grounds, and all—into a recycling bin. Garbage, like those products, contaminates all the recyclables in the bin, Nordmeyer says. "You have to

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sort through all the trash to get to the material that manufacturers want and are willing to pay for." That sorting happens via a combined manual-plus-automated multistep process at a materials recovery facility. About 400 such facilities operate in the US, according to Rue. To start the sorting process, front-end loaders dump huge piles of single-stream recyclables onto conveyor belts. Trained operators manually remove scrap metal, textiles, hoses, and other materials that never belonged in the recycling bin and can damage sorting equipment. Next, automated separators called star screens, together with powerful air jets, remove cardboard and paper, while magnets pull out iron-containing materials. After several more separation steps, a device known as a glass-breaking screen removes most of the glass from the single-stream load so it can be sent to cullet suppliers, who clean it and make it furnace ready for glass manufacturers. Multistream recycling, which is a far less common approach in the US, is simpler on the processing end. In these programs, consumers separate glass from other recyclables, depositing them in glass-only collection bins. This type of collection requires a high level of consumer education and is considerably more expensive than single-stream collection. But glass from multistream collection is much cleaner than what comes out of the single-stream supply. Multistream glass typically bypasses materials recovery facilities and goes directly to cullet processors. Because of the difference in the quality of glass from the two streams, just 40% of glass from single-stream collection ends up being recycled into new products, compared with about 90% of glass from multistream systems. So, one key factor that stands in the way of the US glass industry's ability to boost recycling numbers is the limited availability of satisfactory cullet produced via single-stream processing. "Large quantities of high-quality cullet are essential to further increase the recycled content in our products," says Frank O'Brien-Bernini, vice president and chief sustainability officer for Owens Corning, a major fiberglass manufacturer. Compared with multistream recycling, "single stream is an inherently inefficient and expensive recycling method," Lipetz says. But most municipalities in the US stick with single stream because the collection costs are lower than those with multistream systems. To switch to multistream systems, these municipalities would need to introduce taxes or fees to meet the higher collection and handling costs. And most municipalities are reluctant to do so. But even if the US shifted more to multistream collection, there are other economic factors standing in the way of increasing glass-recycling rates to European levels. One significant difference between the US and European nations is size. Distances in the US between a materials recovery facility and a cullet supplier, or a cullet supplier and a buyer tend to be greater. Transporting glass waste and cullet is costly because of their

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weight, and those costs can be a deal breaker for some glassmakers and can prevent would-be cullet suppliers from opening processing facilities. For example, in the US, some materials recovery facilities do not recover any glass from their single streams because there are no nearby buyers to make it worthwhile, according to Rue. Another factor affecting the costs of recovering cullet from glass waste is that cullet specifications vary from one manufacturer to another depending on the intended application. If a supplier needs to process multiple types of cullet to meet various manufacturers' needs, their production costs increase. In addition, common soda-lime cullet made from bottles and jars isn't compatible with window glass and the type of fiberglass used in reinforced composites, further limiting recycling opportunities. These costs and limited supplies of quality cullet continue to stand in the way of US manufacturers increasing their use of recycled material. "We are a ready and willing customer for increased output from consumer recycling," O'Brien-Bernini says, but the economics of producing cullet aren't always favourable for would-be suppliers.

Recycling Locally

Most of the efforts to boost glass-recycling rates in the US have been state and local affairs. For example, 10 states have passed so-called bottle bills that require consumers to pay deposits on beverage bottles. The idea is consumers will be more likely to recycle the bottles to get back their deposits. The laws are having the intended effect. In states with those laws, 98% of bottles are recycled, compared with the national average of roughly 33%. A few communities have set up bottle-redemption centres and instituted separate curbside glass collection. California passed legislation requiring that insulation glass used in the state contain 30% cullet and that container glass be made with at least 35% cullet. And North Carolina enacted an on-premise recycling bill that requires alcoholic-beverage-permit holders to recycle bottles and cans. But sometimes solving a problem requires grabbing the bull by the horns. That's what Boulevard Brewing did about 10 years ago. The Kansas City, Missouri-based beer maker bemoaned the absence of an active local recycling program, which meant that millions of its empty beer bottles were ending up in landfills. There was hardly any recycling in the community because there was no local cullet processor. And there was no processor because locals didn't recycle much. "It was a classic chicken-and-egg problem," says Michelle Goth. So, Boulevard helped launch Ripple Glass, a cullet supplier for which Goth serves as general manager. Following a European model, Ripple placed 60 large glass-only collection bins across Kansas City and

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nearby locations and has been successful in spreading the word about the benefits of recycling. The effort has driven locals to regularly fill the bins with clean, high-quality recyclable glass. The majority of Ripple's cullet feeds the local Owens Corning fiberglass plant, and a portion goes to a beer-bottle maker in Tulsa, Oklahoma, that supplies Boulevard and other companies with new bottles. Will efforts like these local and state ones bump up recycling rates across the US? Probably not quickly, experts say. It's unlikely in the foreseeable future that the economics of recycling in communities throughout the US will change to favour multistream recycling collection, as is commonly practiced in Europe, Lipetz says. Another factor helping Europe maintain high recycling rates is high landfill costs, which make trashing glass in those countries more expensive than recycling. And, unlike in the US, recycling is legislated in many European countries nationally, not locally. Finally, in Europe, "recycling is the cultural and social norm," Nordmeyer says. Europeans have been recycling for many years, and children there are educated about it at school and at home starting at a young age. "In the US, we tend to teach to the test, and recycling isn't on the test," he says. "But it should be."

Chemical & Engineering News, 11 February 2019

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

Liquid film self-heals and sticks to metals

2019-02-13

Scratching an oil film with a hard object exposes the underlying surface, but only briefly. The oil flows quickly and re-establishes a continuous film. The flow properties make oil films self-healing, which is desirable for protective coatings on metals, for example. But the same property prevents the film from remaining in place. Increasing the viscosity can pin the film to the metal surface, but it slows the healing process. With a nod to Shakespeare, Jiaxing Huang of Northwestern University sums up the dilemma this way: To flow or not to flow, that is question. His group just came up with a solution that enables oil films to do both—flow and not flow (Research 2019, DOI: 10.1155/2019/3517816). By using a spray-drying procedure, Huang, Alane Tarianna O. Lim, and co-workers formed a network of interconnected graphene microcapsules with 10 nm thick walls and 250 nm voids. Tests show that adding a small amount of the microcapsules (5 wt %) to silicone oil increases the oil's viscosity by a factor of 1,000, causing films to remain on metal surfaces. Scratching the films ruptures the capsules, allowing oil to flow quickly but briefly as the network repairs itself and halts the flow. In contrast to some polymers

Network of graphene microcapsules stabilises oil films, enabling coating to repair itself repeatedly

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that exhibit self-healing only on a microscopic scale, the water- and acid-resistant liquid film heals macroscopic damage, even after scratching the same spot 200 times.

Chemical & Engineering News, 10 February 2019

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

Smartphone Sensors Keep AN Eye On Crumbling Bridges

2019-02-13

New technology that uses smartphone-based sensors to monitor crumbling roads and aging bridges could potentially save millions of lives, researchers say. A recent report by the American Society of Civil Engineers gave infrastructure systems in the United States a D+ rating nationwide on an A to F scale. Based on estimations, researchers say the failure of civil infrastructure systems could cause a 1 percent reduction in the US GDP. In 2017, that number was \$200 billion. Scientists say they can use various sensors on smartphones such as a gyroscope, an accelerometer to measure speed, and camera, or tiny external sensors such as an infrared sensor, to determine the specific makeup and deterioration of a road's surface in real-time. Scientists won't collect all the data, however. Once someone plugs the sensor into a smartphone, anyone can easily transmit the data wirelessly to a database while on a road. The researchers hope the large amount of crowdsourced data will allow for better informed decisions about the health of roads and bridges. "Many of the existing methods to monitor our civil infrastructure systems have technical issues and are not user-centred," says Amir Alavi, an assistant professor of civil and environmental engineering at the University of Missouri College of Engineering. "People are looking for smart, cost effective, scalable, and user-centred approaches. With current advances in technology, people can help monitor or detect problems using their own devices, and smartphone technology allows us to do that with civil infrastructure."

"Assessing roads, bridges, and airfields with affordable sensors, such as those found in smartphones, really works," says Bill Buttlar, chair of flexible pavement technology. "With a smartphone, we can stitch together many inexpensive measurements to accurately assess things like the roughness or deterioration of a road surface. "In a recent project sponsored by the Missouri Department of Transportation, we also showed that it can accurately assess the condition of airport runways and taxiways." The study appears in Future Generation Computer Systems. The Missouri Department of Transportation funded the work. The content is solely the

New technology that uses smartphone-based sensors to monitor crumbling roads and aging bridges could potentially save millions of lives, researchers say.

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responsibility of the authors and does not necessarily represent the official views of the funding agencies.

Futurity, 11 February 2019

<http://www.futurity.org>

Marine scientists find toxic bacteria on microplastics retrieved from tropical waters

2019-02-13

A field survey conducted by a team of marine scientists from the National University of Singapore (NUS) has uncovered toxic bacteria living on the surfaces of microplastics, which are pieces of plastic smaller than 5 millimetres in size, collected from the coastal areas of Singapore. These bacteria are capable of causing coral bleaching, and triggering wound infections in humans. The NUS team also discovered a diversity of bacteria, including useful organisms -- such as those that can degrade marine pollutants like hydrocarbons -- in the plastic waste. Dr Sandric Leong, research lead and Senior Research Fellow at the NUS Tropical Marine Science Institute (TMSI), said, "Microplastics form a large proportion of plastic pollution in marine environments. Marine organisms may consume bits of microplastics unintentionally, and this could lead to the accumulation and subsequent transfer of marine pathogens in the food chain. Hence, understanding the distribution of microplastics and identifying the organisms attached to them are crucial steps in managing the plastic pollution on a national and global scale." This study is the first to examine the bacterial community on microplastics found in tropical coastal regions. The results were first published in the journal *Science of the Total Environment* on 17 November 2018.

Small plastics, big problem

There are currently more than 150 million tons of plastics in the ocean. Microplastics, in particular, pose an evident problem as many marine organisms, such as shrimps, mussels and fish, often mistake these tiny plastics for food. Compared to microplastics on land, microplastics in aquatic ecosystems take a much longer time to degrade due to the presence of salt and a lower temperature in the ocean. As a result, they present a habitable environment for marine biota to colonise. Yet, despite their prevalence, the distribution of microplastics along the coasts of tropical regions is not well studied. Dr Leong and Ms Emily Curren, a PhD student from TMSI and the Department of Biological Sciences at the

A team of marine scientists had uncovered toxic bacteria living on the surfaces of microplastics collected from the coastal areas of Singapore. These bacteria are capable of causing coral bleaching, and triggering wound infections in humans.

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NUS Faculty of Science, embarked on a six-month study to examine the bacterial communities on microplastics collected from coastal regions of Singapore.

Diverse bacterial communities living on microplastics

Between April and July 2018, the research team collected and examined 275 pieces of microplastics from three beaches along the coastline of Singapore, namely Lazarus Island, Sembawang Beach, and Changi Beach. By using high-throughput sequencing techniques, the team discovered more than 400 different types of bacteria across all the microplastics collected. Species of the bacteria *Erythrobacter*, which is capable of degrading plastic, and bacteria species *Pseudomonas veronii*, which have been used to clean up oil spills, were found. "Given the predicted increase in plastic waste contamination in oceans, the discovery of such bacteria provides important nature-friendly alternatives for the mitigation of plastic pollution and toxic pollutants such as hydrocarbons," said Ms Curren. In contrast, the bacteria *Photobacterium rosenbergii*, often associated with coral bleaching and disease, was also identified. The proliferation and accumulation of this bacterium could be detrimental to the coral reefs in Singapore as the southern strait is characterised by multiple coral communities with great biodiversity that are under conservation. The research team also uncovered species of marine *Vibrio*, a major cause of wound infections in humans, and species of *Arcobacter*, known to cause gastroenteritis in humans. "As the microplastics we studied were collected from locations easily accessible to the public and in areas widely used for recreation, the identification of potentially pathogenic bacteria would be important in preventing the spread of diseases," elaborated Ms Curren.

Future studies to identify bacteria sources

This study demonstrates that microplastics are a rich habitat that is home to many types of bacteria, including toxic ones. The NUS research team will conduct further studies to examine the origin of the bacteria species transported by the microplastics. This will allow the identification of non-native species that threaten the existing biodiversity, and provide insights on managing the urgent issue of marine plastic pollution.

Science Daily, 11 February 2019

<http://www.sciencedaily.com>

Chemists appear to have finished the quest for a cheaper, efficient alternative to the iridium compounds while also solving the decades-long problem with the colour blue. Surprisingly, copper does it all.

Scientists find a cheaper way to light up OLED screens

2019-02-13

USC Dornsife chemists have found a cheaper way to light up smartphone and TV screens, which could save manufacturers and consumers money without affecting visual quality. Copper is the answer, according to their study, published Feb. 8 in the journal *Science*. "The current technology that is in every Samsung Galaxy phone, high-end Apple iPhone and LG TV relies on iridium compounds for the colours and light on OLED screens," says Mark E. Thompson, a chemist at USC Dornsife College of Letters, Arts and Sciences and the Ray. R. Irani Chairman of the Occidental Petroleum Corporation Chair in Chemistry. "We have been using iridium because you get a highly efficient light emission, but it is the rarest naturally-occurring element on Earth," Thompson says. "One of our challenges has been to come up with an alternative that is more abundant." Prior attempts to generate a copper-based OLED failed. The copper complexes in those studies had weaker structures. The molecules were unstable, with shorter lifetimes than the iridium compounds.

Iridium's link to dinosaurs

Copper definitely solves the problem of availability since it is a plentiful metal worldwide. Iridium, on the other hand, is found in only a few places -- mostly South Africa and parts of Asia. The most widely-accepted hypothesis that explains iridium's scarcity and its origins is that it travelled here on a meteor -- the same one that wiped out the dinosaurs 65 million years ago. Unless another meteor like that hits Earth, iridium will continue to dwindle in supply. Demand for it is only increasing as smartphones, TVs and other devices that feature OLED screens gain popularity. OLEDs have come to replace LED LCD screens. In an OLED screen, each pixel generates light, while in the LCD screens, pixels are illuminated by an LED backlight.

Blue chemistry

Besides its scarcity, iridium has another drawback for OLED technology that has perplexed chemists for more than two decades: weaker molecules for generating blue light. When the molecules from the iridium compounds are excited, they generate two of the OLED screen's primary colours -- red and green -- very efficiently, quickly and in devices that give very long operational lifetimes, says Thompson, whose lab engineered the iridium-based red and green molecules. The third requisite colour, blue, has been the bane of OLED technology because blue emissive OLEDs have a short lifetime. Thompson explained that the bonds within the blue molecules tend to break down. Blue molecules also require

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more electricity than the green and red molecules to energise them. Since blue is among the primary colours for OLED, its poor performance can affect a range of colours that you see on a screen that contain any blue. Thompson's team may have solved that, too, with their new copper complex -- a more rigid molecular complex than the prior, failed types of copper compounds, which were weaker. The new compound's rate of light emission also matches iridium's, so the energy is converted efficiently into light and colour, the chemists found. "Our paper lays out the basic design rules for obtaining iridium-like emission efficiencies out of copper, with colours ranging from blue to green and yellow," said Rasha Hamze, the study's lead author and a USC Dornsife alumna who recently began working for Universal Display Corporation. "Achieving efficient blue emission out of copper compounds opens up entirely new possibilities for tackling the problem of short lifetimes in blue devices." The team at USC has submitted a patent application for their copper compound. Thompson says that next, he wants to see if these copper compounds could also lead to the creation of more energy-efficient lighting.

Science Daily, 7 February 2019

<http://www.sciencedaily.com>

Nanoparticles need some space to transfer energy

2019-02-13

Quickly transferring energy from one place to another—without loss—could fundamentally change solar panels and computers. Materials made from long chains of tiny particles, or nanoparticles, show promise for such energy transfer. However, going even smaller than nano-dimensions hasn't worked quite as planned. Researchers suspected the particles needed to be close to each other to transfer energy efficiently. Now, a team has shown that the particles can be too close. Specifically, the energy transfer drops dramatically when the particles in the chain are less than a nanometre apart. For those who want to build better solar panels or computer chips, this study answers a basic question about the physics of a promising design. That design might use a chemical structure that contains chains of nanoparticles. The study explains why the energy transfer efficiency drops. That is, it shows how quantum mechanical effects alter the transfers. Also, it shows that complex calculations, using a real-time density functional tight binding approach, shed mechanistic insight to analysing energy transfers based on interparticle distance. Scientists wanted to understand the quantum-mechanical effects that can result in qualitatively different and sometimes completely opposite results. In

Quickly transferring energy from one place to another—without loss—could fundamentally change solar panels and computers.

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particular, they wanted to understand the reason behind efficiencies and inefficiencies of energy transfer in long nanoparticle chains. Such chains hold promise in diverse fields, including energy harvesting. Conventional calculation approaches were not up to the task. Researchers used real-time density functional tight binding to characterize energy transfer as a function of interparticle distance. In contrast to classical electrodynamics methods, their quantum dynamical calculations show a drop in efficiency for spacings of subnanometre lengths within the nanoparticle chain. The drop in efficiency is due to quantum mechanical tunnelling that dramatically changes the electronic couplings between nanoparticles. Thus, the team showed that considering nanoparticle spacing as well as larger quantum-mechanical effects is vital to accurately calculate energy transfer mechanisms.

Phys.org, 11 February 2019

<http://phys.org>

How sunlight energises electrons to break nitrogen and form ammonia

2019-02-13

Alfalfa, peanut, and soybean plants take in nitrogen and hydrogen from the air and turn it into ammonia, which helps the plants grow. The reactions to produce ammonia are driven by natural catalysts, which lower the energy necessary to make the reactions happen. Inspired by these catalysts, scientists uncovered how sunlight can kick start the functionalisation of nitrogen molecules. They built a complex that harvests sunlight. The added energy causes electrons to shift and makes the nitrogen molecules receptive to bonding with hydrogen and, thus, on the pathway to making ammonia. Worldwide, farmers need nitrogen-rich fertiliser. Because of this need, researchers are striving to unlock highly efficient production of nitrogen-containing ammonia. Here, researchers explain how a complex's binding of nitrogen changes as it's excited by sunlight. The resulting insights could lead to catalysts that efficiently move electrons to produce ammonia using less energy. Also, the insights could lead to catalysts that use renewable sources of hydrogen, rather than natural gas. Ammonia in fertiliser is vital to growing crops. Producing ammonia for fertilizer is an energy-demanding process that requires natural gas to provide the needed hydrogen. Scientists have long struggled to synthesise a metal-based catalyst that can efficiently produce ammonia with a minimal carbon footprint because nitrogen is notoriously nonreactive. The goal is to develop energy-efficient processes that pump

Inspired by natural catalysts in alfalfa, peanut, and soybean plants, scientists uncovered how sunlight can kick start the functionalisation of nitrogen molecules.

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out ammonia using hydrogen from renewable sources. Now, researchers propose how a molybdenum-based compound can effectively use energy from sunlight to make nitrogen reactive and susceptible to forming the necessary bonds to create ammonia. The team prepared a complex that grasps a nitrogen molecule (dinitrogen) and holds it between two molybdenum atoms. Strand-like molecules attached to the metal centre absorb light, specifically in the near infrared to ultraviolet range. In a fraction of a second, as light energises the complex—and thereby supplies energy to convert nitrogen to ammonia—the light-absorbing molecules vibrate in synch with the nitrogen. This quantum-mechanical connection is hypothesised to lower the reaction barrier, thus making the nonreactive molecule receptive to bonding with hydrogen. Knowing how the electrons move and interact with the complex's structure could help scientists translate this work to catalytic nitrogen functionalisation.

Phys.org, 11 February 2019

<http://phys.org>

Next-generation optics in just two minutes of cooking time

2019-02-13

Optical circuits are set to revolutionise the performance of many devices. Not only are they 10-100 times faster than electronic circuits, but they also consume a lot less power. Within these circuits, light waves are controlled by extremely thin surfaces called metasurfaces that concentrate the waves and guide them as needed. The metasurfaces contain regularly spaced nanoparticles that can modulate electromagnetic waves over sub-micrometre wavelength scales. Metasurfaces could enable engineers to make flexible photonic circuits and ultra-thin optics for a host of applications, ranging from flexible tablet computers to solar panels with enhanced light-absorption characteristics. They could also be used to create flexible sensors to be placed directly on a patient's skin, for example, in order to measure things like pulse and blood pressure or to detect specific chemical compounds. The catch is that creating metasurfaces using the conventional method, lithography, is a fastidious, several-hour-long process that must be done in a clean room. But EPFL engineers from the Laboratory of Photonic Materials and Fibre Devices (FIMAP) have now developed a simple method for making them in just a few minutes at low temperatures - or sometimes even at room temperature - with no need for a clean room. The EPFL's School of Engineering method produces dielectric

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glass metasurfaces that can be either rigid or flexible. The results of their research appear in Nature Nanotechnology.

Turning a weakness into a strength

The new method employs a natural process already used in fluid mechanics: dewetting. This occurs when a thin film of material is deposited on a substrate and then heated. The heat causes the film to retract and break apart into tiny nanoparticles. "Dewetting is seen as a problem in manufacturing - but we decided to use it to our advantage," says Fabien Sorin, the study's lead author and the head of FIMAP. With their method, the engineers were able to create dielectric glass metasurfaces - rather than metallic metasurfaces - for the first time. The advantage of dielectric metasurfaces is that they absorb very little light and have a high refractive index, making it possible to effectively modulate the light that propagates through them. To construct these metasurfaces, the engineers first created a substrate textured with the desired architecture. Then they deposited a material - in this case, chalcogenide glass - in thin films just tens of nanometres thick. The substrate was subsequently heated for a couple of minutes until the glass became more fluid and nanoparticles began to form in the sizes and positions dictated by the substrate's texture. The engineers' method is so efficient that it can produce highly sophisticated metasurfaces with several levels of nanoparticles or with arrays of nanoparticles spaced 10 nm apart. That makes the metasurfaces highly sensitive to changes in ambient conditions - such as to detect the presence of even very low concentrations of bioparticles. "This is the first time dewetting has been used to create glass metasurfaces. The advantage is that our metasurfaces are smooth and regular, and can be easily produced on large surfaces and flexible substrates," says Sorin.

EurekAlert, 11 February 2019

<http://www.eurekalert.org>

New device simplifies measurement of fluoride contamination in water

2019-02-13

Adding fluoride to water has been common practice in a number of countries, including the US, Australia, Brazil, Malaysia, India and Vietnam. In low concentrations (below 1.5 mg/L) can help prevent tooth decay and even strengthen bones, but going above that can have the opposite effect, causing serious dental and bone disease, especially in children

Seeking to address fluoride contamination in drinking water, chemical engineers have developed a portable and user-friendly device that can measure fluoride concentration accurately and reliably.

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and developing fetuses. To keep things in check, the WHO has set 1.5 mg/L as the maximum limit for fluoride in drinking water. "To determine whether drinking water is safe we need to detect fluoride in water at the level of parts-per-million (ppm)," says Kyriakos Stylianou at the Laboratory of molecular simulation at EPFL Valais Wallis. "Around 1-1.5 ppm is good for teeth, but in many countries the water sources have concentrations above 2 ppm can cause serious health issues." But measuring fluoride at such low concentrations with sufficient accuracy is expensive and requires a well-equipped chemical lab. Because of this, fluoride contamination in water affects a number of developing countries today, and even parts of developed countries. Led by Stylianou, a team of scientists have now built a device that can accurately measure fluoride concentrations using only a few drops of water -- even with low-level contamination -- resulting in a simple change in colour brightness. Published in the Journal of the American Chemical Society (JACS), the device is named SION-105, is portable, considerably cheaper than current methods, and can be used on-site by virtually anyone. The key to the device is the design of a novel material that the scientists synthesised (and after which the device is named). The material belongs to the family of "metal-organic frameworks" (MOFs), compounds made up of a metal ion (or a cluster of metal ions) connected to organic ligands, thus forming one-, two-, or three-dimensional structures. Because of their structural versatility, MOFs can be used in an ever-growing list of applications, e.g. separating petrochemicals, detoxing water, and getting hydrogen or even gold out of it. SION-105 is luminescent by default, but darkens when it encounters fluoride ions. "Add a few droplets of water and by monitoring the colour change of the MOF one can say whether it is safe to drink the water or not," explains Mish Ebrahim, the paper's first author. "This can now be done on-site, without any chemical expertise." The researchers used the device to determine the fluoride content in different groundwater samples from Vietnam, the United Arab Emirates, and Saudi Arabia. The data corresponded very well when compared to measurements made using ion chromatography, a standard method for measuring fluoride concentration in water. "This comparison showcases the performance and reliability of SION-105, which, coupled with the portability and ease-of-use of the device, make it a very user-friendly solution for water sampling in remote areas where frequent fluoride concentration monitoring is paramount," says Stylianou.

Stable, colour-changing compound shows potential for electronics, sensors and gas storage.

Science Daily, 11 February 2019

<http://www.sciencedaily.com>

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Turning a porous material's colour on and off with acid

2019-02-13

A research team led by Hokkaido University in Japan have constructed a porous material that is very stable and changes colour when exposed to acid vapor. This is believed to be the first reported instance of a hydrogen-bonded organic framework changing colour in response to acid. The findings are described in the *Journal of the American Chemical Society*. Chemists are working to develop porous materials made from organic molecules that have structures with well-defined openings that can separate and store gasses. Such materials can also be used in electronic devices and sensors. In particular, researchers are investigating how to make materials using molecules bonded together by hydrogen bonds, known as hydrogen-bonding organic frameworks (HOFs). HOFs are high-crystalline, flexible, and regenerable, which make them attractive candidates. But they can also be fragile and crumble apart. Ichiro Hisaki, a chemist at Hokkaido University's Research Institute for Electronic Science, along with Anderrazzak Douhal, a photophysicist at University of Castilla La Mancha, Spain and their colleagues developed a hexagon-shaped framework, called CPHATN-1a, and found a surprising attribute -- it changes colour from yellow to reddish-brown when exposed to acid solution or acid vapor. When the acid solution or vapor is removed, either through heating or ambient evaporation, the HOF reverted back to its original yellow colour. The researchers determined that the colour change is caused by protons adding onto nitrogen atoms within the compound, which shifts the spectrum of light absorbed. Additional tests revealed that CPHATN-1a is extremely stable, maintaining its porous structure at temperatures to at least 633 Kelvin (359 C). The robust material also stood up to heated, common organic solvents, including chloroform, ethanol and water, retaining its structure rather than dissolving or breaking apart. "The present results would open a door to develop new porous materials with stimuli responsiveness," the researchers note. "These could be used in the creation of new sensors or towards the visualization of minute chemical reactions."

Science Daily, 8 February 2019

<http://www.sciencedaily.com>

The aim of the study is to allow cheap and sustainable energy harvesting solutions which can be deployed and left to generate energy with little or no need for maintenance.

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Researchers develop flags that generate energy from wind and sun

2019-02-13

Scientists have created flags that can generate electrical energy using wind and solar power. The novel wind and solar energy-harvesting flags have been developed using flexible piezoelectric strips and flexible photovoltaic cells. Piezoelectric strips allow the flag to generate power through movement, whilst the photovoltaics is the best-known method of harnessing electric power by using solar cells. The study, conducted by researchers at The University of Manchester, is the most advanced of its kind to date and the first to simultaneously harvest wind and solar energies using inverted flags. The research has been published in the journal *Applied Energy*. The newly developed energy harvesting flags are capable of powering remote sensors and small-scale portable electronics which can be used for environmental sensing such as to monitor pollution, sound levels and heat for example. The aim of the study is to allow cheap and sustainable energy harvesting solutions which can be deployed and left to generate energy with little or no need for maintenance. The strategy is known as "deploy-and-forget" and this is the anticipated for model that so-called smart cities will adopt when using remote sensors. Jorge Silva-Leon, from Manchester's School of Mechanical, Aerospace & Civil Engineering and lead-author of the study, says: "Under the action of the wind, the flags we built bend from side to side in a repetitive fashion, also known as Limit-Cycle Oscillations. This makes them perfectly suited for uniform power generation from the deformation of piezoelectric materials. Simultaneously, the solar panels bring a double benefit: they act as a destabilising mass which triggers the onset of flapping motions at lower wind speeds, and of course are able to generate electricity from the ambient light. Dr Andrea Cioncolini, co-author of the study, added: "Wind and solar energies typically have intermittenencies that tend to compensate each other. The sun does not usually shine during stormy conditions, whereas calm days with little wind are usually associated with shiny sun. This makes wind and solar energies particularly well suited for simultaneous harvesting, with a view at compensating their intermittency." The team used and developed unique research techniques such as fast video-imaging and object tracking with advanced data-analysis to prove their flags worked. The developed harvesters were tested in wind speeds varying from 0 m/s (calm) to about 26 m/s (storm/whole gale) and 1.8 kLux constant light exposure, simulating a wide range of environmental conditions. Under these operation conditions, total power outputs of up to 3-4 milli-Watts were generated. Dr Mostafa Nabawy, co-author of the

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study, says: "Our piezo/solar inverted flags were capable of generating sufficient power for a range of low power sensors and electronics that operate in the micro-Watt to milli-Watt power range within a number of potential practical applications in avionics, land and sea remote locations, and smart cities. We hope to develop the concept further in order to support more power-demanding applications such as an eco-energy generating charging-station for mobile devices." Dr Alistair Revell, co-author of work, highlights current and future research directions saying: "We are currently making use of a novel computational framework for modelling and simulation developed at The University of Manchester, building on a long tradition of Computational Fluid Dynamics in the group. The use of computers to model fluid-structure interactions is increasingly referred to as virtual engineering, and plays a key part in device development by reducing the number of models which need to be physically manufactured and tested."

EurekaAlert, 11 February 2019

<http://www.eurekaalert.org>

Quantum strangeness gives rise to new electronics

2019-02-13

Noting the startling advances in semiconductor technology, Intel co-founder Gordon Moore proposed that the number of transistors on a chip will double each year, an observation that has been born out since he made the claim in 1965. Still, it's unlikely Moore could have foreseen the extent of the electronics revolution currently underway. Today, a new breed of devices, bearing unique properties, is being developed. As ultra-miniaturization continues apace, researchers have begun to explore the intersection of physical and chemical properties occurring at the molecular scale. Advances in this fast-paced domain could improve devices for data storage and information processing and aid in the development of molecular switches, among other innovations. Nongjian "NJ" Tao and his collaborators recently described a series of studies into electrical conductance through single molecules. Creating electronics at this infinitesimal scale presents many challenges. In the world of the ultra-tiny, the peculiar properties of the quantum world hold sway. Here, electrons flowing as current behave like waves and are subject to a phenomenon known as quantum interference. The ability to manipulate this quantum phenomenon could help open the door to new nanoelectronic devices with unusual properties. "We are interested in not only measuring quantum phenomena in single molecules, but

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also controlling them. This allows us to understand the basic charge transport in molecular systems and study new device functions," Tao says. Tao is the director of the Biodesign Centre for Bioelectronics and Biosensors. In research appearing in the journal *Nature Materials*, Tao and colleagues from Japan, China and the UK outline experiments in which a single organic molecule is suspended between a pair of electrodes as a current is passed through the tiny structure. The researchers explore the charge transport properties through the molecules. They demonstrated that a ghostly wavelike property of electrons--known as quantum interference-- can be precisely modulated in two different configurations of the molecule, known as Para and Meta. It turns out that quantum interference effects can cause substantial variation in the conductance properties of molecule-scale devices. By controlling the quantum interference, the group showed that electrical conductance of a single molecule can be fine-tuned over two orders of magnitude. Precisely and continuously controlling quantum interference is seen as a key ingredient in the future development of wide-ranging molecular-scale electronics, operating at high speed and low power. Such single-molecule devices could potentially act as transistors, wires, rectifiers, switches or logic gates and may find their way into futuristic applications including superconducting quantum interference devices (SQUID), quantum cryptography, and quantum computing. For the current study, the molecules--ring-shaped hydrocarbons that can appear in different configurations--were used, as they are among the simplest and most versatile candidates for modelling the behaviour of molecular electronics and are ideal for observing quantum interference effects at the nanoscale. In order to probe the way charge moves through a single molecule, so-called break junction measurements were made. The tests involve the use of a scanning tunnelling microscope or STM. The molecule under study is poised between a gold substrate and gold tip of the STM device. The tip of the STM is repeatedly brought in and out of contact with the molecule, breaking and reforming the junction while the current passes through each terminal. Thousands of conductance versus distance traces were recorded, with the particular molecular properties of the two molecules used for the experiments altering the electron flow through the junction. Molecules in the 'Para' configuration showed higher conductance values than molecules of the 'Meta' form, indicating constructive vs destructive quantum interference in the molecules. Using a technique known as electrochemical gating, the researchers were able to continuously control the conductance over two orders of magnitude. In the past, altering quantum interference properties required modifications to the charge-carrying molecule used for the device. The current study marks

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the first occasion of conductance regulation in a single molecule. As the authors note, conductance at the molecular scale is sensitively affected by quantum interference involving the electron orbitals of the molecule. Specifically, interference between the highest occupied molecular orbital or HOMO and lowest unoccupied molecular orbital or LUMO appears to be the dominant determinant of conductance in single molecules. Using an electrochemical gate voltage, quantum interference in the molecules could be delicately tuned. The researchers were able to demonstrate good agreement between theoretical calculations and experimental results, indicating that the HOMO and LUMO contributions to the conductance were additive for Para molecules, resulting in constructive interference, and subtractive for Meta, leading to destructive interference, much as waves in water can combine to form a larger wave or cancel one another out, depending on their phase. While previous theoretical calculations of charge transport through single molecules had been carried out, experimental verification has had to wait for a number of advances in nanotechnology, scanning probe microscopy, and methods to form electrically functional connections of molecules to metal surfaces. Now, with the ability to subtly alter conductance through the manipulation of quantum interference, the field of molecular electronics is open to a broad range of innovations.

EurekaAlert, 11 February 2019

<http://www.eurekaalert.org>

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Heat waves, food insecurity due to climate change may weaken immune systems

2019-02-13

Heat waves can reduce the body's immune response to flu, according to new research in mice at the University of Tokyo. The results have implications for how climate change may affect the future of vaccinations and nutrition. Climate change is predicted to reduce crop yields and nutritional value, as well as widen the ranges of disease-spreading insects. However, the effects of heat waves on immunity to influenza had not been studied before. University of Tokyo Associate Professor Takeshi Ichinohe and third-year doctoral student Miyu Moriyama investigated how high temperatures affect mice infected with influenza virus.

Flu in a heat wave

"Flu is a winter-season disease. I think this is why no one else has studied how high temperatures affect flu," said Ichinohe. The influenza virus survives better in dry, cold air, so it usually infects more people in winter. However, Ichinohe is interested in how the body responds after infection. The researchers housed healthy, young adult female mice at either refrigerator-cold temperature (4 degrees Celsius or 39.2 degrees Fahrenheit), room temperature (22 C or 71.6 F), or heat wave temperature (36 C or 96.8 F). When infected with flu, the immune systems of mice in hot rooms did not respond effectively. Most affected by the high heat condition was a critical step between the immune system recognising influenza virus and mounting a specific, adaptive response. Otherwise, heat-exposed mice had no other significant changes to their immune system: They had normal reactions to flu vaccines injected under the skin. Moreover, bacteria living in the gut, which are increasingly becoming regarded as important for health, remained normal in the mice living in hot rooms.

Temperature and nutrition

Notably, mice exposed to high temperature ate less and lost 10 percent of their body weight within 24 hours of moving to the hot rooms. Their weight stabilised by day two and then mice were infected by breathing in live flu virus on their eighth day of exposure to heat. Mice living in heat wave temperatures could mount a normal immune response if researchers provided supplemental nutrition before and after infection. Researchers gave mice either glucose (sugar) or short-chain fatty acids, chemicals naturally produced by intestinal bacteria. In experiments at room

Researchers at the University of Tokyo are studying the effects of climate change and nutrition on the immune system. Their recent research on influenza is published in the Proceedings of the National Academy of Sciences

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temperature, researchers surgically connected mice so that body fluids moved freely between underfed and normally fed mice, both infected with influenza. The fluids from normally fed mice prompted the immune systems of underfed mice to respond normally to the flu virus. "Does the immune system not respond to influenza virus maybe because the heat changes gene expression? Or maybe because the mice don't have enough nutrients? We need to do more experiments to understand these details," said Moriyama. The results may shed light on the unfortunate experience of getting sick again while recovering from another illness. "People often lose their appetite when they feel sick. If someone stops eating long enough to develop a nutritional deficit, that may weaken the immune system and increase the likelihood of getting sick again," said Ichinohe.

Future of infection

An important area of future study will be the effect of high temperature on different types of vaccinations. Flu vaccines injected into the upper arm use inactivated virus, but vaccines sprayed into the nose use live attenuated (weakened) virus. "The route of delivery and the type of virus both may change how the immune system responds in high temperatures," said Moriyama. Until more research can clarify what these findings may mean for humans, Ichinohe and Moriyama cautiously recommend a proactive approach to public health. "Perhaps vaccines and nutritional supplements could be given simultaneously to communities in food-insecure areas. Clinical management of emerging infectious diseases, including influenza, Zika, and Ebola, may require nutritional supplements in addition to standard antiviral therapies," said Ichinohe. The researchers are planning future projects to better understand the effects of temperature and nutrition on the immune system, including experiments with obese mice, chemical inhibitors of cell death, and different humidity levels.

Medical Xpress, 4 February 2019

<http://medicalxpress.com>

Planes Don't Make 'Chemtrails', But They Can Create Something Else in Their Wake

2019-02-13

While living under the path of aircraft is usually no cause for concern, you might want to keep an umbrella handy: a new study shows planes flying over patches of rain or snow can boost precipitation levels by as

A new study shows planes flying over patches of rain or snow can boost precipitation levels by as much as 14 times.

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much as 14 times. This strange meteorological phenomenon is all down to the design of the wings on modern aircraft, which create changes in air pressure and pockets of freezing water droplets that have an impact lower down in the atmosphere. Conditions need to be exactly right for it to happen though – it's most often seen over airports, where planes are intersecting layers of cloud as they come down to land, adding an extra rain or snow flurry as they go. "The intensified precipitation basically follows the track of an airplane above the cloud," says one of the researchers, Dmitri Moisseev from the University of Helsinki in Finland. "It could extend over hundreds of kilometres, but the cross-section would be maybe 100 metres (330 ft). So, it's a very narrow, long feature." Moisseev and his colleagues first noticed something strange in radar data patterns: narrow streams of heavy rain or snow. Significantly, most of these streams were pointing towards Helsinki-Vantaa airport. The researchers then ploughed through nearly 11 years of weather data, and found 17 cases of these strange patterns, from the end of 2008 to the start of 2018. Cross-checking this data with flight pattern records and local observations, they found a link to passing aircraft. For an explanation, the team turned to something we already know about: hole punch clouds. These clouds form when zones of low pressure around aircraft wings and propellers allow air to expand and cool – this knocks the temperature down significantly around the plane as it flies through. For the effect to happen, the cloud layer needs to be supercooled: water doesn't always freeze at 0 degrees Celsius (32 degrees Fahrenheit). If it's pure enough and doesn't have a surface to latch on to, it can actually go as low as $-40\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$) before solidifying. It's these very cold-water droplets that aircraft can have an effect on. As the temperature drops and ice crystals begin to form, it triggers a chain reaction in a widening circle around the passing aircraft. These ice crystals then drop into lower clouds that are already spitting out rain or snow, which leads to a boost in water or ice discharge. "Falling ice crystals from upper clouds could seed lower clouds and therefore increase rain or snowfall intensity through the process called snowflake aggregation," explains the team of researchers. The idea that this could trigger more rainfall or snowfall lower down has been suggested before. What's new in this study is more detailed documentation of it happening, and the precise conditions required – as well as evidence that it starts happening at a higher level than we thought. In fact, it looks as though the phenomenon can occur even outside of clouds, higher up in the atmosphere, as long as there are enough ultra-cool water droplets to freeze. That would make this effect slightly different to the one we see in hole punch clouds. All of this advanced physics might eventually lead to improved weather forecasts around airports – forecasts that are crucial

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for getting planes safely taking off and landing on time. In particular, the researchers say, this study should help in the “nowcast” that airports rely on: that’s weather conditions predicted over the next two to six hours. It’s also something we’re going to need to investigate even as planes switch to alternative fuel sources. “The interesting thing about this feature is that it is caused by aircraft, but it is not caused by pollution,” says Moisseev. “Even if there would be absolutely ecological airplanes, which don’t have any combustion, no fuel or anything, it would still happen.” The research has been published in the *Journal of Geophysical Research: Atmospheres*.

Science Alert, 5 February 2019

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

For The First Time, Scientists Turn Human Stem Cells Into Insulin-Producing Cells

2019-02-13

Although treatment of type 1 diabetes has come a long way since it was first described in Ancient Egypt, insulin injections and finger pricks are a daily part of life for many diabetics. But researchers have just made a breakthrough that might one day make these technologies obsolete, by transforming human stem cells into functional insulin-producing cells (also known as beta cells) – at least in mice. “We can now generate insulin-producing cells that look and act a lot like the pancreatic beta cells you and I have in our bodies,” explains one of the team, microphysiologist Matthias Hebrok from the University of California San Francisco (UCSF). “This is a critical step towards our goal of creating cells that could be transplanted into patients with diabetes.” Type 1 diabetes is characterised by a loss of insulin due to the immune system destroying cells in the pancreas - hence, type 1 diabetics need to introduce their own insulin manually. Although this is a pretty good system, it’s not perfect. People with the condition can live mostly normal lives, but they do have an increased risk of problems such as kidney failure, heart disease, and stroke. There are other methods of managing type 1 diabetes, such as introducing new beta cells or swapping out the damaged pancreas for a new one, but both of these options have limited availability, as the new cells or organs need to be taken from organ donors. To get around the donor problem, researchers including the team at UCSF has been working on nudging stem cells into becoming fully functional pancreatic beta cells for the last few years, but there have been some issues in getting them all the way there. “The cells we and others were producing were getting stuck at an immature stage where they weren’t able to respond adequately to blood

Researchers have made a breakthrough that might one day allow human stem cells to be transformed into functional insulin-producing cells

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glucose and secrete insulin properly," Hebrok said. "It has been a major bottleneck for the field." But when the team looked at the way these cells develop in the pancreas, they struck gold. Here, the cells separate from the rest of the pancreas and arrange themselves into protrusions called pancreatic islets. The team investigated this process in a petri dish, artificially separating the pancreatic stem cells to reorganise them into the islet-like clusters they naturally form in the body. This arrangement allowed the pancreatic stem cells to mature and function much like regular insulin-producing cells do. And even better, when these islets were transplanted into healthy mice, they found that the cells produced insulin in response to blood sugar levels in a matter of days. Of course, as with any mouse study, we can't get too excited just yet - there's still quite a bit of work to be done before this becomes a helpful treatment for humans. For one, if you were to introduce new pancreatic stem cells into a type 1 diabetic, it's likely that the immune system would still destroy them. This means that anyone undergoing this treatment would have to be on immune suppressors for the rest of their life, an issue that also comes with organ and cell donations. But this latest step is still a huge step forward, and the team is now working on solving these other problems. For example, they are investigating whether CRISPR can be used to change the stem cells enough that they could fly under the radar of the overactive immune system. "We're finally able to move forward on a number of different fronts that were previously closed to us," Hebrok added. "The possibilities seem endless." The research has been published in Nature Cell Biology.

Science Alert, 4 February 2019

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

More bad phthalate news: Early life exposure linked to decreased motor skills

2019-02-13

Kids exposed to phthalates prenatally and as 3-year-olds have decreased motor skills later in their childhood, according to a new study. The study is concerning because phthalates are so widely used. Previous research found that phthalate exposure is linked to decreased motor skills for infants and toddlers but this is the first study to suggest these problems may persist as the children age. "As lower scores on measures of motor development have been associated with more problems in cognitive, socioemotional functioning and behaviour, the findings of this study have implications related to overall child development," the researchers

Kids exposed to phthalates prenatally and as 3-year-olds have decreased motor skills later in their childhood, according to a new study.

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wrote in the study published online in *Environmental Research*. "This is a crucial public health challenge given the globally ubiquitous nature of phthalates," they added. Phthalates—used widely in vinyl flooring, cosmetics, detergents, lubricants and food packages—are endocrine disrupting chemicals, meaning they alter the proper functioning of people's hormones. They've also recently been found in diapers and women's sanitary pads. The chemicals have been linked to multiple health problems, including birth and reproduction problems, diseases, impaired brain development, diabetes and cancer. Just last week researcher linked phthalates to reduced lung function as well. Researchers looked at the prenatal phthalate exposure of 209 children, as well as exposure when they were 3 years old. They found girls that were exposed to higher levels of phthalates while in the womb had decreased motor skills at age 11; and boys exposed to higher levels of phthalates at age 3 had decreased motor skills at age 11. The women and children are from an ongoing study cohort in New York City; the mothers are all either Black or Dominican. Senior author of the paper Pam Factor-Litvak, a professor and epidemiologist at the Columbia University Medical Centre, told EHN the motor skills tests included "fine motor skill" tests such as whether or not kids can put a peg in a peg board or coordinating with their upper limbs, and a focus on larger muscle groups, with tests such as walking on a balance beam or running. She said the importance of motor skills is often overlooked in research. "Motor function is so important and it has a lot to do with cognitive and social development as well," she said. The researchers didn't look at how the phthalates might be impacting motor skills; however, previous studies have shown the chemicals to alter proper function of the thyroid, which is crucial to proper motor skills and brain development. The chemicals could also disrupt vital neuron activity in the kids' brains, which are involved in motor skills' development. Factor-Litvak said it's not entirely understood why they saw different impacts on boys and girls but that phthalates are known to disrupt sex steroid hormones such as oestradiol and androgens, which could impact boys' and girls' brains in different ways. The study alone doesn't prove the compounds are causing these impacts, however, it adds to mounting evidence. Multiple previous studies have found a link between phthalate exposure and decreased motor skills. Those studies focused on newborns to children around preschool age. This study suggests that these prenatal and early life exposures may continue to impact children well into their childhood years—and maybe beyond,

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Factor-Litvak said. "That's what we worry about – the downstream impacts after childhood. [Those impacts] haven't been studied," she said.

Environmental Health News, 11 February 2019

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

A New Mass Extinction Has Started, And Its First Victims Are Disappearing Fast

2019-02-13

In recent years, scientists have been warning us about the disappearance of a type of creature we think we wouldn't miss much - but the dramatic fall of insect numbers across the world has been driven into sharp focus by a new report which warns of a "catastrophic" collapse of natural ecosystems. A newly published review of 73 reports on insect decline around the world has found that over 40 percent of insect species are threatened with extinction. For some comparison, that rate of local species extinction is eight times faster than we're seeing in vertebrates such as mammals, birds, and reptiles. Insects play a crucial role in the animal food chain, as well as pollinating plants and recycling nutrients in the environment. If they go, they take other animals with them, and that's a major problem in maintaining a world we can all live in. "Our work reveals dramatic rates of decline that may lead to the extinction of 40 percent of the world's insect species over the next few decades," write study authors Francisco Sánchez-Bayo from The University of Sydney and Kris Wyckhuys from the University of Queensland. According to the researchers, the main driver of this massive decline is habitat loss due to our increasingly intensive agriculture practices, including heavy pesticide use. Drawing data from 73 historical reports, mostly from Europe and North America, the pair found that the "biodiversity of insects is threatened worldwide." "Unless we change our ways of producing food, insects as a whole will go down the path of extinction in a few decades," write the researchers. "The repercussions this will have for the planet's ecosystems are catastrophic to say the least." As land is farmed more aggressively, the researchers note, insect habitats have been obliterated – with bare fields replacing areas of vegetation. The team also points out increased urbanisation, climate change, pollution and a rise in invasive species that prey on insects as additional contributing factors. When it comes to the contribution of climate change in particular, the authors note that warming temperatures in temperate regions might benefit some species, but in tropical regions insects have little tolerance for increased heat, and would thus be hit harder. "Global warming has increased the populations of certain

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butterflies in northern Europe, expanded their geographical distribution and caused altitudinal shifts of certain species, yet populations of half of the world's insects are declining counter to that trend," they write. The analysis revealed that specialist butterflies and moths are some of the most affected populations, with animals that feed on insects likely to be the first to be impacted – birds, reptiles, amphibians, and fish. While there are gaps in the research in terms of figures for some kinds of insects, the study authors say there's no reason to believe any insect species are bucking the overall trend. A small number of species may end up thriving though, as their insect enemies disappear, particularly bugs like cockroaches and houseflies. "The evidence all points in the same direction," biologist and conservationist Dave Goulson from the University of Sussex in the UK, who wasn't involved in the research, told Damian Carrington at The Guardian. "It should be of huge concern to all of us, for insects are at the heart of every food web, they pollinate the large majority of plant species, keep the soil healthy, recycle nutrients, control pests, and much more. Love them or loathe them, we humans cannot survive without insects." We've heard warnings about this before: a report published last year found insect numbers plummeting in several pockets of the world. Now it's clear that the issue is a widespread one that needs addressing urgently. In fact, this alarming development is part of what scientists are calling a modern mass extinction: a substantial drop in species numbers across all kinds of animals and plants, the size of which we've only seen five times in the last four billion years. Whereas previous mass extinctions have been caused by ice ages and volcanic eruptions, this one is going to be largely down to human activity, scientists say – and we can include insects in that assessment. Unless we start seriously limiting our impact on the planet, the future looks very bleak indeed. The researchers are calling for a massive change to our agricultural practices before it's too late. The research has been published Biological Conservation.

Science Alert, 12 February 2019

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

Beer before wine and you'll feel fine? No you won't says new study

2019-02-13

Plenty of us have been there: waking up after a night out with a thumping headache, feeling sick and swearing never to touch alcohol again. If only there were a way to prevent these terrible hangovers. It isn't uncommon for us to mix our drinks, maybe a beer in the pub before moving on to

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wine. Folk wisdom has something to say about this: “Beer before wine and you’ll feel fine; wine before beer and you’ll feel queer.” This idea is very prevalent and versions of it occur in many languages. In my native country, Germany, for example, we say: “Wein auf Bier, das rat’ ich Dir—Bier auf Wein, das lass’ sein.” This translates as: “Wine on beer, I’ll advise you to drink beer on wine.” But it turns out that there is no truth to these sayings, as we’ve just demonstrated in our latest study, published in the *American Journal of Clinical Nutrition*. In some ways, hangovers are a mystery. We know they’re caused by drinking too much alcohol and that symptoms occur when blood alcohol concentrations drop back to zero. We know all too well what these symptoms are: headache, nausea, tiredness. We think their underlying causes include dehydration, the response of our immune system, and disturbances of our metabolism and hormones. Hangovers cause us to be very unproductive. At the weekend, this might just mean lying in, feeling sorry for ourselves, watching TV instead of venturing out. But during the week it can mean missing work or study or performing poorly. Little wonder, then, that we reach for anything that might reduce – or even prevent – a hangover. And with no effective hangover remedies, instead we rely on folk wisdom. Sometimes folk wisdom turns out to be wise, other times less so.

German volunteers

To look at whether the sayings around drinking were true and whether we could reduce our hangovers by drinking beer before wine, we carried out a study in Germany with 90 healthy volunteers, aged between 19 and 40. We split our volunteers into three groups. The first group drank around two-and-a-half pints of lager followed by four large glasses of white wine. The second group drank the same amounts of alcohol, but in reverse order. Subjects in the third, control group consumed either only lager or only wine. A week later, we switched participants in study groups one and two to the opposite drinking order. Control group subjects who drank only beer the first time around received only wine on the second study day, and vice versa. This way, the groups were not only compared with each other, but each participant was their own control, too. While they were drinking, we asked our volunteers about their well-being at regular intervals and asked them to judge how drunk they felt on a scale of zero to ten at the end of each study day. Before going to bed at the study site, we gave all our participants an amount of drinking water, tailored to their body weight. We kept all our volunteers under medical supervision overnight. When they woke up, we asked our participants about their hangover and gave them a score from 0-56 on the so-called Acute Hangover Scale (yes,

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this exists) based on factors including thirst, fatigue, headache, dizziness, nausea, stomach ache, increased heart rate and loss of appetite.

Not the answer you were hoping for

You might find our results disappointing. We found that none of the three groups had a significantly different hangover score with different orders of alcoholic drinks. The folk wisdom doesn't hold up to scrutiny. Nor was there any way to predict how bad an individual's hangover would be just from blood and urine tests, their age, sex, body weight, drinking habits or hangover frequency. The only way to tell how bad the morning after the night before would be, it seems, was how drunk someone felt or whether they were sick – there are clear red flags we should all pay attention to. We can all agree that hangovers are very unpleasant. In a sense, they are nature's way of trying to protect us from ourselves. Surely, we shouldn't repeat behaviour that makes us feel this terrible? Really, though, there's only one sure-fire way to prevent a hangover: drink responsibly.

The Conversation, 8 February 2019

<http://www.theconversation.com>

This New 'Trojan Horse' Drug Successfully Treated 6 Types of Cancer Tumour

2019-02-13

A toxic antibody is the latest weapon to show promise as a broad-spectrum treatment for multiple forms of advanced cancer. Dubbed a 'Trojan horse' approach to chemotherapy, the new drug has proven itself worthy of moving up the chain of clinical trials to being tested on a greater variety of patients. It's not a fabled cure-all, but this approach might be as close as we're going to get. Researchers from The Institute of Cancer Research, London, and The Royal Marsden NHS Foundation Trust tested the new treatment in a clinical trial involving 147 patients to evaluate its potential benefits and risks of side effects. Called tisotumab vedotin, or simply TV for short, the drug is made up of a monoclonal antibody, and a cytotoxic component which can fatally damage cells. The antibody, if you like, is the spectacular gift horse at the enemy's door - it seeks out cell-signalling flags in membranes called tissue factors and demands entry. While all kinds of healthy cells have this factor, a wide variety of tumours exploit it as a way to grow out of control, making it an appealing target for the cytotoxic seek-and-destroy chemical weapon. In this case, the component tasked with this murderous job is monomethyl auristatin

A toxic antibody is the latest weapon to show promise as a broad-spectrum treatment for multiple forms of advanced cancer.

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E, a molecule that prevents cells from reproducing. "What is so exciting about this treatment is that its mechanism of action is completely novel – it acts like a Trojan horse to sneak into cancer cells and kill them from the inside," says oncologist Johann de Bono from The Institute of Cancer Research. "Our early study shows that it has the potential to treat a large number of different types of cancer, and particularly some of those with very poor survival rates." Those included cancer of the cervix, bladder, ovaries, endometrium, oesophagus, and lung. Those with bladder cancer saw the most impressive response, with 27 percent of enrolled volunteers seeing their disease stabilise. At the other end was endometrial cancer, with a more modest 7 percent of subjects improving. "It's exciting to see the potential shown by TV across a range of hard-to-treat cancers," says The Institute of Cancer Research's Chief Executive, Paul Workman. "I look forward to seeing it progress in the clinic and hope it can benefit patients who currently have run out of treatment options." That progress is slow going. Phase I clinical trials began in 2013 with the testing of TV's safety on just 27 patients. A year and a half later, serious health concerns had emerged, including signs of severe type 2 diabetes, inflammation of the mucosa, and fever. Lower doses saw these more concerning side-effects diminish, though the treatment was still far from problem-free, with nosebleeds, nausea, and fatigue among common complaints. Still, when it's a question of life or death, non-fatal ailments such as these can seem trivial by comparison. Phase I testing gave way into phase II, which showed TV could make a big difference to a lot of patients with cancers little else will treat. "TV has manageable side effects, and we saw some good responses in the patients in our trial, all of whom had late-stage cancer that had been heavily pre-treated with other drugs and who had run out of other options," says de Bono. The next step is to expand phase II testing to include cancers of the bowel and pancreas, while testing it as a second-line drug for cervical cancers that have failed to perish following initial treatments. It's important to note that this isn't a panacea, or the end of cancer as we know it. But when so many promising treatments fail to make it beyond the starting line, seeing promise in one that could make a difference to a wide variety of advanced cancers is exciting. If all goes well, we might expect a third phase of testing in several years, where the drug's efficacy and safety is compared with similar treatments. This all takes time and money, so we can't expect TV to become available for some time yet (if at all). But the demonstrated success of an age-old military strategy applied in an anti-cancer drug bodes well for treatments of its type. "We desperately need innovative treatments like this one that can attack cancers in brand new ways, and remain effective even against tumours

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that have become resistant to standard therapies," says Workman. This research was published in *The Lancet Oncology*.

Science Alert, 11 February 2019

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

Can the Pill Affect How Women Recognize Emotions in Others?

2019-02-13

Birth control pills have been available for nearly 60 years and about 100 million women take them. But despite their ubiquity, some researchers still think certain aspects of the contraceptives deserve more research. Namely: how the pill might affect the brain. "We know a lot about the physical side effects [of birth control pills], but very little about the psychological side effects," said Alexander Lischke, a psychology researcher with the University of Greifswald in Germany. So, Lischke and his lab decided to look into how taking the pill might change someone's ability to process emotion. Their research, published today (Feb. 11) in the journal *Frontiers in Neuroscience*, found that women on the pill mislabelled the emotion on someone's face 10 percent more often than participants who weren't on the pill. Though few researchers have looked at this particular influence of the pill — and others think this research isn't even worth pursuing — the results have Lischke's lab planning further investigations. Even so, Lischke was clear that the findings don't prove cause and effect — in other words, the study doesn't prove that birth control messes with a woman's ability to recognize others' emotions — and that people shouldn't be concerned about the effects of their own birth control. Rather, he told *Live Science* that he hopes additional research follows. "If turns out to be true, then it's worth studying," he said.

Hormones and the brain

Lischke and his team chose this research question because birth control hormones reach regions of the brain that help regulate emotions. While those two chemicals, oestrogen and progesterone, ebb and flow regularly in women not on the pill, oral contraceptives provide a steady supply of these hormones and dampen some of that fluctuation. To see if that steady stream of hormones changed emotional processing skills, the research group gave multiple-choice quizzes to participants — 42 women who were on the pill and 53 who were not — on what emotion was expressed in 36 black-and-white images of a person's eyes. The correct responses

Some researchers think certain aspects of the contraceptives deserve more research. Namely: how the pill might affect the brain.

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ranged from easier to identify emotions, like hostility, to more obscure options, like concern. Lischke and his team found that all participants did the same on the easier questions. But for the harder-to-characterise expressions, women not on the pill got 65 percent correct, while those on the pill got 55 percent correct. Lischke said that it makes sense how, if the pill tampers with emotion-recognition skills, the more challenging emotions would be the ones to separate abilities. But in reality, obvious emotions are a rarity. "We rarely meet people who show prototypical emotional expression," Lischke told Live Science, so the obscure snapshots are closer to what people encounter. But this setup — a computer showing black-and-white portions of faces — still doesn't resemble real life, Lischke said, and it's possible this discrepancy they found in this setting is so small, it doesn't matter, let alone happen, outside the lab.

So, why bother?

Dr. Jonathan Schaffir, an associate professor of obstetrics and gynaecology at Ohio State University, who was not involved in the research, said that he wasn't sure the research question is worth pursuing. It is true that about 10 percent of people on hormonal birth control deal with mood changes, which can be why some stop taking the pill and put themselves at risk for unwanted pregnancy, Schaffir told Live Science. And while it's worth investigating who could be susceptible to those particular mood-related side effects, Schaffir said that he doesn't think it's nearly as important to investigate how the pill may affect emotional processing. What's more, because there is so much research on birth control pills, people can often spot small, coincidental findings that are probably not impacting users' lives, Schaffir said. Besides the premise of the study, Schaffir said that he the researchers also jumped to conclusions about what is causing the different scores. Just because women on birth control didn't do as well doesn't mean they scored lower because of the birth control, he said. There are other factors that weren't considered, like why participants were on birth control in the first place, which it appears none were asked about. "The conclusions they draw from this are overreaching," Schaffir said. Lischke also said that he wants to ensure the difference in scores is due only to birth control, so future studies are needed. For example, he'd like to make sure emotion identification skills weren't influenced by natural hormone levels. This time around, the researchers simply assumed non-pill

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participants were at high or low hormone levels from a questionnaire. But next time, the lab will take blood samples.

Live Science, 11 February 2019

<http://www.livescience.com>

Marijuana Lollipop May Have Triggered Man's Heart Attack

2019-02-14

A marijuana lollipop with a very high dose of the drug's active ingredient tetrahydrocannabinol (THC) may have triggered a man's heart attack, according to a new report of the man's case. The 70-year-old man decided to try edible marijuana to see if it would reduce the pain from his osteoarthritis and help him sleep. The man had smoked some marijuana in his youth, but had never tried an edible product, according to the report, which was published in the *Canadian Journal of Cardiology*. One night, the man consumed nearly an entire marijuana lollipop, which contained a staggering 90 milligrams of THC, more than 12 times the dose in a typical joint. Within a half hour, the man experienced "fearful hallucinations," followed by "crushing chest pain," the report said. The man was taken to the hospital, where doctors determined that he had had a heart attack. The patient had a known history of heart disease, but he was taking several medications for his condition, and had not experienced a heart problem for more than two years. It appears that the large dose of THC placed a "sudden and unexpected strain" on the man's body that may have triggered his heart attack, the report's authors wrote. The high dose led to hallucinations and anxiety, which in turn increased his heart rate, blood pressure and levels of the stress hormone catecholamine, all of which are known to have harmful effects on the heart, they wrote. With the increased legalization of marijuana — the drug is now legal for recreational uses in Canada and several U.S. states — the report's authors say people should be aware that marijuana, like all drugs, may sometimes pose health risks. "Marijuana can be a useful tool for many patients, especially for pain and nausea relief," lead case report author Dr. Alexandra Saunders, of Dalhousie University's Internal Medicine Program in New Brunswick, Canada said in a statement. "At the same time, like all other medications, it does carry risk and side effects." The authors called for more research into how different formulations of marijuana may affect the cardiovascular system, particularly among the aging population.

A marijuana lollipop with a very high dose of the drug's active ingredient tetrahydrocannabinol (THC) may have triggered a man's heart attack, according to a new report of the man's case.

[Marijuana and heart problems](#)

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The new case is just one of multiple reports linking marijuana use to heart problems. For example, in 2014, doctors reported the case of a young man in the United Kingdom who also had a heart attack after smoking marijuana. Larger studies have also linked marijuana to a higher risk of stroke and heart failure. Still, a review study published last year concluded that there is currently not enough scientific evidence available to determine marijuana's effect on the risk of heart problems. In an editorial accompanying the study, Dr. Neal Benowitz, a professor of medicine at the University of California, San Francisco, wrote that marijuana might pose heart risks in three ways: Through the inhalation of smoke from marijuana, through the direct effect of THC on the cardiovascular system, or through indirect effects of THC related to anxiety and hallucinations, as in the current case. So, what should doctors recommend for people with heart disease who want to use cannabis products? Benowitz said there isn't evidence available to answer this question. But he said that for patients with heart disease who want to use marijuana, he would recommend products that contain only the compound cannabidiol (CBD), which does not have psychoactive effects like THC. And if patients want to use marijuana for the effects of THC, Benowitz said he would advise patients not to smoke the products (to reduce exposure to smoke), and would recommend the smallest dose that produces the desired benefit. Benowitz noted that some edible products may contain multiple "servings" of THC, as was the case with the patient's marijuana lollipop. In this case, just a few licks of the 90 mg THC lollipop might have provided an appropriate starting dose, he said. "Understanding appropriate dosing would likely have prevented the toxicity suffered by the patient," Benowitz wrote. "Patients may need counselling as to what constitutes a low dose, and how that compares with the amount of THC in products they may have purchased," he concluded. Shortly after his heart attack, the man said he had trouble doing some daily tasks and wasn't able to exert himself as much as before. His doctors advised him not to consume such a high dose of THC in the future.

Live Science, 11 February 2019

<http://www.livescience.com>

Do You Really Need to Buy Aluminium-Free Deodorant?

2019-02-14

Walk into any organic market or high-end cosmetics store and you'll find shelves stocked with alternative deodorants, many of them loudly advertising that they're aluminium free. This, of course, raises an important

All the major research into aluminium antiperspirants since the early 2000s has suggested that they're not a problem

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body odour question: Did all the deodorants you've been rubbing into your pits until this point contain aluminium, and did that impair your health in any way? The answer (unless you're allergic to aluminium) is an emphatic no. All the major research into aluminium antiperspirants since the early 2000s has suggested that they're not a problem, according to Dr. Susan Massick, a dermatologist at The Ohio State University Wexner Medical Centre. "The claim that aluminium-containing antiperspirants cause cancer is a myth that has been debunked in the minds of doctors and scientists," she said. The idea that antiperspirants with aluminium could be linked to cancer dates back to studies like this one from the early 2000s, showing that if you apply a lot of Old Spice to some cells in a petri dish, those cells suffer DNA damage. Some researchers suggested that the aluminium in the deodorant might be the culprit, and that aluminium-bearing deodorants might be causing breast cancer in women. The main bit of evidence offered for the supposed link? Breast cancer seems more likely to turn up close to the armpit than far away from it. The problem with this line of thinking is that there are lots of things that cause DNA damage to individual cells in petri dishes that don't actually cause cancer in humans. Dunking some loose cells in a heavy chemical bath is a decent first step if you want to know whether a chemical might be dangerous. But all that sort of study can tell you is whether the chemical is worth studying further, not whether it's actually a problem the way humans use it. To get to the bottom of the issue, scientists took a deep dive into the world of antiperspirants. Their results thoroughly debunked the idea that women who use aluminium-based antiperspirants get breast cancer more often than those who don't, Massick told Live Science. She pointed to this paper, published in the journal *Critical Reviews in Toxicology* in 2014, which carefully examined all the existing research into health issues surrounding aluminium and found no evidence that antiperspirant poses any particular danger to human health. Deodorant makers put aluminium in their formulas, Massick explained, because it blocks the sweat ducts but doesn't penetrate deeper into the skin. That makes it an effective antiperspirant. "For a compound to cause cancer," she said, "a mechanism would likely be related to absorption into the bloodstream at a concentration high enough to cause toxicity, and that is not likely with a topical compound applied only to the [armpit]." In other words, for the chemical to cause cancer it has to actually enter the body in high doses. A small daily dab of aluminium to the armpit just doesn't do that. To really purge aluminium from the body, you'd have to get rid of more than just deodorant. Marijuana and tobacco contain aluminium, the researchers said in that 2014 review. And, of course, it's present in aluminium foil and in cookware. The people who actually are at risk for aluminium-related cancers, the

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researchers found, are industrial workers at smelters and other plants, where there's a high concentration of aluminium-laced dust in the air. But that's a different situation from dabbing a gel onto skin. "Our skin is the mighty barrier to the outside world," Massick said, so it keeps us safe. The real exception, she said, are patients with allergies or who otherwise find regular antiperspirants irritating. "For these patients I would recommend alternative options, such as glycopyrrolate ... and Botox injections [to block sweating]," she said.

Live Science, 9 February 2019

<http://www.livescience.com>

The Case for Transmissible Alzheimer's Grows

2019-02-14

The unsettling evidence that Alzheimer's Disease may be transmissible under limited -- but definitely nonzero -- circumstances keeps growing. Last December I wrote about research that revealed that infectious, lethal proteins called prions have the potential to be transmitted on optical medical equipment because they are present throughout the eyes of victims. This was all the more disturbing in light of a study I had also recently written about that suggested that peptide aggregates -- essentially sticky, self-propagating clumps of misfolded protein bits collectively referred to as amyloid -- found in the brains of Alzheimer's patients may be transmissible in the same ways that prions are. Then, just a few days after I wrote about the prion eye hazard, a new paper appeared in Nature that seemed to take the evidence for the transmissibility of Alzheimer's peptides from "circumstantial" to "experimentally produced". It is fascinating, if unsettling, news, that further blurs the line between amyloid and prions. Human prion diseases are rare. Prions usually form spontaneously or are inherited via faulty genes, but sometimes find their way into humans through consumption of contaminated brain or spinal cord tissue. In the case of Mad Cow Disease, it happened via contaminated beef. In rare cases (so far as we know), human prion transmission has happened when surgical instruments used on an infected patient were cleaned and reused on an uninfected one. Prions stick to steel like glue, are stable for decades at room temperature, and survive a bombardment of chemical and physical cleaning assaults that are more than sufficient to obliterate other pathogens. Prions are survivors. In the original Alzheimer's transmissibility study, scientists examined the brains of eight patients treated with prion-contaminated human growth hormone as children who decades later died from prion disease (out of over 30,000 people

What separates a lethal prion from dementia-inducing amyloid plaque? Maybe not much

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so treated, more than 200 died this way). The hormone had become contaminated with prions because it had been extracted from cadavers -- one or a few of whom presumably died of prion disease -- and processed in such a way that the prions remained. Of course, prions are not the only misfolded proteins that potentially lurk in the brains of cadavers. The researchers discovered the brains of seven of the eight contained, in addition to prions, peptide aggregates called Amyloid beta ($A\beta$ for short). $A\beta$ is a collection of misfolded peptides whose correctly folded versions are present in the human brain and perform a variety of mid-level tasks. When the misfolded versions form, they behave like prions, catalysing the conversion of healthy forms into diseased ones and accumulating in clumps called plaques. Indeed, past experiments have shown that injecting small amounts of human $A\beta$ into the brains of primates or of mice bred to express a humanised form of the $A\beta$ precursor protein generates $A\beta$ plaques in these animals. Plaques are characteristic of and possibly the instigators of Alzheimer's Disease when they accumulate around neurons in the brain. However, the seven brains did not have plaques. The $A\beta$ in these brains had built up in the walls of blood vessels, where such accumulations can cause bleeding and dementia. This condition is called cerebral amyloid angiopathy, and it co-occurs with most Alzheimer's Disease but can also strike on its own. The eight victims had all still been young enough that their brains would not be expected to show any signs of Alzheimer's or cerebral amyloid angiopathy unless they had genetic risk factors. Understandably, given the implications, the scientists who studied their brains were concerned. The December Nature study was authored by this same team. In it, they revealed that they had managed get their hands-on original vials of prion-contaminated growth hormone that had been helpfully squirreled away for decades by Public Health England. They tested the samples for both $A\beta$ peptides and tau, another protein that builds up in the brains of Alzheimer's patients and causes its other brain pathology: tangles. Indeed, two types of $A\beta$ and tau were still present in the vials, even after more than three decades of room temperature storage. $A\beta$ and tau, at least, are survivors too. This team took their study a step further by injecting a tiny sample of these vintage vials into the brains of mice engineered to be susceptible to human Alzheimer's. The mice developed both $A\beta$ plaques and cerebral amyloid angiopathy, although they showed no signs of tau. $A\beta$ peptides had not only managed to survive decades of room-temperature storage, they were also still transmissible. This is concerning. It is important -- imperative -- to emphasise that transmissible does not equal contagious. There is absolutely no evidence that people with dementia can spread their disease casually to people around them. Even donated blood

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appears to be safe, as no association with blood transfusions and Alzheimer's Disease has ever been detected. Rather, in the course of some neurological surgeries – and perhaps certain kinds of medical exams – prions may become lodged on equipment. And there is a chance this equipment could transmit the disease. Organ donation protocols may also warrant some review. It was already known that donations of dura mater, a tough brain covering, have transmitted A β to young people in the past. And I wonder. Since Alzheimer's Disease is so common, and we have not (to my knowledge) been looking for Alzheimer's caused by surgical or other medical procedures that access eye or neural tissue -- particularly in patients for whom the appearance of Alzheimer's would not be surprising -- is it possible that we are underestimating the transmission potential of this disease, and that such events are less rare than we would guess? Alzheimer's is not the only neurodegenerative disease in which aggregating misfolded host proteins – a class referred to as amyloid -- seem to propagate and wreak havoc either. In Parkinson's Disease, misfolded alpha-synuclein proteins spread through the brain, and in Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease), the misfolded, accumulating protein is TDP-43. We should investigate the transmission potential of these diseases as well. The only thing that seemed to separate these conditions from classic prion diseases was transmissibility. But now that that barrier has been breached for at least one, I also wonder: What is the difference between amyloid and prions? Are they part of a spectrum? Are they one in the same? If not, what is the difference? Can what we've learned about the biology of prions help our efforts to fight amyloid dementias? Of course, since we still can't cure prion diseases, it may not be much help even if so. The realisation that the peptides involved in some of the most common and feared dementias on Earth may be transmissible under even limited conditions is a sobering and humbling reminder of how very little we still understand about them. Given what we know about prions, I think we would be wise not to underestimate their abilities.

Scientific American, 7 February 2019

<http://www.sciam.com>

Stopping the World's Biggest Infectious Killer

2019-02-14

Diseases that have plagued humanity since ancient times continue to hold billions of people back, and tuberculosis is one of the most significant among them. Today, there are an estimated 10-million-plus new TB cases each year, and the disease causes more than 1.6 million deaths, earning

Science holds the key for ending tuberculosis, but greater effort and sustained innovation are crucial

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it the dubious honour of being the world's number one infectious killer. While training as a doctor in India, where TB is more prevalent than in any other country, I saw first-hand its devastating impact on individuals, families and entire communities. Since my time as a medical trainee, I have been encouraged to see modest progress. Globally, the mortality rate dropped 42 percent from 2000 to 2017. New diagnostics and medicines are now available, including bedaquiline, which is proving to be a potential game-changer for drug-resistant TB—and countries like South Africa have successfully rolled it out. Political commitment is also on the rise, with heads of state agreeing to mobilize \$13 billion for TB care and prevention by 2022 at a high-level meeting in September, 2018. Yet one of the most frustrating challenges in the TB epidemic perseveres: the lack of adequate 21st-century tools to fight what's now a 21st-century epidemic. Despite recent scientific advancements for many diseases, patients and care providers continue to rely on antiquated, inefficient diagnostics, vaccines and drug regimens. This is unacceptable. Take vaccination. The BCG vaccine we use for TB today was developed in the 1920s, and has limited efficacy. What about diagnostics? The most widely used test for TB dates back to German scientist Robert Koch, who identified the tuberculosis bacterium under a microscope in 1882, and it is barely 50 percent sensitive. How can we defeat TB if we have no good vaccine and can only detect it half of the time? For those who do get an accurate diagnosis, the complexity of treatment is another major problem. Existing medications require drug-resistant TB patients to take medicine every day for two years—a regimen to which it is extremely difficult to adhere. If we are going to end the epidemic, we must raise the level of ambition and reimagine how TB care is delivered. Finally, even when patients are accurately diagnosed and adhere to treatment, success is not a foregone conclusion. Multidrug-resistant tuberculosis (MDR TB) is complicating the global response. In 2017, an estimated 3.6 percent of all new cases were drug-resistant, of which India, China and Russia accounted for almost half. While bedaquiline is a step forward, it still not widely available and accessible. We need to continue improving our options. Allowing resistance to spread further could lead to a surge in the epidemic.

New research investments will be critical to fill these gaps. Just this week, Policy Cures Research released its annual G-FINDER report, the world's most comprehensive analysis of neglected disease research investments. According to the report, funding for TB R&D globally increased by \$23 million to \$615 million between 2016 and 2017—a cause for cautious optimism. And it is particularly exciting that domestic funding in India more than tripled during the same period. However, the report also

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shows that we are still falling well short of the funds needed for science and innovation in TB and other diseases. Moreover, the concentration of existing funding among the same major donors is cause for concern; in 2017, the top 12 funders accounted for 90 percent of all R&D funding and the top three funders (the U.S. National Institutes of Health; the Gates Foundation; and private industry) collectively contributed just over two thirds. We need both more investment, and more diversified investment, if we are to end the TB epidemic. We also need countries with high TB burden, especially Brazil, Russia, India, China and South Africa (known collectively in the public health world as BRICS), to step up and lead the research agenda. Financial gaps directly translate into gaps in care. As a doctor and a scientist, I find it impossible not to be an advocate as well. Fortunately, there has never been more momentum than there is today, with virtually unanimous agreement on the massive potential of R&D to change the game for infectious disease. This is largely because we have seen it work: from the Ebola vaccine to antiretroviral therapy for HIV to bed nets to prevent transmission of malaria. Moreover, governments around the world have committed to providing significantly more funding by 2022 for TB R&D, signalling growing political will. Now is the time to science the shit out of TB and hold government leaders accountable to their commitments.

Scientific American, 11 February 2019

<http://www.sciam.com>

New French study explores risks of ultra-processed food

2019-02-14

A major French study published recently has found for the first time a link between the consumption of ultra-processed foods and a higher risk of death, but researchers warned more work was needed to determine which mechanisms were at play. The study, which involved monitoring the diets of tens of thousands of French people between 2009 and 2017, found a modest link between increased consumption of ultra-processed foods—characterised as ready-to-eat or -heat formulations—and a heightened mortality risk during that period. The results were published in *JAMA Internal Medicine* published by the American Medical Association. But “we shouldn’t be alarmist, or say that eating a packaged meal gives you a 15-percent higher chance of dying,” cautioned Mathilde Touvier, director of the nutritional epidemiology research team at Paris 13 University, which managed the NutriNet-Sante study along with teams from Inserm, Inra and CNAM. “It’s another step in our understanding of the link between

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ultra-processed food and health,” she added. The relationship between diet and disease is complex and the results of studies are frequently misinterpreted. Last year, the same French team published a study on organic food and how it related to the risk of cancer. A higher rate of cancer was found in people who ate less organic food—but the study did not conclude there was a causal link—though that did not stop many media outlets from headlining the cancer-fighting effects of organic food. Some 45,000 people over the age of 45, a majority of whom were women, took part in the latest study. Every six months, they were asked to fill out three online surveys, randomly assigned over two weeks, on everything they ate or drank over a 24-hour period. After seven years, about 600 people died. The researchers then crunched the numbers and found that a 10 percent increase in the proportion of ultra-processed foods in the diet corresponded to a 15 percent increase in mortality. But Touvier warned that rather than focus on the figure, what matters is the existence of a statistically significant correlation—and the study is one part of growing body of work on the matter.

Socio-economic inequalities

Ultra-processed foods come under group four of the NOVA food classification system recognised by health agencies including the UN Food and Agriculture Organisation. They have undergone several transformation processes including heating at high temperatures and the presence of additives, emulsifiers and texturisers. Many ready-to-heat products that are rich in salt or sugar and low in vitamins and fibre fall under this category. Last year, French researchers published results from the same NutriNet-Sante study, observing more cancers among heavy consumers of these foods. Since it is not possible for ethical reasons to conduct a controlled experiment in which one group eats ultra-processed foods and the other does not, observational studies are the only option. But they are inevitably flawed, hinging on accurate self-reporting, while there are also a myriad of other “invisible” factors at play—even though the results are adjusted to compensate for socio-demographic criteria and the overall quality of the diet. The burning question remains, what is it about these foods that causes negative impacts on health? One popular hypothesis is the presence of additives, which have been studied in lab conditions on cells and on rats, notably by the French National Institute for Agricultural Research (INRA). The study is “an important contribution to the literature” on the subject, Casey Rebholz, Assistant Professor of Epidemiology at the Johns Hopkins School of Public Health told AFP, who noted the methodology was robust despite the inherent

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limitations of studies of this nature. Another vital message to take away is that such foods are disproportionately consumed by lower-income people, argued Professor Nita Forouhi of Cambridge University's School of Clinical Medicine. "Consumption of highly processed foods reflects social inequalities—they are consumed disproportionately more by individuals with lower incomes or education levels, or those living alone," she said. "Such foods are attractive because they tend to be cheaper, are highly palatable due to high sugar, salt and saturated fat content, are widely available ... More needs to be done to address these inequalities."

Medical Xpress, 11 February 2019

<http://medicalxpress.com>

Changes in lung cells seen almost immediately after contact with low-molecular weight PAHs

2019-02-14

It is well known that exposure to high-molecular weight polycyclic aromatic hydrocarbons (PAHs) increases cancer risk, leading to regulation of compounds like benzo(a)pyrene (BAP). However, less is known about the health effects of low molecular weight PAHs. Now, a University of Colorado Cancer Centre study shows cancer-promoting changes in lung cells as soon as 30 minutes after exposure to low-molecular weight PAHs, adding further evidence that regulators may be underestimating the risk of these compounds commonly found in second-hand cigarette and marijuana smoke, as well as other environmental and occupational exposures. "Our overall goal is to understand what types of adverse effects these low-molecular weight PAHs are eliciting in the lung," says Alison Bauer, Ph.D., investigator at the CU Cancer Centre and associate professor in the Department of Environmental and Occupational Health at the Colorado School of Public Health. Her group was the first to show previously that these low-molecular weight PAHs lead to changes like gap junction dysregulation, p38 MAPK activation, and inflammatory mediator production in lung cells. "And all of these events are thought to be involved in early stage cancer development," Bauer says. The current study looks at how these cancer-promoting changes occur and involved a collaborative team from the Colorado School of Public Health, UC Denver School of Pharmacy, and a collaborator at Michigan State University. "We wanted to understand short-term responses to PAHs—the acute response—what are the early mechanistic events that may be leading to events later on," Bauer says. To explore these early effects, Bauer and colleagues including postdoctoral researcher and

A new study shows cancer-promoting changes in lung cells as soon as 30 minutes after exposure to low-molecular weight PAHs

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paper first author Kate Siegrist, Ph.D., exposed lung cells to a mixture of low-molecular weight PAHs including 1-methylanthracene (1-MeA) and fluoranthene (Flthn), abundant compounds in second-hand smoke and shown in previous studies to produce cancer-supporting changes. Then the researchers blocked specific pathways in these cells to discover what functions are necessary for the PAH mixture's adverse effects. What they saw was the early activation of lipid signalling. Simply put, these low-molecular weight PAHs were turning on lipid signalling that at least, in part, initiated cellular changes that are associated with early events in cancer development, such as inhibition of gap junctions and activation of MAP kinases. "What we're seeing is that early on, 30 minutes to 8 hours after exposure, lipid signalling pathways are getting activated. Based on global metabolomics done with Dr. Nichole Reisdorph in the CU School of Pharmacy Metabolomics Core, we hypothesize that these PAHs are interacting early with the cell membranes to activate these changes," Bauer says. Interestingly, the field of PAH research has long believed that PAHs must be metabolised before causing adverse events. In other words, PAH "parent compounds" are first metabolised into active PAH metabolites, and it is these transformed metabolites that are the drivers of cellular changes. However, Bauer's group measured PAH metabolism to specifically show that their mixture of low-molecular weight PAHs did not need to be metabolised in order to observe cellular changes—it was the parent compounds themselves producing these adverse effects. "The PAH field has always said that PAHs have to be metabolised to have adverse effects, but we're seeing effects before metabolism," Bauer says. The group now plans to move their experiments forward from lung cells to slices of lung tissue, hoping to show the effects of low-molecular weight PAHs in models that are closer to the human lung. "The World Health Organization classifies these compounds as Group III which is unclassifiable, but we're not fully clear on what these low-molecular weight PAHs do in the lung," Bauer says. "Our evidence shows these compounds should be investigated further for their possible adverse effects."

Medical Xpress, 11 February 2019

<http://medicalxpress.com>

Evidence mounts that gut bacteria can influence mood, prevent depression

2019-02-14

Of all the many ways the teeming ecosystem of microbes in a person's gut and other tissues might affect health, its potential influences on the

A new study of two large groups of Europeans has found several species of gut bacteria are missing in people with depression.

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brain may be the most provocative. Now, a study of two large groups of Europeans has found several species of gut bacteria are missing in people with depression. The researchers can't say whether the absence is a cause or an effect of the illness, but they showed that many gut bacteria could make substances that affect nerve cell function—and maybe mood. "It's the first real stab at tracking how" a microbe's chemicals might affect mood in humans, says John Cryan, a neuroscientist at University College Cork in Ireland who has been one of the most vocal proponents of a microbiome-brain connection. The study "really pushes the field from where it's been" with small studies of depressed people or animal experiments. Interventions based on the gut microbiome are now under investigation: The University of Basel in Switzerland, for example, is planning a trial of faecal transplants, which can restore or alter the gut microbiome, in depressed people. Several studies in mice had indicated that gut microbes can affect behaviour, and small studies of people suggested this microbial repertoire is altered in depression. To test the link in a larger group, Jeroen Raes, a microbiologist at the Catholic University of Leuven in Belgium, and his colleagues took a closer look at 1054 Belgians they had recruited to assess a "normal" microbiome. Some in the group—173 in total—had been diagnosed with depression or had done poorly on a quality of life survey, and the team compared their microbiomes with those other participants. Two kinds of microbes, *Coprococcus* and *Dialister*, were missing from the microbiomes of the depressed subjects, but not from those with a high quality of life. The finding held up when the researchers allowed for factors such as age, sex, or antidepressant use, all of which influence the microbiome, the team reports today in *Nature Microbiology*. They also found the depressed people had an increase in bacteria implicated in Crohn disease, suggesting inflammation may be at fault. Microbiome results in one population often don't hold up in another. But when the team looked at data from another group—1064 Dutch people whose microbiomes had also been sampled—they found the same two species were missing among those who were depressed, and they were also missing in seven subjects suffering from severe clinical depression. The data don't prove causality, Raes acknowledges, but they are "an independent observation backed by three [groups of people]." Looking for something that could link microbes to mood, Raes and his colleagues compiled a list of 56 substances important for proper nervous system function that gut microbes either produce or break down. They found, for example, that *Coprococcus* seems to have a pathway related to dopamine, a key brain signal involved in depression, although they have no evidence how this might protect against depression. The same microbe also makes an anti-inflammatory substance

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called butyrate, and increased inflammation is implicated in depression. Linking the absence of the bacteria to depression “makes sense physiologically,” says Sara Campbell, a physiologist at Rutgers University in New Brunswick, New Jersey. Still, no one knows how microbial compounds made in the gut might influence the brain. One possible channel is the vagus nerve, which links the gut and brain. Resolving the microbiome-brain connection “might lead to novel therapies,” Raes suggests. Indeed, some physicians and companies are already exploring typical probiotics—oral bacterial supplements—for depression, although they don’t normally include the missing gut microbes identified in the new study. Clinical neuroscientist André Schmidt of the University of Basel has started a clinical trial in which his team is assessing the mental health and microbiota of 40 depressed people before and after they receive a single faecal transplant. He and other advocates agree that solidifying any depression-microbiome connection will take many more studies. Still, Sven Pettersson, an experimental biologist at the Karolinska Institute in Stockholm who was among the first to suggest such a link, calls the new findings “a massive signal to the clinical community to consider microbiome profiling in their [mental health] patients.”

Science, 4 February 2019

<http://sciencemag.org/>

Protein released from fat after exercise improves glucose

2019-02-14

It’s well-known that exercise improves health, but understanding how it makes you healthier on a molecular level is the question researchers at Joslin Diabetes Centre are answering. After performing experiments in both humans and mice, the researchers found that exercise training causes dramatic changes to fat. Additionally, they discovered that this “trained” fat releases factors into the bloodstream that can have positive effects on health. The study was published online February 11, 2019, in *Nature Metabolism*. It’s known that fat cells secrete proteins called adipokines, and that many adipokines increase with obesity, having harmful effects on metabolism and health. “In contrast to the negative effects of many adipokines, our study identified transforming growth factor beta 2 (TGF-beta 2) as an adipokine released from adipose tissue (fat) in response to exercise that actually improves glucose tolerance,” says Laurie J. Goodyear, PhD, Head of Joslin’s Section on Integrative Physiology and Metabolism and study co-author. Not only did exercise-stimulated TGF-beta 2 improve

Exercise training causes dramatic changes to fat. Additionally, this ‘trained’ fat releases beneficial factors into the bloodstream.

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glucose tolerance, treating obese mice with TGF beta 2 lowered blood lipid levels and improved many other aspects of metabolism. "The fact that a single protein has such important and dramatic effects was quite impressive," says Goodyear, Professor of Medicine at Harvard Medical School. Two years ago, the international research team first demonstrated that adipose tissue offers beneficial metabolic effects in response to exercise. "Our hypothesis was that exercise is changing the fat, and as a result of that change, the fat releases these beneficial proteins into the bloodstream," says Goodyear. "Before this discovery, we always just focused on the positive effects of muscle." Building on this insight, Joslin researchers sought to identify the adipokines released from fat in exercise. To do so, they ran a series of molecular experiments in both humans and mice. They identified levels of adipokines in men before and after a cycle of exercise. They also studied exercising mice. Their analysis identified TGF beta 2 as one of the proteins upregulated in exercise in humans and mice. Additional investigation confirmed that levels of this one adipokine actually increased in the fat tissue as well as in the bloodstream with exercise, in both cases. To find out if the protein promoted beneficial metabolic effects, they treated the mice with TGF beta 2. The experiment showed a number of positive metabolic effects in the mice, including improved glucose tolerance and increased fatty acid uptake. Next, they fed the mice a high fat diet, causing the animals to develop diabetes. To know if TGF beta 2 was actually responsible for the metabolic effects, they treated the diabetic mice with TGF beta 2. This reversed the negative metabolic effects of the high fat diet, similar to what happens with exercise. "Our results are important because it's really the first demonstration of an exercise-released adipokine that can have beneficial metabolic effects on the body," says Goodyear. Another significant finding was that lactic acid, which is released during exercise, serves as an integral part of the process. Lactate is released by the muscles during exercise then travels to the fat where it triggers the release of TGF beta 2. "This research really revolutionizes the way we think about exercise, and the many metabolic effects of exercise. And, importantly, that fat is actually playing an important role in the way exercise works," says Goodyear. These findings suggest that TGF beta 2 may be a potential therapy for treatment of high blood sugar, and eventually a potential therapy for type 2 diabetes. Long-term studies will be needed to determine the safety of TGF beta 2 treatment.

Science Daily, 7 February 2019

<http://www.sciencedaily.com>

Technical Notes

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ENVIRONMENTAL RESEARCH

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[Direct quantitation and characterization of fatty acids in salmon tissue by condensed phase membrane introduction mass spectrometry \(CP-MIMS\) using a modified donor phase](#)

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MEDICAL RESEARCH

[A new analytical framework for multi-residue analysis of chemically diverse endocrine disruptors in complex environmental matrices utilising ultra-performance liquid chromatography coupled with high-resolution tandem quadrupole time-of-flight mass spectrometry](#)

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[Silicosis in underground miners in Lubumbashi, Democratic Republic of the Congo: 27 cases](#)

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Study on the Influence of Government Intervention on the Occupational Health and Safety (OHS) Services of Small- and Medium-Sized Enterprises (SMEs).

Work-Related Stressors and Increased Risk of Benzodiazepine Long-Term Use: Findings From the CONSTANCES Population-Based Cohort

Analytical strategies for assessing occupational exposure to antineoplastic drugs in healthcare workplaces

PUBLIC HEALTH RESEARCH

Advice on assistance and protection from the Scientific Advisory Board of the Organisation for the Prohibition of Chemical Weapons: Part 2. On preventing and treating health effects from acute, prolonged, and repeated nerve agent exposure, and the identification of medical countermeasures able to reduce or eliminate the longer-term health effects of nerve agents

The History of the Dioxin issue in Brazil: From citrus pulp crisis to food monitoring

Child's buccal cell mitochondrial DNA content modifies the association between heart rate variability and recent air pollution exposure at school

Diesel exhaust, respirable dust, and ischemic heart disease: an application of the parametric g-formula

Opening windows and closing gaps: a case analysis of Canada's 2009 tobacco additives ban and its policy lessons