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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

#### Cancellation of Product Label Approvals at the Request of the Holder

2019-08-29

The Australian Pesticide and Veterinary Medicine Authority (APVMA) have published/advised that the following products labels have been cancelled at the request of the holder. The following products have had their labels cancelled:

Product no. (A)	Product name (B)	Registrant (C)	Product label approval number (D)	Date of effect (E)
36713	Dermcare Permaxin Insecticidal Spray and Rinse Concentrate for Dogs and Horses	DERMCARE-VET PTY. LTD	36713/0409 36713/0807 36713/1101 36713/0301 36713/1100	21 August 2019
64870	Shield 40 mg/mL Pour-On Solution for Horses	BOCKO P/L & FLEFSKY P/L IN PARTNERSHIP	64870/49482 64870/60760	21 August 2019
83446	Protim Aquazole Timber Preservative	KOPPERS PERFORMANCE CHEMICALS AUSTRALIA PTY LTD	83446/108296	21 August 2019
59030	Conquest Avalanche 750 WG Herbicide	CONQUEST CROP PROTECTION PTY LTD	59030/0109 59030/0704	21 August 2019
64597	Vetmec LEV Pour-on for Cattle	CHEMVET AUSTRALIA PTY LTD	64597/104953	21 August 2019
55485	4Farmers Triflumuron 25 Pour On Lousicide for sheep	4 FARMERS AUSTRALIA PTY LTD	55485/0614	21 August 2019

**The Australian Pesticide and Veterinary Medicine Authority (APVMA) have published/advised that the following products labels have been cancelled at the request of the holder.**

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Product no. (A)	Product name (B)	Registrant (C)	Product label approval number (D)	Date of effect (E)
56465	Genesis Ultra Pour-On Roundworm, Liver Fluke & External Parasiticide For Cattle	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	56465/56698 56465/1208 56465/1107 56465/0306 56465/0505 56465/0205 56465/1204 56465/1203	21 August 2019
62708	Avomec Plus Pour-On Roundworm, Liver Fluke and External Parasiticide For Cattle	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	62708/0609	21 August 2019
69671	Agrocn Chlorpyrifos 500 EC Insecticide and Termiticide	SHANGHAI AGROCHINA CHEMICAL CO. LTD.	69671/61400	21 August 2019
66354	Ozcrop Chlorpyrifos 500 EC Insecticide	OZCROP PTY. LTD.	66354/53439	21 August 2019
63086	Chemicide 500 Insecticide	HEXTAR CHEMICALS PTY LTD	63086/44672	21 August 2019
50387	Titan Chlorpyrifos 500 Termiticide and Insecticide	TITAN AG PTY LTD	50387/58911 50387/0810 50387/0307 50387/0402 50387/0801	21 August 2019
50452	Titan Chlorpyrifos Pc 450 Insecticide	TITAN AG PTY LTD	50452/0407 50452/0302 50452/0701	21 August 2019
81786	Chlorpyrifos 500EC Insecticide	RURALCO HOLDINGS LIMITED	81786/112047	21 August 2019
81786	Relyon Chlorphos 500EC Insecticide	RURALCO HOLDINGS LIMITED	81786/104053	21 August 2019

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Product no. (A)	Product name (B)	Registrant (C)	Product label approval number (D)	Date of effect (E)
70410	Pyrigran Insecticide	SULPHUR MILLS AUSTRALIA PTY LIMITED	70410/115800 70410/63402	21 August 2019
55213	Kenso Agcare Kensban 500 Insecticide	KENSO CORPORATION (M) SDN BHD	55213/0310 55213/0302	21 August 2019
45486	Strike-Out 500EC Insecticide	ADAMA AUSTRALIA PTY LIMITED	45486/63149 45486/55444 45486/0609 45486/1008 45486/0107 45486/0903 45486/0602 45486/0701	21 August 2019
83386	Sharda Chlorpyrifos 500 Insecticide	SHARDA CROPChem ESPANA S.L	83386/108160	21 August 2019
83426	Echem Chlorpyrifos 500 Insecticide	ECHEM (AUST) PYT LIMITED	83426/108241	21 August 2019
84128	Paramec Pour On for cattle	CHEMVET AUSTRALIA PTY LTD	84128/118387 84128/109742	21 August 2019
67185	Alpha2 Combination Pour on for cattle	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	67185/55410	21 August 2019
69965	Sequel Combination Pour-On for cattle	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	69965/62188	21 August 2019
58978	Young's Triclamec Cattle Pour-on Flukicide and broad spectrum anthelmintic	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	58978/0604	21 August 2019

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Product no. (A)	Product name (B)	Registrant (C)	Product label approval number (D)	Date of effect (E)
58971	Fasimec Cattle Pour-on Flukicide and broad spectrum anthelmintic	BOEHRINGER INGELHEIM ANIMAL HEALTH AUSTRALIA PTY. LTD.	58971/0609 58971/0606 58971/0605 58971/0205 58971/0604	21 August 2019

The following instructions set out how a person can deal with the product bearing the cancelled product label.

### SUPPLY

A person may supply or cause to be supplied the above product(s) bearing the cancelled label manufactured prior to the date listed in Column E of Table 1, at wholesale and retail level, until 12 months after the date listed in Column 1 of Table E. 12 months after the date listed in Column E of Table 1, it will be an offence against the Agvet Codes to have possession or custody of the product(s) bearing the cancelled label with the intention to supply, or to supply the product.

### USE

A person may continue to use the product(s) bearing the cancelled label according to its label instructions until 12 months after the date listed in Column E of Table 1. Any person who possesses, has custody of, uses, or otherwise deals with the listed product bearing the cancelled label in accordance with the above instructions is taken to have been issued with a permit under the Agvet Codes to so possess, have custody of, use or otherwise deal with the product(s) bearing the cancelled label until 12 months after the date listed in Column E of Table 1. The supply and use of the product(s) bearing the cancelled label must be in accordance with the conditions of registration or approval, including any conditions relating to the shelf life or expiry date. It is an offence to possess, have custody of, use, or deal with the product(s) bearing the cancelled label listed in the table in a manner that contravenes the above instructions.

APVMA Gazette, 27 August 2019

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

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### Notice of a final decision to amend (or not amend) the current Poisons Standard, August 2019

2019-08-29

In reconsidering the interim decision for mometasone under the Regulation 42ZCZQ paragraph (2)(a) of the *Therapeutic Goods Regulations 1990*, the Medicines Scheduling Delegate has decided to request additional advice from the Advisory Committee on Medicines Scheduling (ACMS) at its November 2019 meeting. It is anticipated that this invitation for public comment will be published on the TGA website on 12 September 2019. Further information is available at: Print version of Notice of a final decision to amend (or not amend) the current Poisons Standard, August 2019 (pdf, 197 KB)

TGA, 26 August 2019

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

### EPA lifts ban on construction and demolition recycler

2019-08-29

Environment Protection Authority Victoria (EPA) has revoked an official order that banned a Coolaroo recycling facility from accepting combustible recyclable and waste materials. Phoenix Environmental Group Pty Ltd was issued with the notice after EPA inspectors found the company had large stockpiles of waste and recyclable materials that presented a significant risk of fire and would be difficult to extinguish. EPA Project Manager Resource Recovery Facilities Audit Taskforce, Steven Pugh, said the company had made its stockpiles comply with safety regulations within a few days of receiving the notice. "This is the third time the company's stockpiles have failed to comply with the Victorian Waste Management Policy. The policy was introduced in August 2017, and includes measures to reduce the fire risks associated with waste and recycling stockpiles," Mr Pugh said. "The company clearly had the capacity to bring its stockpiles under control and it is disappointing that EPA had to take such strong action," he said. "The message to the recycling and waste industries is that the regulations are there to protect the environment and the community, and they will be enforced." The company processes construction and demolition (C&D) waste, including timber, plasterboard, foam, insulation, cardboard, plastic and metals. The EPA notice prevented it from receiving any new materials to the site, but allowed it to continue processing materials to reduce the size of its stockpiles. The notice was issued when EPA officers found loose stockpiles of combustible recyclable

**Environment Protection Authority Victoria (EPA) has revoked an official order that banned a Coolaroo recycling facility from accepting combustible recyclable and waste materials.**

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waste material at the premises without adequate separation distances between stockpiles and buildings or property boundaries. "The size and contents of the stockpiles, inadequate separation distances and the potential sources of ignition increased the fire risks dramatically. Any fire would have meant toxic gasses from burning plastics, foam and polystyrene, a great deal of smoke, and fire water runoff that could contaminate local waterways," Mr Pugh said. EPA is undertaking further investigations of the company to determine if any breaches of the Environment Protection Act 1970 have occurred and is looking at further compliance and enforcement action available under its powers. Victoria's new environment laws take effect on 1 July 2020 and introduce a general environmental duty requiring businesses and individuals to prevent harm to the environment and human health. Learn more on EPA's website at [www.epa.vic.gov.au/newlaws](http://www.epa.vic.gov.au/newlaws)

EPA Victoria, 26 August 2019

<http://www.epa.vic.gov.au/>

### **MEM Revises the Administrative Measures on Emergency Response Plan for Workplace Accidents**

2019-08-22

On 11 July 2019, China Ministry of Emergency Management (MEM) issued Decree 2 of 2019 to announce *the Decision on Amending the Administrative Measures on Emergency Response Plan for Work Place Accidents* and revise the Measures. This revision has made modified to include 19 provisions, involving the preparation, review, publication, filing, implementation and supervision of emergency response plans. According to the Decree, the revised Measures will enter into force on the 1 September 2019. Compared with the previous version, modifications have been made to adapt the Measures to current management system. For example, under the State Council's proposal, on completion of the government service online, only the digital version of the plans need to be submitted (the paper version is no longer required in the new version). What's more, influenced by the Regulations on the Emergency Response to Work Place Accidents, which was released by State Council earlier this year, the revised Measures strengthens the requirements for the filing and drilling of emergency plans. The amendments focus on the following aspects.

Focusing on high risk enterprise

**On 11 July 2019, China Ministry of Emergency Management released the revised Administrative Measures on Emergency Response Plan for Workplace Accidents.**

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The scope of enterprises required to complete the filing of emergency response plans has been refined. Under new requirements not all enterprises have to submit their plan to government now. High risk enterprises, such as the manufactory, business (with storage facilities, the same below), storage and transportation units of flammable or explosive substance or hazardous chemicals, are required to complete filing within 20 days. At the same time, the new Measures require hazardous chemicals transportation units to examine and appraise their own plan, just like the other high-risk units involving hazardous substances.

### Emphasis on emergency response plan drills

According to the corresponding provisions in the Regulation, modifications have been made to emphasize the importance of drilling the emergency response plan. The frequency and minimum number of drills is specified. High risk enterprises should practice drills once per half-year and the emergency management departments of the people's government at all levels should organise a drill every two years. On the other hand, the people's government at or above the county level should conduct spot checks on the drills of key units in the region and rectify any issues uncovered. Stricter penalties have also been adopted to dissuade deviation from requirements. It is clear that China is trying to make the emergency response plan play an important role in the management of high-risk units. For reference, GB/T 29639-2013 shows the guidelines for enterprises to develop emergency response plan for work place accidents. Further information is available at:

- [the Decision on Amending the Administrative Measures of Emergency Response Plan for Work Place Accidents](#)
- [the Regulations on the Emergency Response to Work Place Accidents](#)
- [the Guidelines for Enterprises to Develop Emergency Response Plan for Work Place Accidents](#)

Chemlinked, 22 August 2019

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

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### AMERICA

#### Common solvent, degreaser 1-bromopropane poses health risks

2019-08-29

Once hailed as an alternative to chlorinated solvents and ozone-depleting substances, 1-bromopropane is now under scrutiny from the US Environmental Protection Agency for potential health risks to workers and consumers. In its latest draft assessment of the chemical, the EPA finds "there could be unreasonable risks to workers, occupational non-users, consumers, and by-standers under certain conditions of use."

1-Bromopropane is a common degreaser and solvent used in dry cleaning, spray adhesives, automotive products, and other applications. In early 2016, the EPA found that 1-bromopropane poses a risk of developmental problems to children born to mothers exposed to the chemical during pregnancy. The agency also found that 1-bromopropane poses cancer and other health risks to workers repeatedly exposed to it. It is unclear what risk-management measures the EPA will suggest in its final assessment, which is due by the end of this year. A committee of external experts will review the draft during a meeting from 10-12 September. The EPA is accepting comments on the draft assessment until 11 October.

Chemical & Engineering News, 23 August 2019

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

#### EPA to Provide Relief for Certain Marine Diesel Engines

2019-08-29

The United States Environmental Protection Agency (EPA) is proposing to amend the national marine diesel engine program to provide relief to boat builders and manufacturers of lightweight and high-power marine diesel engines that are used in high-speed commercial vessels such as lobster fishing boats and pilot boats. "This proposal will provide boat builders the flexibility they need to meet EPA standards while they continue to manufacture products that are critical to marine industries," said EPA Administrator Andrew Wheeler. "This action reflects our mindset that environmental progress is best achieved by working with states and the regulated community to advance sound and attainable regulatory solutions." "This proposed rule will give boat builders and manufacturers regulatory certainty and encourage continued growth at the port," said EPA Region 4 Administrator Mary S. Walker. "This action is a win-win

**Once hailed as an alternative to chlorinated solvents and ozone-depleting substances, 1-bromopropane is now under scrutiny from the US Environmental Protection Agency for potential health risks to workers and consumers.**

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for builders and bar pilots and allows goods and services to continue moving at the port.” “This proposed rule is very important for both our bar pilots and our port in Savannah,” said Congressman Earl L. “Buddy” Carter (GA-01). “The current standards have made it impossible for the bar pilots to purchase any new vessels because there simply is not a single manufacturer that can meet the requirements. The new guidance will give the pilots the ability to purchase new vessels, so they are able to continue to do their important job while ensuring there won’t be any disruptions to the shipping traffic or other unnecessary delays at the port. I thank the EPA for working with us to correct the current flawed guidance to ensure the growth at our port and in our region isn’t negatively impacted by standards that are impossible to reach.” EPA’s proposal will help boat builders whose production capabilities have been impacted by a lack of certified engines available with the desired size and power characteristics. The proposal will provide additional lead time to meet the agency’s Tier 4 standards for qualifying engines and vessels and includes a new waiver process, which would allow for continued installation of Tier 3 engines for certain vessels if suitable Tier 4 engines continue to be unavailable. The proposal also includes changes to streamline the engine certification process to promote certification of engines with high power density. This rule also includes a proposed technical correction to the national marine diesel fuel program. This change will clarify that fuel manufacturers and distributors may sell distillate diesel fuel that meets the 2020 global sulfur standard adopted by the International Maritime Organisation (IMO). The proposed correction will help U.S. fuel manufacturers and distributors to meet the IMO standard on time and without creating additional burdens for the industry.

For more information, please visit: <https://www.epa.gov/regulations-emissions-vehicles-and-engines/amendments-related-marine-diesel-engine-emission>

U.S EPA, 26 August 2019

<http://www.epa.gov>

### **EPA Proposes to Designate 20 Chemical Substances as High-Priority Substances for Risk Evaluation under TSCA**

2019-08-29

On 23 August 2019, the United States Environmental Protection Agency (EPA) published a *Federal Register notice*, proposing to designate 20

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chemical substances as high-priority substances for risk evaluation under the Toxic Substances Control Act (TSCA). 84 Fed. Reg. 44300. The notice and supporting docket materials identify the proposed designation for each of the chemical substances and instructions on how to access the chemical-specific information, analysis, and basis used by EPA to support the proposed designation for each chemical substance. EPA requests information that would inform the exposure and hazard assessments and the identification of conditions of use for the 20 chemical substances. Comments are due 21 November 2019. In March 2019, EPA released a list of 40 chemicals for which it initiated the prioritisation process for risk evaluation. EPA selected 20 chemical substances as candidates for designation as high-priority substances and now proposes to designate the same 20 chemical substances as high-priority substances:

Chemical Name	Docket Number
p-Dichlorobenzene	EPA-HQ-OPPT-2018-0446
1,2-Dichloroethane	EPA-HQ-OPPT-2018-0427
trans-1,2-Dichloroethylene	EPA-HQ-OPPT-2018-0465
o-Dichlorobenzene	EPA-HQ-OPPT-2018-0444
1,1,2-Trichloroethane	EPA-HQ-OPPT-2018-0421
1,2-Dichloropropane	EPA-HQ-OPPT-2018-0428
1,1-Dichloroethane	EPA-HQ-OPPT-2018-0426
Dibutyl phthalate (DBP) (1,2-Benzenedicarboxylic acid, 1,2-dibutyl ester)	EPA-HQ-OPPT-2018-0503
Butyl benzyl phthalate (BBP) (1,2-Benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester)	EPA-HQ-OPPT-2018-0501
Di-ethylhexyl phthalate (DEHP) (1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester)	EPA-HQ-OPPT-2018-0433
Di-isobutyl phthalate (DIBP) (1,2-Benzenedicarboxylic acid, 1,2-bis(2-methylpropyl) ester)	EPA-HQ-OPPT-2018-0434
Dicyclohexyl phthalate	EPA-HQ-OPPT-2018-0504
4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)	EPA-HQ-OPPT-2018-0462
Tris(2-chloroethyl) phosphate (TCEP)	EPA-HQ-OPPT-2018-0476
Phosphoric acid, triphenyl ester (TPP)	EPA-HQ-OPPT-2018-0458
Ethylene dibromide	EPA-HQ-OPPT-2018-0488

**On 23 August 2019, the United States Environmental Protection Agency (EPA) published a Federal Register notice, proposing to designate 20 chemical substances as high-priority substances for risk evaluation under the Toxic Substances Control Act (TSCA).**

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Chemical Name	Docket Number
1,3-Butadiene	EPA-HQ-OPPT-2018-0451
1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta [g]-2-benzopyran (HHCB)	EPA-HQ-OPPT-2018-0430
Formaldehyde	EPA-HQ-OPPT-2018-0438
Phthalic anhydride	EPA-HQ-OPPT-2018-0459

The supporting materials for the 20 proposed high-priority chemical substances are available for comment in their respective dockets. EPA states that it generally used reasonably available information to screen the candidate chemical substances against the following criteria and considerations:

- The chemical substance's hazard and exposure potential;
- The chemical substance's persistence and bioaccumulation;
- Potentially exposed or susceptible subpopulations;
- Storage of the chemical substance near significant sources of drinking water;
- The chemical substance's conditions of use or significant changes in conditions of use;
- The chemical substance's production volume or significant changes in production volume; and
- Other risk-based criteria that EPA determines to be relevant to the designation of the chemical substance's priority.

In conducting the screening review during the prioritisation process, EPA states that it considered sources of information relevant to the screening-review criteria as outlined in TSCA Section 6(b)(1)(A) and 40 C.F.R. Section 702.9(a) and consistent with the scientific standards of TSCA Section 26(h), including, as appropriate, sources for hazard and exposure data listed in Appendices A and B of EPA's 2012 *TSCA Work Plan Chemicals: Methods Document*. In addition, EPA considered the hazard and exposure potential of the chemical substances and states that it did not consider costs or other non-risk factors in making the proposed priority designations. EPA's initiation of the prioritisation process in March 2019 included a 90-day comment period for the submission of relevant information on the 20 chemical substances identified as candidates for high-priority substance designation. EPA states that it received 125 submissions from commenters that addressed the overall prioritisation process (e.g., the collection and consideration of relevant information), the review process (e.g., the use

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of data and approaches in risk evaluation), information specific to the candidate chemical substances (e.g., relevant studies, assessments, and conditions of use), and topics not germane to the prioritisation process (e.g., scheduling future chemicals for prioritization and concerns about risk evaluation fees). To the extent that comments provided information on additional conditions of use for the 20-candidate high-priority chemical substances, EPA discusses those conditions of use in the proposed designation documents for each chemical substance. EPA will respond to those and any additional comments in conjunction with the final priority designation of the chemical substances. According to the notice, under TSCA Section 6(b)(1)(B) and 40 C.F.R. Section 702.3, a high-priority substance is defined as “a chemical substance that EPA determines, without consideration of costs or other non-risk factors, may present an unreasonable risk of injury to health or the environment because of a potential hazard and a potential route of exposure under the conditions of use, including an unreasonable risk to potentially exposed or susceptible subpopulations identified as relevant by EPA.” EPA notes that a proposed designation of a chemical substance as a high-priority substance is not a finding of unreasonable risk. EPA states that instead, when prioritisation is complete, it will have evidence that the chemicals it designated as high-priority substances may present an unreasonable risk of injury to health or the environment because of a potential hazard and a potential route of exposure under the conditions of use. Final designation of a high-priority substance initiates the risk evaluation process, culminating in a finding of whether the chemical substance presents an unreasonable risk of injury to health or the environment under the conditions of use.

### Commentary

EPA continues to develop the prioritisation process. EPA suggested the 20 high- and 20 low-priority candidate substances in March in what it deemed an “initiation” of the prioritisation process. EPA invited stakeholders to submit comments or information related to the proposed designations. EPA reports that it received 125 comment submissions touching on a variety of topics, including information on additional conditions of use. EPA states that it discussed the additional conditions of use in the proposed designation documents but does not otherwise discuss or deal with the comments. The high- and low-priority designations seem to have been a foregone conclusion. In the formal proposed designation for prioritisation, EPA does not directly respond to comments it received in the “initiation” phase, but EPA states that it will respond to those comments along with other comments it receives

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in this 90-day comment period. EPA does not defend its selection of the “next 20” in any robust way; rather, EPA seems to restate its justifications from the “initiation” phase. If comments received in response to the initiation stage are not addressed in proposing the designations, the value of the “initiation” phase seems questionable, except to extend the comment period for prioritisation. The prioritisation-risk evaluation-risk management clock is relentless and puts EPA in a difficult position if data gaps are identified in any phase. Going forward, EPA may have to initiate data gathering activities before EPA initiates or proposes substances for prioritization because once EPA starts the prioritization process, it is essentially too late to generate new information other than the most basic data. EPA can extend the prioritization deadline for three months if it requires information development under Section 4(a)(2)(B), a process that involves issuing the test order requiring industry to conduct and report the testing, followed by EPA review of the information and issuance of its final designation within 90 days of receiving the new information. TSCA Section 6(b)(1)(C) further requires that if EPA cannot support a low-priority designation during this 90-day period, it must designate the chemical as high-priority. Perhaps EPA can identify a way to time all of these steps in the process that would allow for data generation to occur while still providing the required comment periods before issuing a final designation. Then again, perhaps the complications and requirements that attend to this prioritization-related data development process are why EPA has not yet used this additional new Section 4 authority.

EPA seems to have ample evidence that the 20 high-priority candidates are worthy of that designation. Some may question whether EPA selected the “right” 20, but EPA does have some discretion on which substances it designates for prioritisation, even if EPA has not thoroughly explained why it selected these 20 among the dozens of other Work Plan chemicals. The prioritisation “preference” guidance found in Section 6(b)(2)(D) seems to be of limited value in sorting this out, as relatively few 2014 Work Plan substances have persistence *and* bioaccumulation scores of three or are known human carcinogens *and* have high acute *and* chronic toxicity.

Perhaps the more interesting outcome will be the low-priority designations. EPA will have to establish, subject to legal challenge, that it has sufficient data to establish that each substance does not meet the criteria for high-priority designation. If EPA cannot adequately satisfy the criteria for low-priority designation, EPA will have more than 20 high-

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priority substances in its risk evaluation queue while at the same time missing the statutory deadline to designate 20 low-priority substances.

National Law Review, 26 August 2019

The National Law Review, 1 April 2016

### **PEER Petitions EPA for TSCA Rule Prohibiting Oil Refineries from Using Hydrofluoric Acid in Manufacturing Processes**

2019-08-29

On 7 August 2019, the United States Environmental Protection Agency (EPA) posted a [petition for rulemaking](#) submitted by the Public Employees for Environmental Responsibility (PEER) under Section 21 of the Toxic Substances Control Act (TSCA). PEER asks that oil refineries be prohibited from using hydrofluoric acid in their manufacturing processes and that oil refineries be required to phase out the use of hydrofluoric acid within two years. According to PEER, TSCA and the Clean Air Act (CAA) regulate hydrofluoric acid and provide the statutory authority for EPA to issue a regulation prohibiting the use of hydrofluoric acid in oil refineries. PEER states that under TSCA, EPA “possesses the power to promulgate rules banning chemicals that pose an unreasonable risk to human health.” If the EPA Administrator determines that the “manufacture, processing, distribution in commerce, use, or disposal of a chemical substance . . . presents an unreasonable risk of injury to health or the environment,” TSCA Section 6(a) provides EPA the authority to prohibit or otherwise restrict “the manufacture, processing, or distribution in commerce of such substance or mixture for (i) a particular use.” PEER argues that the EPA Administrator could ban the use of hydrofluoric acid in refineries if the Administrator found that its use in that context presented an unreasonable risk to health or the environment. PEER maintains that the use of hydrofluoric acid presents such a risk. On 16 August 2019, EPA [sent a letter](#) to PEER, confirming receipt of its petition and noting that Section 21 provides the Administrator 90 days to grant or deny the petition. If the EPA Administrator grants the petition, the Administrator will “promptly commence an appropriate preceding [sic].” If the Administrator denies the petition, the Administrator will publish the reasons for the denial in the *Federal Register*.

National Law Review, 23 August 2019

The National Law Review, 1 April 2016

**On 7 August 2019, the United States Environmental Protection Agency (EPA) posted a petition for rulemaking submitted by the Public Employees for Environmental Responsibility (PEER) under Section 21 of the Toxic Substances Control Act (TSCA).**

## Regulatory Update

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### OSHA Considers Revising Silica Standard for General Industry

2019-08-29

The United States Department of Labor's Occupational Safety and Health Administration (OSHA) is now accepting comments regarding a revision to both the Respirable Crystalline Silica Standard for Construction and the Respirable Crystalline Silica Standard for General Industry. The revision(s) would further limit exposure to silica in two ways:

1. using additional engineering and work practice control methods; equipment; and tasks; and
2. broadening the circumstances under which general industry and maritime employers would be allowed to comply with the silica standard for construction as an alternative to the general standard.

As with any revision consideration to industry standards, if submitted information and response indicates these revisions are necessary, the agency will then propose the revisions to the Federal Register for public comment. Comments must be submitted by 13 November 2019. Comments and materials may be submitted electronically at <http://www.regulations.gov>, the Federal e-Rulemaking Portal, or by facsimile or mail. Further details are available at: Federal Register notice

Occupational Health & Safety News, 15 August 2019

<http://www.ohsonline.com>

**Many are calling for an expansion of silica exposure considerations, and an OSHA consideration of change is now underway.**

## EUROPE

### EC Requests Scientific Opinion on Three Coatings for Nano Forms of Zinc Oxide as a UV Filter in Dermally Applied Cosmetic Products

2019-08-29

On 19 August 2019, the Scientific Committee on Consumer Safety (SCCS) posted a request from the European Commission (EC) for a scientific opinion on three coatings for nano zinc oxide as an ultraviolet (UV) filter in dermally applied cosmetic products — methicone, silica, and isostearic acid. SCCS previously reviewed nano zinc oxide and the coatings triethoxycaprylylsilane, dimethicone, dimethoxydiphenylsilanetriethoxycaprylylsilane cross-polymer, and octyl triethoxy silane. SCCS concluded that the use of nano zinc oxide as a UV

## Regulatory Update

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filter in sunscreens, with the characteristics laid out in its opinion, and at a concentration of up to 25%, can be considered to “pose no or limited risk for use on the skin as UV filter in sunscreen formulations.” Regarding the use of other coatings not covered in the opinion, SCCS concluded that “[o]ther cosmetic ingredients can be used as coatings as long as they are demonstrated to the SCCS to be safe and do not affect the particle properties related to behaviour and/or effects, compared to the nanomaterials covered in the current opinion.” In its request, the EC asks whether:

- SCCS considers safe the use of methicone with a maximum concentration of 3% as coating on nano zinc oxide for use as UV filter in dermally applied cosmetic products;
- SCCS considers safe the use of methicone with a maximum concentration of 3% when applied in combination with 8% silica as coatings on nano zinc oxide for use as UV filter in dermally applied cosmetic products;
- SCCS considers safe the use of isostearic acid with a maximum concentration of 4% when applied in combination with 2.0% triethoxycaprylylsilane as coatings on nano zinc oxide for use as UV filter in dermally applied cosmetic products; and
- SCCS has any further scientific concerns regarding the use of nano zinc oxide coated with the above-mentioned materials when used as UV filter in dermally applied cosmetic products.

The deadline for SCCS’s opinion is March 2020.

Nano & Other Emerging Technologies Blog, 20 August 2019

<http://nanotech.lawbc.com>

### **RoHS 2- Exemption for lead in solders and termination finishes used in certain hand-held combustion engines**

2019-08-29

The European Commission have published a draft Commission Delegated Directive amending, for the purposes of adapting to scientific and technical progress, Annex III to Directive 2011/65/EU of the European Parliament and of the Council as regards an exemption for lead in solders and termination finishes used in certain hand-held combustion engines. This draft Commission Delegated Directive concerns an application specific and temporary exemption from the RoHS 2 (Directive 2011/65/EU) substance restrictions. Further information is available at:

**The European Commission have published a draft Commission Delegated Directive amending, for the purposes of adapting to scientific and technical progress, Annex III to Directive 2011/65/EU of the European Parliament and of the Council as regards an exemption for lead in solders and termination finishes used in certain hand-held combustion engines.**

## Regulatory Update

CHEMWATCH

- [19 4507 01 e.pdf](#)
- [19 4507 00 e.pdf](#)

Chemycal, 21 August 2019

<http://chemycal.com>

### French mayors ban glyphosate weedkiller, defying government

2019-08-29

Some 20 French mayors have banned glyphosate from their municipalities, defying the government, which is now taking legal action to impose national legislation which allows the controversial weedkiller's continued use for now. In 2017, President Emmanuel Macron had pledged to ban glyphosate in France within three years, rejecting a European Union decision to extend its use for five years after heated debate over whether glyphosate, developed by Bayer-owned Monsanto, can cause cancer. But Macron has since said that a blanket ban is not possible within that time frame. Bayer says regulators and extensive research have found glyphosate to be safe. Recently, the administrative tribunal of Rennes, western France, heard the mayor of Langouet, Brittany, who has banned the use of pesticides in his town within 150 meters of people's homes and workplaces. Mayor Daniel Cueff told the court - which is set to rule next week - the ban was aimed at protecting residents from molecules considered a health risk. About 300 people attended the hearing and nearly 100,000 have signed a petition to support Cueff's ban. A lawyer for the French state argued that is not in a mayor's powers to ban phytosanitary products, which are regulated by the agriculture ministry. The ministry declined to comment, but Agriculture Minister Didier Guillaume said in January France will phase out 80% of its glyphosate usage by 2021. Farmers' unions opposed the ban, saying there are no viable alternatives for the chemical and that a transition to organic farming is too costly. Allowing the mayor to override the state over glyphosate "would be the return of the local barons and the reign of the lords over their serfs," Cedric Henry, head of Brittany farmers union FDSEA-35 said in a statement. Under current legislation, glyphosate application needs to stay five to 10 meters away from housing. Wheat growers' union AGPB said in a statement that extending the non-treatment zone would withdraw thousands of hectares of land from production. Environment Minister Elisabeth Borne said that the government would review pesticides regulation soon. The government is also disputing local glyphosate bans in several other rural communes around France. Glyphosate is widely

**Some 20 French mayors have banned glyphosate from their municipalities, defying the government, which is now taking legal action to impose national legislation which allows the controversial weedkiller's continued use for now.**

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used in France, the European Union's largest grain producer, mainly by farmers, gardeners and railway operators who want to get rid of unwanted grasses at low cost. Developed by Monsanto under the brand Roundup, Glyphosate is now off-patent and marketed worldwide by dozens of other firms including Dow Agrosciences and BASF.

Reuters, 23 August 2019

<http://www.reuters.com>

### Plastics in contact with food Regulation Annex I amended

2019-08-29

Commission Regulation (EU) No. 10/2011 on plastic materials and articles intended to come into contact with food has been amended as per Commission Regulation (EU) 2019/1338 of 8 August 2019. The following substance, already listed in Annex I, has been amended:

- Poly((R)-3-hydroxybutyrate-co-(R)-3-hydroxyhexanoate)

Yorda's Hive, 20 August 2019

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

**Regulation Annex I – plastics in contact with food has been amended.**

## REACH Update

CHEMWATCH

### Public consultation on harmonised classification and labelling

2019-08-30

The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposals for 5 substances. The substances are as follows:

- N-(2-nitrophenyl)phosphoric triamide (EC 477-690-9, CAS 874819-71-3).
- A public consultation is ongoing for four isocyanates which belong to the same group of substances:
- 1,3-bis(1-isocyanato-1-methylethyl)benzene (EC 220-474-4, CAS 2778-42-9);
- 1,3-bis(isocyanatomethyl)benzene (EC 222-852-4, CAS 3634-83-1);
- 2,4,6-triisopropyl-m-phenylene diisocyanate (EC 218-485-4, CAS 2162-73-4); and
- 1,5-naphthylene diisocyanate (EC 221-641-4, CAS 3173-72-6).

The deadline for comments is 25 October 2019. Further information is available at: [Give comments](#)

ECHA News, 28 August 2019

<http://echa.europa.eu>

### New substance evaluation conclusions published

2019-08-30

The European Chemicals Agency have published new substance evaluation conclusion documents on its website. The documents are for the following substances:

- Triphenyl phosphite (EC 202-908-4, CAS 101-02-0), added to the CoRAP list in 2013 and evaluated by United Kingdom;
- A mixture of: N,N'-ethane-1,2-diylbis(decanamide);12-hydroxy-N-[2-[1-oxydecyl)amino]ethyl]octadecanamide;N,N'-ethane-1,2-diylbis(12-hydroxyoctadecanamide) (EC 430-050-2, CAS -), added to the CoRAP list in 2017 and evaluated by Spain;
- Reaction mass of 4,4'-methylenediphenyl diisocyanate and o-(p-isocyanatobenzyl)phenyl isocyanate / methylene diphenyl diisocyanate (EC 905-806-4, CAS -), added to the CoRAP list in 2015 and evaluated by Estonia.

**The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposals for 5 substances.**

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Further information is available at:

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

ECHA News, 28 August 2019

<http://echa.europa.eu>

### Scientific committees in September – agendas available

2019-08-30

The European Chemicals Agency (ECHA) has published the agenda of the upcoming meetings of the Committee for Risk Assessment (RAC) and for Socio-economic Analysis (SEAC). RAC meets from 9 to 13 September and from 16 to 20 September 2019; SEAC from 16 to 20 September 2019.

Further information is available at:

- [RAC agenda](#)
- [SEAC agenda](#)

ECHA News, 28 August 2019

<http://echa.europa.eu>

### New intentions to harmonise classification and labelling

2019-08-30

The European Chemicals Agency (ECHA) has received 3 new intentions to harmonise the classification and labelling. The intentions to harmonise the classification and labelling were received for:

- [Malathion](#) (EC 204-497-7, CAS 121-75-5);
- [9-\[2-\(ethoxycarbonyl\)phenyl\]-3,6-bis\(ethylamino\)-2,7-dimethylxanthylum chloride](#) (EC 213-584-9, CAS 989-38-8); and
- [4-phenoxyphenyl \(RS\)-2-\(2-pyridyloxy\) propyl ether](#) (EC 619-166-6, CAS 95737-68-1).

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

ECHA News, 28 August 2019

<http://echa.europa.eu>

**The European Chemicals Agency (ECHA) has published the agenda of the upcoming meetings of the Committee for Risk Assessment (RAC) and for Socio-economic Analysis (SEAC).**

## Janet's Corner

CHEMWATCH

### Environmental Sustainability Ninja

2019-08-29



## Hazard Alert

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### Maleic Anhydride

2019-08-19

Maleic anhydride (butenedioic anhydride, toxilic anhydride, 2,5-dioxofuran) is an organic compound with the formula  $C_2H_2(CO)_2O$ . [1] Under normal conditions, maleic anhydride is found as colourless crystals or a white solid, with a choking, acrid smell. It melts at 58 degrees Celsius. Maleic anhydride is corrosive. It dissolves in water to give maleic acid. It also dissolves in most organic (carbon-containing) solvents. [2]

### USES [3]

Maleic anhydride is used primarily in the formation of unsaturated polyester resins for use in boats, autos, trucks, buildings, piping, and electrical goods. Lube oil adhesives synthesised from maleic anhydride are used to prolong oil-change intervals and improve engine efficiency. Maleic anhydride is also used to make copolymers, pesticides, and other organic compounds, and in Diels-Alder syntheses.

### IN THE ENVIRONMENT [2]

Maleic anhydride in soils is readily broken down. It does not bind particularly strongly to soil particles, so can leach to groundwaters where it will be broken down naturally. In air, it reacts fairly quickly and so has a short life. Maleic anhydride does not accumulate in the environment. It is not considered likely that maleic anhydride pollution has any effects on the global environment.

### SOURCES & ROUTES OF EXPOSURE

#### Sources of Exposure [2,3]

Releases of maleic anhydride may occur from industry manufacturing, transporting, storing and using it. There are not thought to be any natural sources of maleic anhydride to the environment. Exposure to maleic anhydride would primarily be occupational from contact with spills, fugitive emissions, or vent gases. It may also be spilled or emitted into the atmosphere during its manufacture, transport, or use.

#### Routes of Exposure [4]

The major routes of exposure for maleic anhydride are:

- Inhalation

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- Skin contact
- Eye contact
- Ingestion

### HEALTH EFFECTS [3]

#### Acute Effects

Acute inhalation exposure of humans to maleic anhydride has been observed to cause irritation of the respiratory tract, burning in the larynx, reflex cough, lacrimation, headaches, eye irritation, and corneal burns (that healed within 48 hours). Bronchial asthma was observed in guinea pigs acutely exposed to maleic anhydride. Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated maleic anhydride to have moderate to high acute toxicity by ingestion and moderate acute toxicity from dermal exposure.

#### Chronic Effects

Chronic exposure to maleic anhydride has been observed to cause chronic bronchitis, asthma-like attacks, pulmonary oedema, upper respiratory tract irritation, eye irritation, and dermatitis in workers. In some people, allergies have developed so that lower concentrations can no longer be tolerated. Nose and eye irritation, upper respiratory lesions, nasal discharge, dyspnea (shortness of breath), and sneezing have been observed in rats, hamsters, and monkeys chronically exposed to maleic anhydride by inhalation. Renal lesions were observed in rats chronically exposed to maleic anhydride via gavage (experimentally placing the chemical in the stomach). Decreased body weight and increased kidney weight have also been observed in orally exposed rats. EPA has not established a Reference Concentration (RfC) for maleic anhydride. The Reference Dose (RfD) for maleic anhydride is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on renal lesions in rats. The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of  $2 \times 10^{-4}$  milligrams per cubic metre (mg/m<sup>3</sup>). The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur.

#### Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of maleic anhydride in humans. No teratogenic or fetotoxic effects were observed in the offspring of rats exposed via gavage or diet.

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### Cancer Risk

No information is available on the carcinogenic effects of maleic anhydride in humans. A study reported no treatment-related increased tumour incidence in rats exposed in their diet. EPA has not classified maleic anhydride for carcinogenicity because it has not been adequately tested regarding potential carcinogenicity.

### **SAFETY [5]**

#### First Aid Measures

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

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### Exposure Controls & Personal Protection

#### Engineering Controls

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

#### Personal Protective Equipment

The following personal protective equipment is recommended when handling maleic anhydride:

- Splash goggles;
- Synthetic apron;
- Vapour and dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves.

#### Personal Protective Equipment in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour and dust 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.

### REGULATION

#### United States [6]

**OSHA:** The Occupational Safety & Health Administration has set a Permissible Exposure Limit (PEL) for maleic anhydride of:

- General Industry: 0.25 ppm, 1 mg/m<sup>3</sup>
- Construction Industry: 0.25 ppm, 1 mg/m<sup>3</sup>TWA

**ACGIH:** The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for maleic anhydride of 0.25 ppm, 1 mg/m<sup>3</sup>TWA

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**NIOSH:** The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for maleic anhydride of: 0.25 ppm TWA

### Australia [7]

Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for maleic anhydride of: 0.25ppm, 1 mg/m<sup>3</sup>

### REFERENCES

1. [http://en.wikipedia.org/wiki/Maleic\\_anhydride](http://en.wikipedia.org/wiki/Maleic_anhydride)
2. <http://apps.sepa.org.uk/spripa/Pages/SubstanceInformation.aspx?pid=64>
3. <http://www.epa.gov/ttn/atw/hlthef/maleican.html>
4. <http://www.cdc.gov/niosh/docs/81-123/pdfs/0376.pdf>
5. <http://www.sciencelab.com/msds.php?msdsId=9927565>
6. [https://www.osha.gov/dts/chemicalsampling/data/CH\\_250100.html](https://www.osha.gov/dts/chemicalsampling/data/CH_250100.html)
7. <http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx>

## Gossip

## CHEMWATCH

### Printing flattens polymers, improving electrical and optical properties

2019-08-20

Researchers have found a way to use polymer printing to stretch and flatten twisted molecules so that they conduct electricity better. A team led by chemical and biomolecular engineers from the University of Illinois report their findings in the journal *Science Advances*. Conjugated polymers are formed by the union of electron-rich molecules along a backbone of alternating single and double chemical bonds. The conjunction allows electricity to travel very quickly through a polymer, making it highly desirable for use in electrical and optical applications. This mode of transporting charges works so well that conjugated polymers are now poised to compete with silicon materials, the researchers said. However, these polymers tend to contort into twisted spirals when they join, severely impeding charge transport. "The flatness or planarity of a conjugated polymer plays a large role in its ability to conduct electricity," said chemical and biomolecular engineering professor Ying Diao, who led the study. "Even a slight twist of the backbone can substantially hinder the ability of the electrons to delocalize and flow." It is possible to flatten conjugated polymers by applying an enormous amount of pressure or by manipulating their molecular structure, but both techniques are very labour-intensive, Diao said. "There really is no easy way to do this." Postdoctoral researcher Kyung Sun Park and graduate student Justin Kwok noticed something while running printing experiments and flow simulations in Diao's lab. Polymers go through two distinct phases of flow during printing: The first phase occurs when capillary action pulls on the polymer ink as it begins to evaporate, and the second phase is the result of the forces imposed by the printing blades and substrate, the researchers said. "Park and Kwok uncovered another phase that occurs during printing in which the polymers appear to have vastly different properties," Diao said. "This third phase occurs in between the two already-defined phases, and shows the polymers being stretched into planar shapes." Not only are the polymers stretched and flattened in this third phase, but they also remain that way after precipitating out of solution, Diao said, making it possible to fine-tune printer settings to produce conjugated polymers for use in new, faster biomedical devices and flexible electronics. "We are discovering a whole zoo of new polymer phases, all sensitive to the forces that take place during the printing process," Diao said. "We envision that these unexplored equilibria and flow-induced phases will ultimately translate into new conjugated polymers with exciting optoelectronic properties." Diao also is affiliated with the department of materials sciences

**Researchers have found a way to use polymer printing to stretch and flatten twisted molecules so that they conduct electricity better.**

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and engineering and the Beckman Institute for Advanced Science and Technology at Illinois. The National Science Foundation, Office of Naval Research and the American Association of University Women supported this study.

Science Daily, 9 August 2019

<http://www.sciencedaily.com>

### Designing a better low-fat potato chip

2019-08-20

Munching on low-fat potato chips might reduce the guilt compared with full-fat versions, but many people don't find the texture as appealing. Now, researchers have developed a technique to analyse potato chips' physical characteristics from simulated first bite to swallow, which they say could be used to help formulate a tastier low-fat snack. They report their results in the *Journal of Agricultural and Food Chemistry*. Cutting fat in potato chips usually involves reducing the vegetable oil content. However, the oil helps give the product its characteristic crunch, taste and mouthfeel. When food scientists formulate a new low-fat chip, they often rely on trained sensory panellists to tell them how well the new snack simulates the full-fat version. This process can be expensive, time-consuming and often subjective, since perceptions can vary based on factors like a person's saliva flow rate and composition. While at PepsiCo, Stefan Baier — now at Motif Ingredients — and Jason Stokes' team at the University of Queensland wanted to develop a more objective method to analyse the physical characteristics of a potato chip at four stages of simulated eating: the first bite, when the chip is taken from the package and broken by the teeth; comminution, when the chip particles are broken down further and wet by saliva; bolus formation, when the small, softened particles begin to clump as enzymes in saliva digest the starches; and swallow, when the clumped mass moves to the rear of the mouth and is finally swallowed. To develop their method, called *in vitro* oral processing, the researchers used different instruments to measure the physical characteristics of chips with various oil contents at each of the four stages. For example, for the "first bite" stage, they conducted mechanical testing to measure the force required to break the chips, and for bolus formation, they measured the hydration rate of particles in buffer as the fragments became a soft solid. The researchers used the results to design a lower-fat chip coated in a thin layer of seasoning oil, which contained a small amount of a food emulsifier. The seasoning oil made the low-fat chip more closely resemble the greasiness of a full-fat one in tests with sensory panellists, but it only

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added 0.5% more oil to the product. Food scientists could use the new technique to link physical measurements with sensory perceptions, the researchers say.

Phys.org, 7 August 2019

<http://phys.org>

### Analysis and detoxification in one step

2019-08-20

Many industrial and agriculture processes use chemicals that can be harmful for workers and the ecosystems where they accumulate. Researchers from Thailand have now developed a bioinspired method to detect and detoxify these chemicals in only one step. As they report in the journal *Angewandte Chemie*, a combination of two natural enzymatic reactions convert harmful chloro- and nitrophenols into the substance that causes the characteristic glowing of fireflies: luciferin. Oxygenated benzene or phenol molecules are part of the chemical structure of many organic substances, from lignin and tar, to pharmaceuticals, dyes, and herbicides. Phenol-derived compounds are added to plastics as plasticizers. Although many of these chemicals are not harmful as such, pesticides, herbicides, or flame retardants may degrade to cancerous and stable nitrophenols and halogenated phenols that accumulate in the workplace or in fields. Phenolic compounds are usually detected with techniques such as mass spectrometry. Biochemist Pimchai Chaiyen at the Vidyasirimedhi Institute of Science and Technology, Thailand, and colleagues, have now developed a more practical approach. They combined an established biodetoxification method with chemical and biochemical conversion schemes to detect and remove contaminants in one step. The key product is witnessed widely on summer nights in gardens and in the countryside: luciferin -- the bioluminescent compound produced by fireflies. Nature has developed several mechanisms to degrade and detoxify chemicals. Bacteria use specialised enzymes to dehalogenate phenols and convert them into oxidized compounds called benzoquinones, which can be metabolised by organisms. Enzymes called dehalogenases or mono-oxygenases have thus been used in industry for biological detoxification. Chaiyen and colleagues went further than pure detoxification and coupled the enzymatic process with a method to convert the benzoquinone product into luciferin. "The developed chemoenzymatic cascade offers additional value: it provides biodetection technology for nitrophenols and halogenated phenols," they claim. The chemoenzymatic cascade entails conversion of the product from the

**Researchers have developed a bioinspired method to detect and detoxify these chemicals in only one step. A combination of two natural enzymatic reactions convert harmful chloro- and nitrophenols into the substance that causes the characteristic glowing of fireflies: luciferin.**

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first enzymatic conversion step, benzoquinone, into luciferin in a second step, but within the same reaction vessel. To achieve conversion of benzoquinone into luciferin, the authors added the natural compound cysteine to the reaction mixture. They then included a third step in the reaction sequence and detected the luciferin product through the glowing reaction caused by an enzyme called luciferase, which is also present in fireflies. The authors also proved that their detoxification-luciferin production and detection scheme was robust and capable of quantitative conversion of hazardous phenols into luciferin. Simultaneous detoxification and luciferin production may offer additional benefits. Luciferin is a highly valued compound in biomedicine. The authors point out that their approach is a remarkably straightforward and useful strategy for analysis and detoxification of the workplace in one step, and it can be used to synthesize luciferin from waste chemicals.

Science Daily, 8 August 2019

<http://www.sciencedaily.com>

### Antiseptic resistance in bacteria could lead to next-gen plastics

2019-08-20

The molecular machinery used by bacteria to resist chemicals designed to kill them could also help produce precursors for a new generation of nylon and other polymers, according to new research by scientists from Australia and the UK. "Resistance to artificial antiseptics appears to be a lucky accident for the bacteria, and it could also be useful for humans," says Professor Ian Paulsen of Australia's Macquarie University, one of the leaders of the research group. Bacteria that are unaffected by antiseptics and antibiotics, often termed "superbugs", are a growing problem, but exactly how they develop resistance is not fully understood. In 2013 Paulsen and colleagues discovered how a bacterium called *Acinetobacter baumannii* resisted chlorhexidine, a powerful hospital-grade antiseptic listed by the World Health Organisation as an "essential medicine". *A. baumannii*'s secret weapon, they found, is a protein called Acel, which sits on its surface and pumps out any chlorhexidine that gets inside. That was surprising, because the protein has been around for a lot longer than the antiseptic. "The gene that encodes the Acel protein appears to be very old, but chlorhexidine was only created in the twentieth century," says lead author Dr Karl Hassan, from Australia's University of Newcastle. "So, the gene can't have the native function of protecting against chlorhexidine. It's a side reaction that is fortunate for the bacteria." Now Hassan, Paulsen

**Australia-UK researchers identify ancient protein pumps that make bacteria tough to treat -- but could be key to new green polymers**

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and colleagues have looked at what other compounds are transported by Acel and its relations, collectively known as Proteobacterial Antimicrobial Compound Efflux (PACE) proteins. They found good news and bad news. The bad news was that PACE proteins are likely to be future engines of antimicrobial resistance. The good news is that their ability to transport a wide range of substances means that they could be effectively repurposed in an industrial context to catalyse the manufacture of "petroleum-free" polymers such as nylon. "These PACE proteins are very promiscuous in the compounds that they transport and are a likely cause of future resistance to new antimicrobials that are currently being developed," says Professor Peter Henderson at the University of Leeds, a senior researcher on the team.

EurekAlert, 12 August 2019

<http://www.eurekalert.org>

### **Aspirin may interact with cells' DNA modifications to alter breast cancer outcomes**

2019-08-20

New findings suggest that women with specific DNA characteristics in certain areas of the genome may live longer if they take aspirin before they are diagnosed with breast cancer. Published early online in *CANCER*, a peer-reviewed journal of the American Cancer Society, the findings point to the need for studies on the potential of aspirin to prevent or treat breast cancer in some individuals. It is often unclear why some patients benefit from a particular therapy while others do not. In some cases, gene sequences play a role, but in other cases, chemical modifications to DNA may be important. The latter are termed epigenetic changes, and they include a process called DNA methylation. Tengteng Wang, PhD, MSPH, and her mentor Marilie Gammon, PhD, of the University of North Carolina at Chapel Hill, wondered whether DNA methylation may influence the effects of aspirin in patients with breast cancer. The team examined DNA methylation in breast tumour tissues--including at DNA sites that control the expression of 13 breast cancer-related genes--and also in cells circulating in patients' blood. The study is the first to examine the effect of DNA methylation on the association between aspirin use and mortality in women with breast cancer. In the study of 1266 women who were diagnosed with breast cancer during the 1996-1997 period, 476 died from any cause and 202 died specifically from breast cancer by the end of 2014. In women who used aspirin, the risk of dying from any cause and the risk of dying from breast cancer was lower among those

**New findings suggest that women with specific DNA characteristics in certain areas of the genome may live longer if they take aspirin before they are diagnosed with breast cancer.**

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whose DNA was not methylated in the region that controlled expression of the breast cancer-related BRCA1 gene. Other methylation patterns related to aspirin use and mortality were also observed. The authors noted that the findings could help identify individuals who may benefit from aspirin after a breast cancer diagnosis due to their cells' DNA methylation profile. Future research should consider a more comprehensive DNA methylation profile in order to better characterise women who are at risk. "Consideration of DNA methylation profiles as potential modifiers of the aspirin-mortality association may provide new insights on the underlying biological mechanisms on aspirin use in relation to mortality after breast cancer diagnosis," said Dr. Wang. "Our findings, if confirmed, may also impact clinical decision-making by identifying a subgroup of patients, using epigenetic markers, for whom pre-diagnosis aspirin use impacts subsequent mortality, and may help refine risk reduction strategies to improve survival among women with breast cancer," added Dr. Gammon.

In an accompanying editorial, Kristen Malecki, PhD, MPH, of the University of Wisconsin-Madison, noted that the findings support the importance of research examining interactions between epigenetics and low-cost therapies such as aspirin. According to Dr. Malecki, "The study by Wang et al. shows that beyond gene-environment interactions, epigenetic and environment interactions also exist, and suggest that DNA methylation could in the future help to support the identification of individuals for whom treatment may or may not be successful.

EurekAlert, 12 August 2019

<http://www.eurekalert.org>

### Clip this tiny gadget to your backpack and get real-time reports of the air quality around you

2019-08-20

Government air quality measurements only come from a few locations. Now you can find out how clean the air is on your block, on your commute, or even in your house. You might be surprised by what you find. A few years ago, when product designers from a San Francisco-based design studio travelled to China to visit factories for client projects, they couldn't stop thinking about the smog. "We began to wonder how we can understand if the air around us was safe and how we could measure it," says Vera Kozyr, one of the founders of the studio, called NotAnotherOne. Cities typically measure air pollution only in a few locations and report averages, though pollution varies block by block. (In China, the

**Researchers have developed a tiny device called the Atmotube Pro, which is a tiny device that can be clipped to a backpack that allows real-time reports of air quality.**

## Gossip

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government also reports the data in misleading ways.) When the designers couldn't find a device to give more personalised and accurate air quality data, they created one. For the last few days, I've tried using the latest version of their device, called the Atmotube Pro. A little smaller than a deck of cards, it's designed to clip on the side of a backpack or bag, so you can track changing pollution levels as you walk down the street. A tiny fan inside the gadget pulls in air and pushes it through chambers with sensors that measure pollutants like particulate matter, microscopic particles of soot, and other pollution that can worsen asthma and cause other health problems. The sensors measure three sizes of particulate matter—PM 1, PM 2.5, and PM 10. The smaller the particle, the more likely it will enter the bloodstream. The device also measures volatile organic compounds, gases that are also linked to disease. On a connected app, it tracks pollution levels in real time—with alerts if pollution gets particularly bad—along with temperature, humidity, atmospheric pressure, and altitude. As I walk around the Bay Area, the data is mostly a testament to the power of strict air quality laws. In the 1970s, when my parents first moved to the area, the sky was often a sickly yellow. Old photos show freeways surrounded by haze and heavy smog behind the Golden Gate Bridge. But the state had recently enacted new regulations to begin to reduce emissions—including regulations to cut smog from cars that predated the Clean Air Act. And while pollution hasn't disappeared, the air has transformed. As I walk down my own block, the Atmotube app gives me air quality readings in the upper 90s; 100 is a perfect score. Street by street, the app showed slight changes in pollution, as the levels ticked higher with more traffic. The device can be a tool to better understand the impact of your daily commute. "One option is just changing your route, if you're walking or if you're using a bicycle," says Kozyr. Drivers using the device might notice how much pollution they're breathing as they sit in traffic and decide to close their windows. I watched levels climb as I waited at an intersection next to an idling truck, or when I passed a construction site. The biggest revelation was the level of pollution in my apartment when I returned from a weekend away. It also spiked higher as I turned on a gas stove to start cooking dinner. "Air quality stations in the city don't take into account indoor air pollution at all," Kozyr says, adding that levels of VOCs can be five times higher inside than outside. She says that some customers stop using typical cleaning products after they watch VOC levels rise, and many customers end up getting air purifiers. At a bigger scale, the outdoor

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data can give a more detailed picture of pollution in cities. The app crowdsources data from each device to map pollution around the world.

Fast Company, 15 August 2019

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

### This Superconductor Could Be Key to a Whole Different Type of Quantum Computer

2019-08-20

For quantum computing to become fully realised, we're going to have to make a few huge scientific leaps along the way – including finding a superconductor that can act in the same way as silicon does in today's computing. A team of researchers thinks that search might now be over. Introducing the compound uranium ditelluride (UTe<sub>2</sub>), which a new study says could be used to build logic circuits with qubits – those super-powerful quantum bits that can be in two states at once. One of the major problems quantum physicists are currently coming up against is keeping those qubits operational and stable for long enough to do some actual computing with them. It's a thorny issue known as quantum decoherence. What makes UTe<sub>2</sub> stand out as a superconductor is its strong resistance to magnetic fields - resistance to the errors that could otherwise creep into quantum calculations. "This is potentially the silicon of the quantum information age," says physicist Nick Butch, from the National Institute of Standards and Technology (NIST). "You could use uranium ditelluride to build the qubits of an efficient quantum computer." Butch and his colleagues stumbled on the quantum-friendly properties of UTe<sub>2</sub> while investigating a variety of uranium-based magnets. The initial thinking was that UTe<sub>2</sub> might become magnetic at low temperatures – and while that didn't happen, the compound did become a superconductor. Technically, uranium ditelluride is a spin triplet, rather than a spin singlet, like most other superconductors are. This means that its Cooper pairs – electrons bound together at low temperatures – can be orientated differently. The physics can get very complex very quickly, but the important point is that these properties mean the Cooper pairs can be aligned in parallel rather than in opposition, and that in turn suggests UTe<sub>2</sub> should retain its superconductivity in the face of external disturbances (threats to quantum coherence). "These parallel spin pairs could help the computer remain functional," says Butch. "It can't spontaneously crash because of quantum fluctuations." One of the reasons why quantum computing can be a head-spinner is that there are several possible approaches to it, and scientists aren't yet sure which one is going to work best (or at all). Using UTe<sub>2</sub>

**For quantum computing to become fully realised, we're going to have to make a few huge scientific leaps along the way – including finding a superconductor that can act in the same way as silicon does in today's computing.**

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in this way would take the topological quantum computing approach, an approach that hasn't been explored as much as other options so far: essentially, it aims to encode qubits in a type of quasiparticle that may not actually exist. Much of topological quantum computing is still hypothetical, but its big advantage – if indeed it works – is that it wouldn't require the same level of quantum error correction just to remain coherent and stable. That could give us logical qubits that work without the need for a lot of other qubits just for error correction. Topological quantum computing has challenges of its own, and we're still a long way from a general-purpose quantum computer, but it's a step in the right direction – like many other exciting advancements we're seeing. And the team thinks uranium ditelluride has a few more secrets to give up yet, both in regards to quantum computing and superconductors in general. "Exploring it further might give us insight into what stabilises these parallel-spin superconductors," says Butch. "A major goal of superconductor research is to be able to understand superconductivity well enough that we know where to look for undiscovered superconductor materials." "Right now, we can't do that. What about them is essential? We are hoping this material will tell us more." The research has been published in Science.

Science Alert, 17 August 2019

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

### Wearable sensors detect what's in your sweat

2019-08-20

Needle pricks not your thing? A team of scientists at the University of California, Berkeley, is developing wearable skin sensors that can detect what's in your sweat. They hope that one day, monitoring perspiration could bypass the need for more invasive procedures like blood draws, and provide real-time updates on health problems such as dehydration or fatigue. In a paper appearing 16 August in Science Advances, the team describes a new sensor design that can be rapidly manufactured using a "roll-to-roll" processing technique that essentially prints the sensors onto a sheet of plastic like words on a newspaper. They used the sensors to monitor the sweat rate, and the electrolytes and metabolites in sweat, from volunteers who were exercising, and others who were experiencing chemically induced perspiration. "The goal of the project is not just to make the sensors but start to do many subject studies and see what sweat tells us -- I always say 'decoding' sweat composition," said Ali Javey, a professor of electrical engineering and computer science at UC Berkeley and senior author on the paper. "For that we need sensors

**New easy-to-make sensors can provide real-time measurements of sweat rate and electrolytes and metabolites in perspiration**

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that are reliable, reproducible, and that we can fabricate to scale so that we can put multiple sensors in different spots of the body and put them on many subjects," said Javey, who also serves as a faculty scientist at Lawrence Berkeley National Laboratory. The new sensors contain a spiraling microscopic tube, or microfluidic, that wicks sweat from the skin. By tracking how fast the sweat moves through the microfluidic, the sensors can report how much a person is sweating, or their sweat rate. The microfluidics are also outfitted with chemical sensors that can detect concentrations of electrolytes like potassium and sodium, and metabolites like glucose. Javey and his team worked with researchers at the VTT Technical Research Centre of Finland to develop a way to quickly manufacture the sensor patches in a roll-to-roll processing technique similar to screen printing. "Roll-to-roll processing enables high-volume production of disposable patches at low cost," Jussi Hiltunen of VTT said. "Academic groups gain significant benefit from roll-to-roll technology when the number of test devices is not limiting the research. Additionally, up-scaled fabrication demonstrates the potential to apply the sweat-sensing concept in practical applications." To better understand what sweat can say about the real-time health of the human body, the researchers first placed the sweat sensors on different spots on volunteers' bodies -- including the forehead, forearm, underarm and upper back -- and measured their sweat rates and the sodium and potassium levels in their sweat while they rode on an exercise bike. They found that local sweat rate could indicate the body's overall liquid loss during exercise, meaning that tracking sweat rate might be a way to give athletes a heads up when they may be pushing themselves too hard. "Traditionally what people have done is they would collect sweat from the body for a certain amount of time and then analyse it," said Hnin Yin Nyein, a graduate student in materials science and engineering at UC Berkeley and one of the lead authors on the paper. "So, you couldn't really see the dynamic changes very well with good resolution. Using these wearable devices, we can now continuously collect data from different parts of the body, for example to understand how the local sweat loss can estimate whole-body fluid loss." They also used the sensors to compare sweat glucose levels and blood glucose levels in healthy and diabetic patients, finding that a single sweat glucose measurement cannot necessarily indicate a person's blood glucose level. "There's been a lot of hope that non-invasive sweat tests could replace blood-based measurements for diagnosing and monitoring diabetes, but we've shown that there isn't a simple, universal correlation between sweat and blood glucose levels," said Mallika Bariya, a graduate student in materials science and engineering at UC Berkeley and the other lead author on the lead author on the paper. "This is important for

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the community to know, so that going forward we focus on investigating individualized or multi-parameter correlations.”

Science Daily, 16 August 2019

<http://www.sciencedaily.com>

### New tools of data science used to capture single molecules in action

2019-08-20

In high school chemistry, we all learned about chemical reactions. But what brings two reacting molecules together? As explained to us by Einstein, it is the random motion of inert molecules driven by the bombardment of solvent molecules. If brought close enough together, by random chance, these molecules may react. Capturing the motion of single molecules is achieved by a method known as Fluorescence Correlation Spectroscopy (FCS). The catch? It takes very many detections of light particles, photons, emitted by single molecules to get a clear picture of molecular motion. As an illustration, think of a political poll. At any given time in a campaign cycle, polls are used to predict the outcome of an upcoming election. But how many voters must we interrogate to get an accurate prediction and, given how time-sensitive polling information is, how quickly can we probe the nation’s political leanings? Asking every voter in every state would yield accurate results but be too costly in time and dollars. For practical reasons, we need to take a sample of voters and efficiently exploit all information contained in that sample. The voters in this illustration are our proverbial photons here. The long times needed to acquire data in FCS is just like the naïve polling strategy highlighted earlier. It takes too long, and the chemistry we care about learning might already be done. Furthermore, exposing samples to the laser for long periods of time may result in the photochemical damage of molecules under study, preventing the widespread use of FCS in biological research. “Single-molecule fluorescence techniques have revolutionised our understanding of the dynamics of many critical molecular processes, but signals are inherently noisy and experiments require long acquisition times,” explained Marcia Levitus, an associate professor in the School of Molecular Sciences and the Biodesign Institute. This work leverages new tools from data science in order to make every photon detected count and refine our picture of molecular motion. “New mathematical tools make it possible to think about old but powerful experiments in a new light,” said Steve Pressé, lead author on the study and joint professor in the Department of Physics and School of Molecular Sciences at ASU at

**Capturing the motion of single molecules is achieved by a method known as fluorescence correlation spectroscopy (FCS). The catch? It takes many detections of light particles -- photons -- emitted by single molecules to get a clear picture of molecular motion.**

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Arizona State University. A paper published in Nature Communications by Pressé and collaborators now addresses these issues using tools from data science and, more specifically, Bayesian nonparametrics -- a type of statistical modelling tool so far largely used outside the natural sciences. Levitus adds "Old strategies limited our ability to probe anything but slow processes, leaving a vast number of interesting biological questions involving faster chemical reactions out of reach. Now we can begin asking questions on processes resolved in short order."

Science Daily, 14 August 2019

<http://www.sciencedaily.com>

### Stronger graphene oxide 'paper' made with weaker units

2019-08-20

Want to make a super strong material from nano-scale building blocks? Start with the highest quality building blocks, right? Wrong -- at least when working with "flakes" of graphene oxide (GO). A new study from Northwestern University researchers shows that better GO "paper" can be made by mixing strong, solid GO flakes with weak, porous GO flakes. The finding will aid the production of higher quality GO materials, and it sheds light on a general problem in materials engineering: how to build a nano-scale material into a macroscopic material without losing its desirable properties. "To put it in human terms, collaboration is very important," said Jiaxing Huang, Northwestern Engineering professor of materials science and engineering, who led the study. "Excellent players can still make a bad team if they don't work well together. Here, we add some seemingly weaker players and they strengthen the whole team." The research was a four-way collaboration. In addition to Huang's, three other groups participated, led by Horacio Espinosa, professor of mechanical engineering at the McCormick School of Engineering; SonBinh Nguyen, professor of chemistry at Northwestern; and Tae Hee Han, a former postdoc researcher at the University who's now a professor of organic and nano engineering at Hanyang University, South Korea. The study was published today in Nature Communications.

#### High-tech paper

GO is a derivative of graphite that can be used to make the two-dimensional, super material graphene. Since GO is easier to make, scientists study it as a model material. It generally comes as a dispersion of

**A counterintuitive discovery will help engineers make stronger materials.**

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tiny flakes in water. From one end to the other, each flake is smaller than the width of a human hair and only one nanometre thick. When a solution of GO flakes is poured onto a filter and the water removed, a thin “paper” is formed, usually a few inches in diameter with a thickness less than or equal to 40 micrometres. Intermolecular forces hold the flakes together, nothing more.

#### Strength from weakness

Scientists can make strong GO in single layers but layering the flakes into a paper form doesn't work too well. While testing the effect of holes on the strength of GO flakes, Huang and his collaborators discovered a solution. Using a mixture of ammonia and hydrogen peroxide, the researchers chemically “etched” holes in the GO flakes. Flakes left soaking for one to three hours were drastically weaker than un-etched flakes. After five hours of soaking, flakes became so weak they couldn't be measured. Then, the team found something surprising: Paper made from the weakened flakes was stronger than expected. At the single layer level, one-hour-etched porous flakes, for example, were 70 percent weaker than solid flakes, but paper made from those flakes was only 10 percent weaker than paper made from solid flakes. Things got even more interesting when the team mixed solid and porous flakes together, Huang said. Instead of weakening the paper made solely from solid flakes, the addition of 10 or 25 percent of the weakest flakes strengthened it by about 95 and 70 percent, respectively.

#### Effective connection

If GO sheets can be likened to aluminium foil, Huang said, making a GO paper is just like stacking the foil up to make a thick aluminium slab. If you start with large sheets of aluminium foil, chances are good that many will wrinkle, impeding tight packing between sheets. On the other hand, smaller sheets don't wrinkle as easily. They pack together well but create tight stacks that don't integrate well with other tight stacks, creating voids within GO paper where it can easily break. “Weak flakes warp to fill in those voids, which improves the distribution of forces throughout the material,” Huang said. “It's a reminder that the strength of individual units is only part of the equation; effective connection and stress distribution is equally important.” This finding will be directly applicable to other two-dimensional materials, like graphene, Huang said, and will also lead to the

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design of higher quality GO products. He hopes to test it out on GO fibres next.

Science Daily, 15 August 2019

<http://www.sciencedaily.com>

### There's a link between dementia risk and blood pressure

2019-08-20

Researchers have discovered a link between better control of high blood pressure than current standards and lower risks of dementia and cognitive impairment. Specifically, the magnetic resonance imaging (MRI) study of 449 adults shows that those with high blood pressure who achieved systolic blood pressure of less than 120 mm Hg—known as “intensive” blood pressure control—had a small but significantly lower amount of white matter lesions on their brain but a slightly greater decrease in brain volume than similar patients who achieved the current standard for healthy blood pressure of 140 mm Hg. The great news from this research is that high blood pressure is a treatable condition, and if you treat high blood pressure aggressively, you could have a positive benefit on cognition and brain structure,” says R. Nick Bryan, chair and professor of the diagnostic medicine department at Dell Medical School at the University of Texas at Austin. “Though the benefit may be small, it’s one of the few impactful cognition-related interventions we have,” Bryan says. White matter brain lesions are well documented to be associated with a greater likelihood or intensity of cognitive decline. According to the American Heart Association, high blood pressure is considered 130 mm Hg or higher. The current study supports the findings of a related study published in January that showed intensive blood pressure control is associated with fewer incidents of cognitive adverse events. Both studies were part of a larger body of research known as Systolic Blood Pressure Intervention Trial (SPRINT), designed to determine the protective value of lower blood pressure for heart, kidney and brain health. Previous research within SPRINT also showed that intensive blood pressure control among people with hypertension is linked to better outcomes in terms of risks of heart attack, heart failure, and death. In the current study, researchers compared MRI scans of adults age 50 and older with an average age 67 years old with systolic blood pressure between 130 and 180 mm Hg at baseline and four years later, noting white matter lesions and brain volume. The next step in this investigation is to understand the effects of intensive blood pressure control among younger adults, such as those

**Researchers have discovered a link between better control of high blood pressure than current standards and lower risks of dementia and cognitive impairment.**

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in their 40s, says Bryan. "We need to understand how aggressive should we be with blood pressure control when we're earlier on in the process," he says. The research appears in the *Journal of the American Medical Association*. Funding for the study came from the National Institutes of Health.

Futurity, 15 August 2019

<http://www.futurity.org>

### Ring-shaped multi-carbon compound cyclocarbon synthesised

2019-08-20

A team of researchers from Oxford University and IBM Research has for the first time successfully synthesised the ring-shaped multi-carbon compound cyclocarbon. In their paper published in the journal *Science*, the group describes the process they used and what they learned about the bonds that hold a cyclocarbon together. Carbon is one of the most abundant elements, and has been found to exist in many forms, including diamonds and graphene. The researchers with this new effort note that much research has been conducted into the more familiar forms (allotropes) how they are bonded. They further note that less well-known types of carbon have not received nearly as much attention. One of these, called cyclocarbon, has even been the topic of debate. Are the two-neighbour forms bonded by the same length bonds, or are there alternating bonds of shorter and longer lengths? The answer to this question has been difficult to find due to the high reactivity of such forms. The researchers with this new effort set themselves the task of finding the answer once and for all. The team's approach involved creating a precursor molecule and then whittling it down to the desired form. To that end, they used atomic force microscopy to create linear lines of carbon atoms atop a copper substrate that was covered with salt to prevent the carbon atoms from bonding with the subsurface. They then joined the lines of atoms to form the carbon oxide precursor C<sub>24</sub>O<sub>6</sub>, a triangle-shaped form. Next, the team applied high voltage through the AFM to shear off one of the corners of the triangle, resulting in a C<sub>22</sub>O<sub>4</sub> form. They then did the same with the other two corners. The result was a C<sub>18</sub> ring—an 18-atom cyclocarbon. After creating the ring, the researchers found that the bonds holding it together were the alternating long- and short-type bonds that had been previously suggested. The researchers note that their technique allows for further experimentation—they could try fusing cyclocarbons, for example, to create new kinds of molecules and, by extension, materials. They further

**A team of researchers from Oxford University and IBM Research has for the first time successfully synthesised the ring-shaped multi-carbon compound cyclocarbon.**

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note that the technique also opens the door to the creation of new types of electronics based on single-electron transfer.

Phys.org, 16 August 2019

<http://phys.org>

### Organic dye in zinc oxide interlayer stabilises and boosts the performance of organic solar cells

2019-08-20

Organic solar cells are made of cheap and abundant materials, but their efficiency and stability still lag behind those of silicon-based solar cells. A Chinese-German team of scientists has found a way to enhance the electric conductivity of organic solar cells, which increases their performances. Doping the metal oxide interlayer, which connected the electrode and active layer, with a modified organic dye boosted both the efficiency and stability, the study published in the journal *Angewandte Chemie* revealed. Organic solar cells convert light into electric current. The heart of the cells is the active organic layer made of specially designed organic molecules. Here, electrons and holes, the positive counterparts of the electrons, are generated by light and travel to the electrodes to form the electric current. A recurrent problem in organic solar cell design is the matching of the material types. The electrodes are made of inorganic materials, but the active layer is organic. To join the two materials, metal oxide interlayers are introduced in many organic cell types. But in most designs, the resulting conductivities are not optimal. Frank Würthner at the University of Würzburg, Germany, and Zengqi Xie at the South China University of Technology (SCUT), Guangzhou, China, investigated the idea of making a zinc oxide interlayer slightly more organic and photoconductive to reduce the contact resistance when irradiated with sunlight. The scientists prepared an organic dye in such a way that it formed stable complexes with the zinc ions present in the zinc oxide layer. Under sunlight, this modified dye called hydroxy-PBI would then inject electrons into the zinc oxide interlayer, which would increase its conductivity. The scientists then assembled the organic solar cell, which consisted of an indium tin oxide glass (ITO) electrode, the zinc oxide layer doped with the hydroxy-PBI dye, the active layer made of a polymer as the electron donor and an organic molecule as the acceptor, another metal oxide interlayer, and an aluminium electrode as the positive electrode. This architecture, which is called an inverted bulk heterojunction cell, is that of a state-of-the-art organic solar cell, which achieves a maximum 15 percent power conversion efficiency. The interlayer doping was beneficial

**Organic solar cells are made of cheap and abundant materials, but their efficiency and stability still lag behind those of silicon-based solar cells.**

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in several ways. Depending on the dye—the scientists checked the performance of several dyes with slightly different structures— conversion efficiencies of almost 16 percent were achieved. And the dye-doped zinc oxide interlayer also appeared to be more stable than one without the doping. The authors said that it was important that the PBI dye was modified to its hydroxy-PBI form, which gave rise to tight complexes with the zinc ions. Only then could an inorganic–organic hybrid structure evolve to form a good contact with the active materials.

Phys.org, 16 August 2019

<http://phys.org>

### Ammonia for fuel cells

2019-08-20

Fuel cells are pollution-free power sources that convert chemical energy to electricity with high efficiency and zero emissions. Fuel cell cars, trucks, and buses would allow people to travel long distances with convenient refuelling and less of a carbon footprint. Researchers at the University of Delaware are working on technology to make fuel cells cheaper and more powerful so that fuel cell vehicles can be a viable option for all someday. Traditional fuel cell research involves hydrogen fuel cells, but the UD researchers are engineering fuel cells that utilise ammonia instead. In a new analysis published in the journal *Joule*, a team of engineers at the Centre for Catalytic Science and Technology found that among fuels produced from renewable energy, ammonia has the lowest cost per equivalent gallon of gasoline. "As a nitrogen-based liquid fuel, ammonia is cheaper to store and distribute than hydrogen and avoids the carbon dioxide emissions of other liquid fuels, which are expensive to capture" said Brian Setzler, one of the lead authors and a postdoctoral associate at UD. The challenges, however, are that ammonia does not work in a proton exchange membrane fuel cell; and that ammonia is more difficult to oxidise than hydrogen, which causes ammonia fuel cells to produce less power than hydrogen fuel cells. The team solved the first problem by using hydroxide exchange membrane fuel cells that have been studied for over a decade in the lab of Yushan Yan, a Distinguished Engineering Professor at UD. Assisted by a \$2.5 million grant from the REFUEL program of the Advanced Research Projects Agency-Energy (ARPA-E) in the U.S. Department of Energy, the UD team engineered a fuel cell membrane that can operate at higher temperatures to speed up ammonia oxidation. They also identified catalysts that were not poisoned by ammonia. "With these improvements, we have demonstrated a new direct ammonia fuel

**Traditional fuel cell research involves hydrogen fuel cells, but UD researchers are engineering fuel cells that utilise ammonia.**

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cell prototype with a peak power density of 135 milliwatts per square centimetre, which closes much of the performance gap compared to hydrogen," said research associate Yun Zhao, the lead author of the paper who has been working on direct ammonia fuel cells since 2016.

Phys.org, 15 August 2019

<http://phys.org>

### Optofluidic chip with nanopore 'smart gate' developed for single molecule analysis

2019-08-20

A new chip-based platform developed by researchers at UC Santa Cruz integrates nanopores and optofluidic technology with a feedback-control circuit to enable an unprecedented level of control over individual molecules and particles on a chip for high-throughput analysis. In a paper published 16 August in Nature Communications, the researchers reported using the device to control the delivery of individual biomolecules--including ribosomes, DNA, and proteins--into a fluid-filled channel on the chip. They also showed that the device can be used to sort different types of molecules, enabling selective analysis of target molecules from a mixture. The capabilities of the programmable nanopore-optofluidic device point the way toward a novel research tool for high-throughput single-molecule analysis on a chip, said Holger Schmidt, the Kapany Professor of Optoelectronics at UC Santa Cruz and corresponding author of the paper. "We can bring a single molecule into a fluidic channel where it can then be analysed using integrated optical waveguides or other techniques," Schmidt said. "The idea is to introduce a particle or molecule, hold it in the channel for analysis, then discard the particle, and easily and rapidly repeat the process to develop robust statistics of many single-molecule experiments." The new device builds on previous work by Schmidt's lab and his collaborator Aaron Hawkins' group at Brigham Young University to develop optofluidic chip technology combining microfluidics (tiny channels for handling liquid samples on a chip) with integrated optics for optical analysis of single molecules. The addition of nanopores allows controlled delivery of molecules into the channel, as well as the opportunity to analyse the electrical signal produced as a molecule passes through the pore. This latest work was led by first author Mahmudur Rahman, a graduate student in Schmidt's lab at UC Santa Cruz. Nanopore technology has been successfully used in DNA sequencing applications, and Schmidt and other researchers have been exploring new ways to exploit the information in the signals produced as molecules

**Programmable device enables on-demand delivery of individual biomolecules with feedback-controlled gating for high-throughput analysis**

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or particles translocate through a nanopore. With the feedback control system (a microcontroller and solid-state relay) in the new device, real-time analysis of the current turns the nanopore into a "smart gate" that can be programmed by the user to deliver molecules into the channel in a predetermined manner. The gate can be closed as soon as a single molecule (or any number set by the user) has passed through, and opened again after a set time. "The use of nanopores as 'smart gates' is a key step toward a single-molecule analysis system that is user-friendly and can work at high throughput," Schmidt said. "It allows user-programmable control over the number of molecules that are being delivered to a fluidic channel for further analysis or processing, selective gating of different types of single molecules, and the ability to deliver single molecules into a chip at record rates of many hundreds per minute." Using bacterial (70S) ribosomes, the researchers demonstrated controlled delivery of more than 500 ribosomes per minute. Co-author Harry Noller, the Sinsheimer Professor of Molecular Biology at UC Santa Cruz, has done pioneering research on the structure and function of ribosomes, the molecular machines that synthesize proteins in all living cells, and has been collaborating with Schmidt's group since 2006. The researchers also used a mixture of DNA and ribosomes to show the device's capacity to selectively activate the gating function for a target molecule (in this case, DNA). This can enable, for example, fluorescence experiments on a controlled number of target molecules, while unlabelled particles are ignored and discarded. Selective gating could also be used for purification or sorting of different particles downstream from the nanopore, based on the signals as the particles pass through the nanopore, Schmidt said. The programmable system allows flexibility for a wide range of potential applications, he said.

EurekaAlert, 16 August 2019

<http://www.eurekaalert.org>

### **Nanoscale 'glass' bottles could enable targeted drug delivery**

2019-08-20

Tiny silica bottles filled with medicine and a special temperature-sensitive material could be used for drug delivery to kill malignant cells only in certain parts of the body, according to a study published recently by researchers at the Georgia Institute of Technology. The research team devised a way to create silica-based hollow spheres around 200 nanometres in size, each with one small hole in the surface that could enable the spheres to encapsulate a wide range of payloads to be released

**Tiny silica bottles filled with medicine and a special temperature-sensitive material could be used for drug delivery to kill malignant cells only in certain parts of the body, according to a study published recently by researchers at the Georgia Institute of Technology.**

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later at certain temperatures only. In the study, which was published on 4 June in the journal *Angewandte Chemie International Edition*, the researchers describe packing the spheres with a mixture of fatty acids, a near-infrared dye, and an anticancer drug. The fatty acids remain solid at human body temperature but melt a few degrees above. When an infrared laser is absorbed by the dye, the fatty acids will be quickly melted to release the therapeutic drug. "This new method could allow infusion therapies to target specific parts of the body and potentially negating certain side effects because the medicine is released only where there's an elevated temperature," said Younan Xia, professor and Brock Family Chair in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University. "The rest of the drug remains encapsulated by the solid fatty acids inside the bottles, which are biocompatible and biodegradable." The researchers also showed that the size of the hole could be changed, enabling nanocapsules that release their payloads at different rates. "This approach holds great promise for medical applications that require drugs to be released in a controlled fashion and has advantages over other methods of controlled drug release," Xia said. An earlier method for achieving controlled drug release involves loading the temperature-sensitive material into low-density lipoproteins, which is often referred to as "bad cholesterol." Another method involves loading the mixture into gold nanocages. Both have disadvantages in how the material used to encapsulate the drugs interact with the body, according to the study. To make the silica-based bottles, the research team started by fabricating spheres out of polystyrene with a small gold nanoparticle embedded in its surface. The spheres are then coated with a silica-based material everywhere except where the gold nanoparticle is embedded. Once the gold and polystyrene are removed, only a hollow silica sphere with a small opening remains. To adjust the size of the opening, the researchers simply changed the size of the gold nanoparticle. The process to load the bottles with their payload involves soaking the spheres in a solution containing the mixture, removing the trapped air, then washing away the excess material and payload with water. The resulting nanocapsules contain an even mixture of the temperature-sensitive material, the therapeutic drug, and the dye. To test the release mechanism, the researchers then put the nanocapsules in water and used a near-infrared laser to heat the dye while tracking the concentration of the released therapeutic. The test confirmed that without the use of the laser, the medicine remains encapsulated. After several minutes of heating, concentrations of the therapeutic rose in the water. "This controlled release system enables us to deal with the adverse impacts associated with most chemotherapeutics by only releasing

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the drug at a dosage above the toxic level inside the diseased site," said Jichuan Qiu, a postdoctoral fellow in the Xia group.

EurekaAlert, 15 August 2019

<http://www.eurekaalert.org>

### Green chemists find a way to turn cashew nut shells into sunscreen

2019-08-20

A team of international scientists has found an environmentally friendly way of producing potential sunscreens by using cashew nut shells, a waste material. The team of "green chemists" from the University of the Witwatersrand, along with colleagues from Universities in Germany, Malawi and Tanzania, are working on techniques to produce useful compounds from wood and other fast growing non-edible plant waste, through a chemical process named xylochemistry (wood chemistry). By using cashew nut shells, the team has produced new aromatic compounds that show good UVA and UVB absorbance, which may be applied to protect humans, livestock, as well as polymers or coatings from harmful rays from the sun. The research has just been published as the cover article of the European Journal of Organic Chemistry. UV rays are damaging to most materials, with its effects leading to the discoloration of dyes and pigments, weathering, yellowing of plastics, loss of gloss and mechanical properties, while it can lead to sunburn, premature aging and even the development of potentially lethal melanomas in both humans and animals. To mitigate UV damage, both organic and inorganic compounds are used as UV filters. Ideal organic UV filters display a high UV absorption of UVA rays (in the region ranging from 315-400 nm) and UVB rays (280-315 nm). One important family of UV absorber molecules are derived from aromatic compounds known as phenols, which contain a hydrogen-bonded hydroxyl group that plays an important role in the dissipation of the absorbed energy. For example, an organic compound known as oxybenzone is a common ingredient that has also been added to plastics to limit UV degradation. Apart from their petrochemical origin, a major drawback of current UV protection agents is their negative effect on aquatic ecosystems associated with a poor biodegradability. As a result, there is growing attention from regulatory bodies and stricter regulations are being enforced on the production of sun filtering products. "With the current concerns over the use of fossil resources for chemical synthesis of functional molecules and the effect of current UV absorbers in sunscreens on the ecosystem, we aimed to find a way to produce new UV absorbers

**Team is working on techniques to produce useful compounds from wood and other fast growing non-edible plant waste, through a chemical process named xylochemistry**

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from cashew nut shell liquid (CNSL) as a non-edible, bio renewable carbon resource," says Professor Charles de Koning, of the Wits School of Chemistry and principal author of the paper, together with Till Opatz from Johannes Gutenberg University in Mainz, Germany. "Cashew nut shells are a waste product in the cashew-farming community, especially in Tanzania, so finding a useful, sustainable way to use these waste products can lead to completely new, environmentally friendly ways of doing things." The team has already filed a patent application in order to commercialise the process in South Africa.

EurekAlert, 15 August 2019

<http://www.eurekalert.org>

### Rewriting the periodic table at high pressure

2019-08-20

The periodic table has been a vital foundational tool for material research since it was first created 150 years ago. Now, Martin Rahm from Chalmers University of Technology presents a new article which adds an entirely new dimension to the table, offering a new set of principles for material research. The article is published in the Journal of the American Chemical Society. The study maps how both the electronegativity and the electron configuration of elements change under pressure. These findings offer materials researchers an entirely new set of tools. Primarily, it means it is now possible to make quick predictions about how certain elements will behave at different pressures, without requiring experimental testing or computationally expensive quantum mechanical calculations. "Currently, searching for those interesting compounds which appear at high pressure requires a large investment of time and resources, both computationally and experimentally. As a consequence, only a tiny fraction of all possible compounds has been investigated. The work we are presenting can act as a guide to help explain what to look for and which compounds to expect when materials are placed under high pressure," says Martin Rahm, Assistant Professor in Chemistry at Chalmers, who led the study. At high pressures the properties of atoms can change radically. The new study shows how the electron configuration and electronegativity of atoms change as pressure increases. Electron configuration is fundamental to the structure of the periodic table. It determines which group in the system different elements belong to. Electronegativity is also a central concept to chemistry and can be viewed as a third dimension of the periodic table. It indicates how strongly different atoms attract electrons. Together, electron configuration and electronegativity are important

**The periodic table has been a vital foundational tool for material research since it was first created 150 years ago. Now, researchers add an entirely new dimension to the table, offering a new set of principles for material research.**

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for understanding how atoms react with one another to form different substances. At high pressure, atoms which normally do not combine can create new, never before seen compounds with unique properties. Such materials can inspire researchers to try other methods for creating them under more normal conditions, and give us new insight into how our world works. "At high pressure, extremely fascinating chemical structures with unusual qualities can arise, and reactions that are impossible under normal conditions can occur. A lot of what we as chemists know about elements' properties under ambient conditions simply doesn't hold true any longer. You can basically take a lot of your chemistry education and throw it out the window! In the dimension of pressure there is an unbelievable number of new combinations of atoms to investigate" says Martin Rahm. A well-known example of what can happen at high pressure is how diamonds can be formed from graphite. Another example is polymerisation of nitrogen gas, where nitrogen atoms are forced together to bond in a three-dimensional network. These two high-pressure materials are very unlike one another. Whereas carbon retains its diamond structure, polymerised nitrogen is unstable and reverts back to gas form when the pressure is released. If the polymer structure of nitrogen could be maintained at normal pressures, it would without doubt be the most energy dense chemical compound on Earth. Currently, several research groups use high pressures to create superconductors -- materials which can conduct electricity without resistance. Some of these high-pressure superconductors function close to room temperature. If such a material could be made to work at normal pressure, it would be revolutionary, enabling, for example, lossless power transfer and cheaper magnetic levitation. "First and foremost, our study offers exciting possibilities for suggesting new experiments that can improve our understanding of the elements. Even if many materials resulting from such experiments prove unstable at normal pressure, they can give us insights into which properties and phenomena are possible. The steps thereafter will be to find other ways to reach the same results," says Martin Rahm. High pressure research: The research has theoretically predicted how the nature of 93 of the 118 elements of the periodic table changes as pressure increases from 0 pascals up to 300 gigapascals (GPa). 1 GPa is about 10,000 times the pressure of the Earth's surface. 360 GPa corresponds to the extremely high pressure found near the Earth's core. Technology to recreate this pressure exists in different laboratories, for example, using diamond anvil cells or shock experiments. "The pressure that we are used to on Earth's surface is actually rather uncommon, seen from a larger perspective. In addition to facilitating for high pressure material synthesis on Earth, our work can also enable a better understanding of processes occurring on other planets

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and moons. For example, in the largest sea in the solar system, many miles under the surface of Jupiter's moon Ganymede. Or inside the giant planets, where the pressure is enormous," says Martin Rahm. The work was done using a mathematical model, in which each atom was placed in the middle of a spherical cavity. The effect of increased pressure was simulated through gradual reduction of the volume of the sphere. The physical properties of the atoms in different stages of compression could then be calculated using quantum mechanics.

Science Daily, 14 August 2019

<http://www.sciencedaily.com>

### Chemists find new path to make strong 2D material better for applications

2019-08-20

Hexagonal-boron nitride is tough, but Rice University scientists are making it easier to get along with. Two-dimensional h-BN, an insulating material also known as "white graphene," is four times stiffer than steel and an excellent conductor of heat, a benefit for composites that rely on it to enhance their properties. Those qualities also make h-BN hard to modify. Its tight hexagonal lattice of alternating boron and nitrogen atoms is highly resistant to change, unlike graphene and other 2D materials that can be easily modified -- aka functionalized -- with other elements. The Rice lab of chemist Angel Martí has published a protocol to enhance h-BN with carbon chains. These turn the 2D tough guy into a material that retains its strength but is more amenable to bonding with polymers or other materials in composites. The lab's paper in the American Chemical Society's Journal of Physical Chemistry suggests h-BN can be made more dispersible in organic solvents as well. Martí and his team modified the Billups-Birch reaction process they had successfully used to alter boron nitride nanotubes to attack the defences of h-BN and covalently attach carbons. Birch reduction, discovered in the 1940s and enhanced in 2004 by Rice Professor Emeritus of Chemistry Edward Billups to functionalize carbon nanotubes, frees electrons to bind with other atoms. In the Rice process, Martí and his team can control the amount of h-BN functionalization by varying the amount of lithium in the reaction. Lithium is an alkali metal that sheds free electrons when combined with liquefied ammonia. Mixed with h-BN flakes and a carbon source, 1-Bromododecane in this case, the reaction produces an alkyl radical, a chemical species that reacts with h-BN and makes a bond. Martí said it's the best method found so far to modify h-BN, which resists change even under high temperatures.

**Scientists make hexagonal-boron nitride, a 2D material much stiffer than steel and an excellent conductor of heat, much simpler to modify for applications through a new chemical process.**

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"You take a little bit of graphite and put it in a furnace at 800 degrees (Celsius), and it will be gone," he said. "You take hexagonal-boron nitride and do the same, and it will still be there smiling at you." That gives you an idea of how stable it is, and that's the problem we wanted to address," Martí said. "The material is good for certain applications, but to control its properties for manufacturing, you have to graft different groups onto the surface." He said a 20-to-1 molar ratio of lithium to h-BN optimised the process of grafting carbon chains to the surface and edges. Because the base h-BN remains stable under high temperatures, it can be returned to its pristine state by simply burning off the functional chains. While h-BN is naturally hydrophilic (water-attracting), the functional carbons make them nearly superhydrophobic (water-avoiding), a good property for making protective films, Martí said. But even when enhanced, the flakes remain amenable to dispersion in non-polar solvents. Martí said his group is exploring what other kinds of molecules can be grafted onto white graphene. "What about benzene groups? What about ethers? What about groups that will make it compatible with other materials?" There's a lot of interest in making composite materials between h-BN, boron nitride nanotubes and polymers," he said. "Ultimately, we'd like to graft different groups onto h-BN and build a library, kind of a toolbox, of functional groups that can be used with these materials."

Science Daily, 12 August 2019

<http://www.sciencedaily.com>

### Scientists find a way to create long-life, fast-charging batteries

2019-08-20

A group of researchers led by Skoltech Professor Pavel Troshin studied coordination polymers, a class of compounds with scarcely explored applications in metal-ion batteries, and demonstrated their possible future use in energy storage devices with a high charging/discharging rate and stability. The results of their study were published in the journal *Chemistry of Materials*. The charging/discharging rate is one of the key characteristics of lithium-ion batteries. Most modern commercial batteries need at least an hour to get fully charged, which certainly limits the scope of their application, in particular, for electric vehicles. The trouble with active materials, such as the most popular anode material, graphite, is that their capacity decays significantly, as their charging rate increases. To retain the battery capacity at high charging rates, the active electrode materials must have high electronic and ionic conductivity,

**A group of researchers led by Skoltech Professor Pavel Troshin studied coordination polymers, a class of compounds with scarcely explored applications in metal-ion batteries, and demonstrated their possible future use in energy storage devices with a high charging/discharging rate and stability.**

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which is the case with the newly-discovered coordination polymers that are derived from aromatic amines and salts of transition metals, such as nickel or copper. Although these compounds hold a great promise, their application in lithium-ion batteries remains virtually unexplored. A recent study undertaken by a group of scientists from Skoltech and the Institute for Problems of Chemical Physics of RAS led by Professor P. Troshin in collaboration with the University of Cologne (Germany) and the Ural Federal University, focused on tetraaminobenzene-based linear polymers of nickel and copper. Although the linear polymers exhibited much lower initial electronic conductivity as compared to their two-dimensional counterparts, it transpired that they can be used as anode materials that get charged/discharged in less than a minute, because their conductivity increases dramatically after the first discharge due to lithium doping. Additionally, it was found that these anode materials have excellent stability at high charging/discharging rates: they were demonstrated to retain up to 79% of their maximum capacity after as many as 20,000 charging-discharging cycles. Furthermore, it was discovered that copper-based polymers can be used both as anode and high-capacity cathode materials. The authors point out that there is plenty of opportunity for structure optimisation, even though the cathode cannot yet operate in a stable manner. "There are a lot of methods for fine-tuning the characteristics of coordination polymers," explains the first author of the study and Skoltech Ph.D. student, Roman Kapaev. "Actually, we deal here with a sort of a construction kit where the parts can be easily changed or replaced. We can modify both the amine structure and the transition metal cation, and by doing so, raise the capacity, increase or decrease the redox potential, improve stability and various other performances. This trail-blazing study touches upon an extensive research area, which, I am sure, has yet a lot to reveal."

Phys.org, 15 August 2019

<http://phys.org>

### **Bending the rules: A revolutionary new way for metals to be malleable**

2019-08-20

For nearly 100 years, scientists thought they understood everything there was to know about how metals bend. They were wrong. Materials science and engineering researchers at the University of Wisconsin-Madison have demonstrated that the rules of metal-bending aren't so hard and fast after all. They described their findings Aug. 9 in the journal Nature

**Materials science and engineering researchers at the University of Wisconsin-Madison have demonstrated that the rules of metal-bending aren't so hard and fast after all.**

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Communications. Their surprising discovery not only upends previous notions about how metals deform, but could help guide the creation of stronger, more durable materials. "This creates new opportunities for materials design," says Izabela Szlufarska, a professor of materials science and engineering at UW-Madison. "It adds another parameter we can control to enable strength and ductility." Ductility is the ability of a metal to bend. Most approaches to increase a metal's strength do so at the expense of flexibility—and as metals become more resistant to bending, they're more likely to crack under pressure. However, the researchers' new mechanism for bending might allow engineers to strengthen a material without running the risk of fractures. It's an advance that holds particular interest for the United States Army, which has an urgent need for strong and durable materials in order to keep troops safe in combat zones. "Professor Szlufarska has opened up an entirely new area for exploration for structural materials processing and design," said Michael Bakas, synthesis and processing program manager at Army Research Office in the U.S. Army Combat Capabilities Development Command Army Research Laboratory. "By making such a high-impact discovery, Professor Szlufarska has potentially laid the technical foundation for the development of a new generation of advanced structural materials that could eventually be employed in future Army equipment and vehicles." Engineers typically manipulate the strength of a metal through techniques such as cold working or annealing, which exert their effects through small, yet important, structural irregularities called dislocations. "Everybody in the metals community knows that dislocations are critical," says Szlufarska. It's a truism that's held since 1934, when three researchers independently realized that dislocation explained an ages-old paradox: Metals are much easier to bend than their molecular structures—which typically take the form of regularly repeating three-dimensional grids—would suggest. Dislocations are tiny irregularities in the otherwise well-ordered crystal lattice of a metal. They arise from slight mismatches—picture the pages of a book as rows of atoms, and imagine how the neat stack of paper becomes ever-so-slightly distorted at the spot where someone inserts a bookmark. Normal metals bend because dislocations are able to move, allowing a material to deform without ripping apart every single bond inside its crystal lattice at once. Strengthening techniques typically restrict the motion of dislocations. So, it was quite a shock when Szlufarska and colleagues discovered that the material samarium cobalt—known as an intermetallic—bent easily, even though its dislocations were locked in place. "It was believed that metallic materials would be intrinsically brittle if dislocation slip is rare," says Hubin Luo, a former staff scientist in Szlufarska's lab now working at Ningbo Institute of Industrial Technology

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in China. "However, our recent study shows that an intermetallic can be deformed plastically by a significant amount even when the dislocation slip is absent." Instead, bending samarium cobalt caused narrow bands to form inside the crystal lattice, where molecules assumed a free-form "amorphous" configuration instead of the regular, grid-like structure in the rest of the metal. Those amorphous bands allowed the metal to bend. "It's almost like lubrication," says Szlufarska. "We predicted this in simulations, and we also saw the amorphous shear bands in our deformation studies and transmission electron microscopy experiments." A combination of computational simulations and experimental studies was critical to explaining the perplexing result, which is why Szlufarska and her group were exceptionally suited to crack open the mystery. "It is often easier to carry out theoretical simulations to explain existing experimental results," says Hongliang Zhang, a UW-Madison postdoctoral scholar. "Here, we first theoretically predicted the existence of shear bands and their role in plasticity in samarium cobalt; these were entirely surprising phenomena. We then confirmed these results experimentally with many different types of experiments to test our theory and to be sure that the predicted phenomenon can be indeed observed in nature." The researchers plan to search for other materials that might also bend in this peculiar manner. Eventually, they hope to use the phenomenon to tune a material's properties for strength and flexibility. "This might change the way you look for optimization of material properties," says Szlufarska. "We know it's different, we know it's new, and we think we can use it."

Phys.org, 9 August 2019

<http://phys.org>

## Curiosities

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### Unusually High Levels of Sex Hormones in The Womb Linked to Autism Once More

2019-08-21

A small new study has once again found a link between elevated hormone levels in the womb and the likelihood of developing autism. But this time, instead of major androgens such as testosterone, researchers are pointing the finger at oestrogen. Currently, prenatal hormones such as androgens and oestrogens are thought to influence the development of a foetus's brain. When these levels are out of whack, there's a possibility they could lead to autism later on in life. This idea was first put forward roughly two decades ago; in that time, several studies have shown that prenatal hormones – including testosterone, cortisol, and progesterone – are higher in male foetuses who later develop autism. These findings are often used to explain why so many men are diagnosed with autism compared to women. But while the majority of research has so far focused on androgens, the role of estrogen in autism has hardly been studied at all. Researchers from the University of Cambridge and the State Serum Institute in Denmark have now provided the first evidence that prenatal oestrogen levels may be more predictive of autism than even androgens. "This new finding supports the idea that increased prenatal sex steroid hormones are one of the potential causes for the condition," says lead author Simon Baron-Cohen, director of the Autism Research Centre at Cambridge University. "Genetics is well established as another, and these hormones likely interact with genetic factors to affect the developing foetal brain." Testing 275 amniotic fluid samples included in the Danish Biobank, researchers measured the levels of four types of prenatal oestrogens, including oestradiol, oestrone, oestriol and progesterone. Ninety-eight of these samples belonged to male individuals who later went on to develop autism. When their amniotic samples were compared to 177 foetuses who did not, there was a considerable difference in their hormone levels. On average, all four estrogens were significantly elevated in those who would later develop autism, with oestradiol levels having the strongest positive effect. In fact, compared to their previous study from 2015, which focused on prenatal androgen levels in the Danish Biobank, the authors found an even stronger link between prenatal oestrogens and the odds of developing autism. The sample size used is admittedly small, and they appear to contradict some other studies that have shown oestrogen can actually reduce the odds of autism in female humans, while limiting autistic behaviour in zebra fish and mice. So, we need to take this study with a pinch of salt. The authors explain, however, that their recent findings correspond to a slightly earlier time point in pregnancy, and that

**A small new study has once again found a link between elevated hormone levels in the womb and the likelihood of developing autism.**

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this could ultimately make all the difference in the way these hormones interact with the developing brain. "These elevated hormones could be coming from the mother, the baby or the placenta," says co-author Alex Tsompanidis, who studies the role of hormones in autism at Cambridge. "Our next step should be to study all these possible sources and how they interact during pregnancy." The authors caution that their goal for further research is not to prevent autism or somehow screen it using these prenatal hormones - it's not a disease, after all. It's only to understand the condition better. Over the years, it's become increasingly clear that oestrogens and androgens cannot simply be split into 'masculinising' and 'feminising' hormones, and although this new study is small, it adds further weight to this idea. As a result, the authors are now curious to see whether the same patterns are observed in autistic females. "This is a terrific example of how a unique biobank set up 40 years ago is still reaping scientific fruit today in unimagined ways, through international collaboration," says co-author Arie Cohen, a biochemist based at the State Serum Institute in Copenhagen. The new research has been published in *Molecular Psychiatry*.

Science Alert, 12 August 2019

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

## Why Do Humans Grunt When They Bend Over? Science Weighs In

2019-08-21

You never think it's going to happen to you. Then suddenly you're middle-aged and you find yourself grunting when you pick up something from the floor or groaning when you get out of the chair. Why do we do this? Is it a sign that we're ageing fast? Or is it just one of those things that come with the middle years, like reading glasses, greying hair and "dad jokes"? As far as I could find, there have been no specific studies to explain why otherwise healthy older people grunt or groan with the physical effort of everyday activities. But noises relating to physical exertion are common in a range of ages and activities, as anyone who has watched cricket, boxing or in particular, tennis, will know. Think Serena Williams and Rafael Nadal. So, we can look to the evidence of what's behind grunting in sport or training instead. When we lift something relatively heavy, make fast movements (like hitting a tennis ball), or even stand up from sitting, we stiffen our torso. This stabilises our entire body. If we were too relaxed, we would be floppy, lose balance and risk falling over. So, we fill the lungs by breathing in and tense up the muscles of the torso to stabilise the spine.

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We throw our arms forward to provide momentum and with this effort, we hold our breath to maintain that stability as we stand. We then release the breath slowly or quickly, depending on the nature of the task. With fast (or ballistic) movements like pitching a ball or punching in boxing, we'd release the breath quickly. With slow movements, like lifting a barbell or getting off the couch, we'd release it slowly. If the muscles that move the vocal cords together are activated, we make a sound. This results in a grunt or groan of the kind you might often hear at the gym. Or at least you would if not for the deafening music.

Does grunting help us move, strike or lift?

The evidence of whether grunting helps us move, strike or lift is mixed. According to a 20-year-old study, grunting doesn't help weightlifters lift heavier weights. They lifted as much in a "dead lift" whether they grunted or not. However, in a 2011 study, shouting helped martial artists grip with greater force. And in a 2014 study, tennis players had stronger serves and forehand strokes when they were allowed to grunt compared with when they were told to be silent. So, it seems that whether grunting or other vocalisations help you perform depends on the task. That said, tennis great Roger Federer (a "non-grunter") seems to perform very well without this audible shot enhancement.

What does this mean for everyday activities?

What all this means for grunting during everyday activities is unclear. Clearly, athletes' grunts during fast, ballistic movements are different to the noises we make when exercising in a gym or when we get up from a chair. Perhaps we are more likely to make such noises if we are tired or fatigued. And if someone thinks a task is going to be hard, they might be more likely to grunt or vocalise. So that's when they're most likely holding their breath, to try to provide momentum and stability for the task ahead, then releasing it. While there has been no research on this phenomenon, as far as I can tell, grunting with physical exertion does seem to be habitual. These noises are most likely learned behaviours that we copy from friends and relatives and start doing without realising it. So, you can choose not to groan the next time you get off the couch.

Science Alert, 11 August 2019

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

## Curiosities

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### **Not All Viruses Are Bad For You. Here Are Some That Can Have a Protective Effect**

2019-08-21

It's true, most viruses have a pathogenic relationship with their hosts – meaning they cause diseases ranging from a mild cold to serious conditions like severe acute respiratory syndrome (SARS). They work by invading the host cell, taking over its cellular machinery and releasing new viral particles that go on to infect more cells and cause illness. But they're not all bad. Some viruses can actually kill bacteria, while others can fight against more dangerous viruses. So, like protective bacteria (probiotics), we have several protective viruses in our body.

#### Protective 'phages'

Bacteriophages (or "phages") are viruses that infect and destroy specific bacteria. They're found in the mucus membrane lining in the digestive, respiratory and reproductive tracts. Mucus is a thick, jelly-like material that provides a physical barrier against invading bacteria and protects the underlying cells from being infected. Recent research suggests the phages present in the mucus are part of our natural immune system, protecting the human body from invading bacteria. Phages have actually been used to treat dysentery, sepsis caused by *Staphylococcus aureus*, salmonella infections and skin infections for nearly a century. Early sources of phages for therapy included local water bodies, dirt, air, sewage and even body fluids from infected patients. The viruses were isolated from these sources, purified, and then used for treatment. Phages have attracted renewed interest as we continue to see the rise of drug resistant infections. Recently, a teenager in the United Kingdom was reportedly close to death when phages were successfully used to treat a serious infection that had been resistant to antibiotics. Nowadays, phages are genetically engineered. Individual strains of phages are tested against target bacteria, and the most effective strains are purified into a potent concentration. These are stored as either bacteriophage stocks (cocktails), which contain one or more strains of phages and can target a broad range of bacteria, or as Adapted bacteriophages, which target specific bacteria. Before treatment, a swab is collected from the infected area of the patient, cultured in the lab to identify the bacterial strain, and tested against the therapeutic phage stocks. Treatment can be safely administered orally, applied directly onto wounds or bacterial lesions, or even spread onto infected surfaces. Clinical trials for intravenous administration of phages are ongoing.

**Some viruses can actually kill bacteria, while others can fight against more dangerous viruses.**

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### Beneficial viral infections

Viral infections at a young age are important to ensure the proper development of our immune systems. In addition, the immune system is continuously stimulated by systemic viruses at low levels sufficient to develop resistance to other infections. Some viruses we come across protect humans against infection by other pathogenic viruses. For example, latent (non-symptomatic) herpes viruses can help human natural killer cells (a specific type of white blood cell) identify cancer cells and cells infected by other pathogenic viruses. They arm the natural killer cells with antigens (a foreign substance that can cause an immune response in the body) that will enable them to identify tumour cells. This is both a survival tactic by the viruses to last longer within their host, and to get rid of competitive viruses to prevent them from damaging the host. In the future, modified versions of viruses like these could potentially be used to target cancer cells. Pegivirus C or GBV-C is a virus that does not cause clinical symptoms. Multiple studies have shown HIV patients infected with GBV-C live longer in comparison to patients without it. The virus slows disease progression by blocking the host receptors required for viral entry into the cell, and promotes the release of virus-detecting interferons and cytokines (proteins produced by white blood cells that activate inflammation and removal of infected cells or pathogens). In another example, noroviruses were shown to protect the gut of mice when they were given antibiotics. The protective gut bacteria that were killed by the antibiotics made the mice susceptible to gut infections. But in the absence of good bacteria, these noroviruses were able to protect their hosts.

### The future of therapeutic viruses

Modern technology has enabled us to understand more about the complexities of the microbial communities that are part of the human body. In addition to good bacteria, we now know there are beneficial viruses present in the gut, skin and even blood. Our understanding of this viral component is largely in its infancy. But it has huge potential in helping us understand viral infections, and importantly, how to fight the bad ones. It could also shed light on the evolution of the human genome, genetic diseases, and the development of gene therapies.

Science Alert, 10 August 2019

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

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### Have we found the true cause of diabetes, stroke and Alzheimer's?

2019-08-21

For decades, health experts have been lecturing us about our bad habits, blaming them for the surge in "lifestyle diseases". These often come on as we age and include heart disease, Alzheimer's, type 2 diabetes and some cancers. Worldwide, 70 per cent of all deaths are now attributed to these conditions. In the UK, it is a whopping 90 per cent. Too much red meat, too little fruit and veg, smoking, drinking, obesity and not enough exercise appear to make all these diseases more likely – and having any of them makes getting the others more likely. But no one really knows why, and we still haven't worked out what causes any of them. Alzheimer's is now one of the UK's biggest killers, yet the main hypothesis for how it originates imploded this year after drugs based on it repeatedly failed. High blood cholesterol is blamed for heart attacks, except most people who have heart attacks don't have it. What we do know is that these conditions usually start causing symptoms later in life, and their prevalence is skyrocketing as we live longer. They all turn inflammation, the method our immune system uses to kill invaders, against us. And, by definition, these diseases aren't communicable. They are down to bad habits and unlucky genes, not germs. Right? Not necessarily. In disease after disease, we are finding that bacteria are covertly involved, invading organs, co-opting our immune systems to boost their own survival and slowly making bits of us break down. The implication is that we may eventually be able to defeat heart attacks or Alzheimer's just by stopping these microbes. Until now, bacteria's involvement completely eluded us. That's because they tend to work very slowly, stay dormant for long periods or hide inside cells. That makes them difficult to grow in culture, once the gold standard for linking bacteria to disease. But now DNA sequencing has revealed bacteria in places they were never supposed to be, manipulating inflammation in just the ways observed in these diseases. The findings are so contrary to received wisdom and emerging in so many diseases, each with its own separate research community, that awareness of all this is only starting to hit the mainstream. And predictably, as with any paradigm shift, there is resistance. But some researchers, frustrated by years of failure to find causes, and therefore real treatments, for the diseases of ageing, are cautiously excited. And with reason: this could change everything. The worst culprits, which seem to play a role in the widest range of ailments, are the bacteria that cause gum disease. This is the most widespread disease of ageing – in fact, "the most prevalent disease of mankind", says Maurizio Tonetti at the University of Hong Kong. In the US, 42 per cent of

**The diseases most people die of have been attributed to unhealthy lifestyles. But evidence now suggests bacteria are to blame, heralding a revolution in medicine**

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those aged 30 or above have gum disease, but that rises to 60 per cent in those 65 and older. It has been measured at 88 per cent in Germany. Strikingly, many of the afflictions of ageing – from rheumatoid arthritis to Parkinson’s – are more likely, more severe, or both, in people with gum disease. It is possible that some third thing goes wrong, leading to both gum disease and the other maladies. But there is increasing evidence that the relationship is direct: the bacteria behind gum disease help cause the others. Circumstantial evidence is certainly damning. In the US, states that put federal Medicaid funds towards people’s dental costs, including those related to preventing or treating gum disease, ultimately pay between 31 and 67 per cent less than states that don’t, to help those people later with heart attacks, diabetes, strokes and cancer. Private insurance companies report similar patterns, says David Ojcius at the University of the Pacific in San Francisco. But how can the bacteria that cause gum disease play a role in all these conditions? To answer that, we have to look at how they turn the immune system against us. Your mouth hosts more than 1000 species of bacteria, in a stable community where potential bad actors are kept in check by peaceful bacteria around them. Elsewhere in the body, including on the skin or the lining of the gut, communities of bacteria live on a continuous sheet of cells, where the outermost layer is constantly shed, getting rid of invasive bacteria. But your teeth can’t cast off a layer like that, says Tonetti. There, the bacteria live on a hard surface, which pierces through the protective outer sheet of cells. When the plaque the bacteria on your teeth live in builds up enough to harden and spread under the gum, it triggers inflammation: immune cells flood in and destroy both microbes and our own infected cells. If this goes on too long, an oxygen-poor pocket develops between gum and tooth. A handful of bacteria take advantage of this and multiply. One of them, *Porphyromonas gingivalis*, is especially insidious, disrupting the stable bacterial community and prolonging inflammation. This might seem a strange thing to do. Most pathogens try to block or avoid inflammation, which normally kills them before it shuts down again. Starting in our 30s and 40s, this shutdown begins failing, leading to the chronic inflammation involved in diseases of ageing. No one knows why. *P. gingivalis* may have a hand in it. It actually perpetuates inflammation by producing molecules that block some inflammatory processes, but not all of them, says Caroline Genco of Tufts University in Massachusetts. The resulting weakened inflammation never quite destroys the bacteria, but keeps trying, killing your own cells in the process. The debris is a feast for *P. gingivalis*, which, unlike most bacteria, needs to eat protein. The destruction also liberates the iron that bacteria need and which the body therefore normally keeps locked up. “These bacteria manipulate their interaction with the host immune response to

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enhance their own survival,” says George Hajishengallis at the University of Pennsylvania.

### Gum control

Eventually, the infected tooth falls out – but long before that *P. gingivalis* escapes into the bloodstream. There your immune system makes antibodies against it, which usually defend us from germs. But *P. gingivalis* antibodies seem to be more a mark of its passing than protection. People with these antibodies are actually more likely to die in the next decade than those with none, and more likely to get rheumatoid arthritis or have a heart attack or stroke. This could be because, once in the blood, *P. gingivalis* changes its surface proteins so it can hide inside white blood cells of the immune system, says Genco. It also enters cells lining arteries. It remains dormant in these locations, occasionally waking to invade a new cell, but otherwise remaining hidden from antibiotics and immune defences. However, even hunkered down within our cells, *P. gingivalis* continues to activate or block different immune signals, even changing a blood cell’s gene expression to make it migrate to other sites of inflammation, where the bacteria can hop out and feast again. One explanation for why gum disease makes you more likely to get conditions like diabetes and Alzheimer’s disease is that it adds to your general “inflammatory load”. But *P. gingivalis* may act more directly too: the bacteria have been detected in inflamed tissue in the brain, aorta, heart, liver, spleen, kidneys, joints and pancreas in mice and, in many cases, humans. The strongest case against *P. gingivalis* is as a cause of Alzheimer’s disease. This constitutes more than two-thirds of all dementia, now the fifth largest cause of death worldwide. It was long blamed on the build-up of two brain proteins, amyloid and tau. But that hypothesis is crumbling: people with dementia may lack this build-up, while people with lots of the proteins may have no dementia – and most damningly, no treatments reducing either have improved symptoms. Then, in January, teams at eight universities and the San Francisco company Cortexyme found a protein-digesting enzyme called gingipain, produced only by *P. gingivalis*, in 99 per cent of brain samples from people who died with Alzheimer’s, at levels corresponding to the severity of the condition. They also found the bacteria in spinal fluid. Giving mice the bacteria caused symptoms of Alzheimer’s, and blocking gingipains reversed the damage. Moreover, half of the brain samples from people without Alzheimer’s also had gingipain and amyloid, but at lower levels. That is as you would expect if *P. gingivalis* causes Alzheimer’s, because damage can accumulate for 20 years before symptoms start. People who develop symptoms may be those who

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accumulate enough gingipain damage during their lifetimes, says Casey Lynch at Cortexyme. Still, dementia researchers have questioned how a bacterial cause can account for genetic risk factors for Alzheimer's. But it may actually explain them, according to a team in Sweden. The people with the highest genetic risk, produce a particular form of an immune protein called ApoE that is destroyed in the disease. Last year, Swedish researchers discovered that gingipains are better at destroying that particular ApoE than other forms. *P. gingivalis* may literally break our hearts too. There is growing evidence for a causal link to atherosclerosis, or "hardening of the arteries". Researchers have found *P. gingivalis* in the fatty deposits that line arterial walls and cause blood clots. When bits of clots clog blood vessels in hearts or brains, they cause heart attack and stroke. The bacteria trigger the molecular changes in artery linings that are typical of atherosclerosis, says Genco. We have also found that *P. gingivalis* creates the lipoproteins thought to trigger atherosclerosis, causes it in pigs and affects arteries much like high fat diets. Lakshmyya Kesavalu at the University of Florida, who has cultured viable *P. gingivalis* from the atherosclerotic aortas of mice, calls the bacteria "causal". The American Heart Association agrees that gum disease is an "independent" risk factor for cardiovascular disease, but doesn't call it causal. It argues that although treating gum disease improves hardened arteries, no studies have found that it reduces heart attacks or strokes. But, according to Steve Dominy at Cortexyme, that could be because, while gum treatment helps arteries by easing inflammatory load, it doesn't eradicate the *P. gingivalis* already in the blood vessels. Clinical trials are needed to firm up the connection, but these are expensive and difficult – especially when the bacterial hypothesis is still in its early days. The link is clearer for type 2 diabetes, in which people lose sensitivity to insulin and eventually can't make enough to control blood sugar. It is currently a pandemic, blamed on the usual lifestyle suspects. Diabetes worsens gum disease, because high blood sugar levels hurt immune cells. But gum disease also worsens diabetes, and treating it helps as much as adding a second drug to the regimen taken by someone with the condition, according to the American Academy of Periodontology. Treatment is now recommended by diabetes associations, yet none of them list gum disease as a risk factor. As with other conditions, there is evidence that *P. gingivalis* isn't promoting diabetes just by adding to the body's inflammatory load, but may also be acting directly in the liver and pancreas to cut insulin sensitivity. "It is very hard to prove causation in a complex disease," says Genco. We know that mice given a mouthful of *P. gingivalis* get gum disease – and diabetes, rheumatoid arthritis, atherosclerosis, fatty liver disease and Alzheimer's-like symptoms. We know that, in humans, gum disease makes the other

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diseases more likely, and that *P. gingivalis* lurks in the affected tissues and makes the precise cellular changes typical of these conditions. If these diseases actually share a more direct cause, it might finally suggest cures— as well as explaining just how the same bad habits bring them all on. People who drink more alcohol tend to have more *P. gingivalis* and are more susceptible to gum disease. Tobacco smoke helps the bacteria to invade gum cells. Exercise, the only known way to lower your risk of Alzheimer's, improves gum disease by damping inflammation and ending *P. gingivalis*'s feast. Then there is diet. Douglas Kell at the University of Manchester, UK, believes our blood contains many dormant bacteria, needing only a dose of free iron to awaken and cause disease. That could be why eating too much red meat and sugar or too little fruit and veg lead to these diseases: all increase your blood iron.

### The long haul

No official medical advice for warding off these diseases includes “see your dentist”, at least not yet. “Periodontal disease should be better recognised by the community as a clearly established risk factor,” says Dominy. One of the clearest risks is for Alzheimer's. But guidelines for avoiding Alzheimer's published in May by the World Health Organization (WHO) say nothing about preventing gum disease. “There is insufficient evidence to suggest that treating gum disease reduces the risk of dementia,” says Benoit Varenne at the WHO, echoing the verdict on heart disease, even though the same caveats probably apply. The guidelines recommend avoiding diabetes and high blood pressure, despite stating that there is little or no evidence that this stops Alzheimer's. “It's perhaps too easy to mock the notion that flossing your teeth may contribute to good brain health,” says Margaret Gatz at the University of Southern California. And that may be part of why this idea hasn't yet taken off in mainstream medicine. “There is a history of dental and medical doctors working apart and not cooperating,” says Thomas Kocher at the University of Greifswald, Germany. But it also reflects the long-held belief that heart attacks and the other conditions are primarily the result of bad lifestyle, not bacteria. Such underlying paradigms in science can take decades to change. That happened when bacteria, not stress and stomach acid, were shown to cause stomach ulcers. After decades pursuing these explanations, many medical experts are reluctant to admit that amyloid may not cause Alzheimer's and high cholesterol may not lead to heart disease. With the world's population ageing, we don't have decades before these diseases become a health crisis severe enough to break health systems and

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societies. We need a new paradigm. That means facing the possibility that it may all be down to germs, after all.

New Scientist, 7 August 2019

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

### **Pancreatic cancer good news: Two breakthrough studies in one week**

2019-08-21

Scientists from Sydney's Garvan Institute of Medical Research have announced findings they hope could slow the spread of pancreatic cancer. Researchers found that reducing the levels of a molecule called perlecan leads to a reduction in the spread of pancreatic cancer – and an improved response to chemotherapy, in an animal model. The quick spreading of cancer from the pancreas is the main cause of pancreatic cancer-related death. The early stage of pancreatic cancer generally has no symptoms; subsequent late diagnosis has an average survival rate of three-and-a-half months. Moreover, chemotherapy tends not to be effective because pancreatic tumours are protected by a kind of hard shell. The researchers found some pancreatic tumours produce more perlecan than others to remodel the environment around them, which helps cancer cells spread more easily. Perlecan also protects tumours against chemotherapy. Led by Associate Professor Paul Timpson, head of the Invasion and Metastasis Laboratory, and Dr Thomas Cox, leader of the Matrix and Metastasis Group, the research could provide a viable path to more effective treatment options for pancreatic cancer and possibly breast and prostate cancers. "Pancreatic cancer is very aggressive, and by the time most cases are diagnosed, the tumour is often inoperable," said Associate Professor Timpson in a prepared statement.

#### New focus reduces spread, boost drug therapy

"What we've discovered in this study is a two-pronged approach for treating pancreatic cancer that we believe will improve the efficiency of chemotherapy and may help reduce tumour progression and spread." The focus of this research was to investigate why some pancreatic cancers spread, while others appear to stay in one place. They took a lateral step in comparing the tissue around tumour cells in both metastatic (spreading) and non-metastatic (non-spreading) cancers. This tissue is known as the matrix – and acts like a glue that holds different cells in an organ or in a tumour together. Using mouse models, the team extracted fibroblasts –

**Scientists from Sydney's Garvan Institute of Medical Research have announced findings they hope could slow the spread of pancreatic cancer.**

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cells that produce most of the matrix – from spreading and non-spreading pancreatic tumours.

### Some cancer cells teach others to be more aggressive

They found that cancer cells from a non-spreading tumour began to spread when mixed with fibroblasts from a spreading tumour. "Our results suggest that some pancreatic cancer cells can 'educate' the fibroblasts in and around the tumour. This lets the fibroblasts remodel the matrix and interact with other less-aggressive cancer cells in a way that supports the cancer cells' ability to spread," said first author Dr Claire Vennin. "This means that in a growing tumour, even a small number of aggressive metastatic cells – a few bad apples – can help increase the spread of other, less aggressive cancer cells."

### Poo transplants choke tumours

Meanwhile, in another promising study, University of Texas researchers found that "a key difference between the few pancreatic cancer patients who survive long term and the many whose disease overcomes all treatments is the bacterial signatures on their tumours that either stimulate or suppress immune response." The researchers showed that faecal microbiota transplants (FMT) from long-term human survivors prompted an immune response and stifled tumours in a mouse model of the disease by altering the bacteria on the tumour. This is the latest and somewhat startling example of gut health playing a powerful part in treating challenging conditions. In this instance, long-term pancreatic cancer survivors – a rare cohort – have a more diverse tumour microbiome than those who die quickly. "Results of the FMT experiments represent a significant therapeutic opportunity to improve pancreatic cancer treatment by altering the tumour immune microenvironment," said senior author Florencia McAllister, MD, assistant professor of Clinical Cancer Prevention at MD Anderson. "There is promise here but we have a lot of work ahead."

The New Daily, 12 August 2019

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

## **This Enzyme Could Hold the Secret to Longevity and Healthy Aging**

2019-08-21

healthy aging

**This could be the first step to achieving longer lifespans.**

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Calorie-restricted diets have been shown to increase the lifespan and healthspan of everything from yeast to monkeys — as long as there is no malnutrition. And while no long-term studies have proven the benefits of calorie restriction on human lifespan, shorter-term studies suggest that it does improve health. Here's how it might work. Our bodies monitor and sense the amount of nutrients available through specific molecules in our cells. Depending on the amount of food we eat, these molecules tweak our metabolism to regulate how we use the available nutrients. One of these molecules is an enzyme called TOR. When there is a lot of food, the TOR enzyme instructs cells in the body to grow. If there is less food, TOR instructs the body to be on alert — a state that scientists refer to as a “mild stress response.” Many experiments have shown that when animals eat a lot of food, especially for prolonged periods, TOR senses this and their lifespan becomes shorter. But do all foods have this effect on TOR? TOR enzyme is especially activated when cells sense large amounts of amino acids (the building blocks of protein) or protein. A protein-restricted diet, without malnutrition, can have the same effects on the metabolism and lifespan of lab animals as a calorie-restricted diet.

### Age-Related Disease

Age-related diseases are known to be caused by genetic mutations, but could there be a connection between TOR, nutrition, and diseases of old age? We know that nutrition is associated with cancer and heart disease, and overactive TOR is known to be involved in these diseases, but recent studies show that TOR is also directly related to neurodegenerative diseases. For example, the activity of the TOR enzyme in the brains of people with Alzheimer's is much higher compared with healthy brains. Also, simulating these diseases in mice and other lab animals has shown that removing excess TOR stops brain cells dying. So, there may be a link between what we eat, how it is sensed by our body, and the risk of neurodegenerative disease. Scientists are exploring different possibilities to prevent neurodegeneration. If more protein means more active TOR, we could either modify our diet, safely, or develop a drug that tricks our body into thinking it is getting less protein. Work in many labs, including ours, have shown that caffeine and a drug called rapamycin do exactly that. While cells have abundant protein, their metabolism and lifespan are similar to protein-restricted cells. We are currently investigating this in human neurons and the first results point in the same direction.

### Not That Simple

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Does that mean that we should change our diets and protein intake? What about other nutrients such as sugars? Unfortunately, as expected, things are not that simple. Many other molecules within our bodies are involved in sensing nutrients, including carbohydrates, which affect longevity and age-related disease. This is why we need to be very cautious. First, everyone has different needs for nutrients depending on their developmental stage and age, gender or activity levels — to name only a few important factors. Also, while evidence from the lab using human cells and tissues is piling up, we need large population studies that can record specific diets, including protein, fat, and carbohydrate intakes, with parallel analyses of the relevant health or molecular markers. Such studies need decades to generate solid data and valid conclusions. Still, with the development of new technologies and scientific approaches, we are taking steps towards understanding the underlying causes of aging and age-related disease. Coupled with targeted clinical trials and population studies, perhaps one day soon we'll be able to achieve healthy aging and longer lifespans.

Inverse, 12 August 2019

<http://www.inverse.com>

### **Australian power stations among world's worst for toxic air pollution**

2019-08-21

Power stations in Victoria's Latrobe Valley and New South Wales's Lake Macquarie region have been named on a list of the world's biggest hotspots for toxic air pollution. A new report by Greenpeace, published recently, used satellite data published by Nasa to analyse the world's worst sources of sulphur dioxide (SO<sub>2</sub>) pollution, an irritant gas known to affect human health and one of the main pollutants contributing to deaths from air pollution worldwide. The greatest source of SO<sub>2</sub> in the atmosphere is the burning of fossil fuels in power stations and other industrial facilities. Australia ranks 12th on a list of the top-emitting countries for human-caused sulphur dioxide emissions and is singled out in the report for air pollution standards that allow power stations to emit sulphur dioxide at higher rates than in China and the EU. It comes as state and federal environment ministers are reviewing Australia's air pollution standards for sulphur dioxide, now 11 times higher than what is recommended by the World Health Organisation. India, China and Russia rank first, second and third respectively in the Greenpeace report for emissions of SO<sub>2</sub> in 2018. The report also ranks the worst individual sources of toxic emissions, with

**Coal-fired stations in Victoria's Latrobe Valley and NSW's Lake Macquarie region among biggest hotspots for deadly sulphur dioxide, report finds**

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two locations in Australia appearing in the top 50, and a further two inside the top 100. The biggest source of SO<sub>2</sub> pollution in Australia is a complex of mining operations with copper, lead and zinc smelters in Mount Isa in Queensland. This site ranked 32nd in the report, producing 207 kilotonnes of sulphur dioxide emissions in 2018, according to the analysis. The Yallourn, Loy Yang A and Loy Yang B power stations in Victoria's Latrobe Valley ranked 49th at 151 kilotonnes. The Vales Point and Eraring coal-fired power stations in the Lake Macquarie region of NSW ranked 79th, and the Liddell and Bayswater power stations near Muswellbrook in the Hunter Valley 91st. The Victorian SO<sub>2</sub> air pollution hotspot covers a population of more than 470,000 people, and the NSW hotspot covers an area of more than 1.7 million people, but Greenpeace said the impacts from secondary pollution covered a far greater population. In Sydney alone, more than 100 premature deaths a year are thought to be caused by pollution from coal-fired power stations. Nationally it's more than 4,000. "Australian coal-burning power stations are polluting at levels that would be illegal in China and most other parts of the world," said Jonathan Moylan, a campaigner with Greenpeace Australia Pacific. "Air pollution is the price our communities pay for the federal government's failure to stand up to big polluters. It's time for state environment ministers to show leadership by championing health-based sulphur and nitrogen dioxide standards, strong pollution limits for industry and speeding up the switch to clean renewable energy." Sulphur dioxide can cause health problems including heart and lung disease, and asthma. Ben Ewald, a doctor with Doctors for the Environment Australia, said there were places in Australia that had "a serious SO<sub>2</sub> problem" and limits were set well above what was needed to protect human health. He said the same was the case for nitrogen dioxide, another airborne pollutant. "These pollutants can cause childhood asthma, lung disease, cancer, birth defects and reproductive issues," he said. "Australian governments must introduce tougher standards to protect community health." Environmental Justice Australia has been pushing for tougher air pollution standards across the country. EJA is representing the Nature Conservation Council in a legal challenge to the NSW Environmental Protection Authority's decision not to vary the pollution licences of the Mount Piper, Vales Point and Eraring power stations. EJA is also calling for Victoria's Environment Protection Authority to finalise a long-running review of the pollution licences for the Latrobe power stations and set tougher limits. "Although power stations obviously have [existing] limits on their licences, those limits are so lax that power stations essentially pollute as much as they want," said Nicola Rivers, EJA's director of advocacy and research. "It's pretty extraordinary to see the Latrobe Valley in that list of highest-polluting hotspots in the world." A spokesman

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for the Victorian EPA said it had considered 477 submissions to its review of the three licences in the Latrobe Valley and was drafting its assessment and amendments to the licences. He said the EPA had also designed an air-monitoring network with the Latrobe Valley community “because we value their involvement, knowledge and concerns”. “Victoria’s air quality is considered good by world standards but scientific knowledge on the impacts of air pollution on public and environmental health is continually growing and EPA is keen for this to be reflected in industry standards and requirements,” he said. The spokesman said Victoria’s EPA was also leading the national review under way for nitrogen dioxide and sulphur dioxide under the national environment protection (ambient air quality) measure and it was likely this would lead to stricter national standards. There have been 17,000 public submissions to the review.

The Guardian, 19 August 2019

<http://www.guardian.com>

### **Microplastics ‘significantly contaminating the air’, scientists warn**

2019-08-21

Abundant levels of microplastic pollution have been found in snow from the Arctic to the Alps, according to a study that has prompted scientists to warn of significant contamination of the atmosphere and demand urgent research into the potential health impacts on people. Snow captures particles from the air as it falls and samples from ice floes on the ocean between Greenland and Svalbard contained an average of 1,760 microplastic particles per litre, the research found. Even more – 24,600 per litre on average – were found at European locations. The work shows transport by winds is a key factor in microplastics contamination across the globe. The scientists called for research on the effect of airborne microplastics on human health, pointing to an earlier study that found the particles in cancerous human lung tissue. In June, another study showed people eat at least 50,000 microplastic particles per year. Many millions of tonnes of plastic are discarded into the environment every year and are broken down into small particles and fibres that do not biodegrade. These particles, known as microplastics, have now been found everywhere from high mountains to deep oceans and can carry toxic chemicals and harmful microbes. The latest study was led by Dr Melanie Bergmann of the Alfred Wegener Institute for Polar and Marine Research in Germany. She said: “We really need research on the human health aspect. There are so many studies being published now on microplastics but nothing on

**Discovery of pollution in snowfall from the Arctic to the Alps leads to call for urgent research on potential human health impacts**

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human health, and that is really strange in my opinion.” Bergmann added that microplastics should be included in air pollutant monitoring schemes. Bergmann had previously found 12,000 microplastic particles per litre in samples of Arctic sea ice: “So we asked where does it all come from?” Some is carried from populated regions by ocean currents, but analysis of snow samples shows much is blown by the wind. “Microplastic concentrations in snow were very high, indicating significant contamination of the atmosphere,” concluded the study published in the journal *Science Advances*. “It basically gets everywhere with the wind,” said Bergmann. Pollen and dust from the Sahara are already known to be blown over long distances. As well as the Arctic ice floes, the team’s 22 samples included snow from Svalbard, an island well north of the Arctic circle, the German and Swiss Alps and the city of Bremen. The team found that the smallest particles were the most abundant, but their equipment could not detect particles smaller than 11 microns. “I am convinced there are many more particles in the smaller size range beyond our detection limit,” said Bergmann. “The worry with smaller particles is they can be taken up by a greater range of organisms and, if they reach nano-scale, they could penetrate cell membranes and translocate into organs much more easily than the larger fraction.” Microplastics from polymer-based protective coatings on vehicles, buildings and ships were the most common of those frequently found by the researchers, followed by rubber, polyethylene and polyamides including nylon. The researchers cite a 1998 study as the only assessment of microplastic in human lungs. It found inhaled fibres were present in cancerous lung specimens and concluded: “These bioresistant and biopersistent plastic fibres are candidate agents contributing to the risk of lung cancer.” The European commission’s chief scientific advisers said in a report in April: “The evidence [on the environmental and health risks of microplastics] provides grounds for genuine concern and for precaution to be exercised.” Scientists not involved in the latest study expressed concern that supposedly pristine ecosystems such as the Arctic were contaminated. “The work is very important because it strengthens the argument for much more stringent regulations on the plastics industry and forcing the governments of the world to address the issue of plastic pollution,” said Steve Allen, at the EcoLab research institute in France. “With [microplastics] pouring into our environment, it is highly likely we will only find out the safe levels after we have exceeded them.” An earlier study published by Allen in April found significant microplastic quantities falling from the air in the Pyrenees, also implicating wind as a transport mechanism. The Bergmann-led research, however, is the first to look the contamination of snow. Just two previous studies have looked at the presence of microplastics in the air, one in Paris, France, and another

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in Dongguan, China. Both found a steady fall of particles. Other recent research has found microplastics raining down on the Rockies in North America and in farmland soils near Shanghai in China.

The Guardian, 15 August 2019

<http://www.guardian.com>

### **New Study Shows Bee-Killing Neonicotinoids Build Up in Environment**

2019-08-21

According to Henderson, neonicotinoids are a downstream, destructive solution to pest problems—to protect healthier crops, farmers should look upstream. Insects are our professors of agriculture, guiding organic farmers like me in maintaining a healthy farm ecosystem. That is why I am so concerned about the overuse of toxic pesticides and the massive insect die-offs reported around the world. What is causing this “insect apocalypse” and what does it say about the state of agriculture today? A study published in the peer-reviewed journal PLOS ONE this week provides new insight. For the first time, it provides a way to compare changes in the toxicity of U.S. agriculture from year to year. The study found that since neonicotinoid pesticides (often shortened to “neonics”) were first introduced in the 1990s, U.S. agriculture has become 48 times more toxic to insects. Incredibly, neonics account for 92 percent of the increased toxicity. Farmers are attracted to neonics because they can use smaller quantities of them than comparable products. However, while other pesticides break down in the environment within hours or days, neonics can go on killing insects for months to years after they’re applied. They accumulate in the soil contaminating groundwater and streams. And because they are water-soluble, they are taken up into the plants themselves. Bees and birds can be poisoned just by drinking the moisture that treated plants exude. Neonic residues also show up in the food we eat. We cannot wash these pesticides off when we cook with treated crops. The main use of these pesticides is as seed coatings for the millions of acres of corn and soybeans that blanket the rural landscape of the U.S. Only about five percent of the pesticide in the coating enters the crop, while the rest contaminates the soil and from there goes into groundwater or streams. Astonishingly, these seed coatings, according to research conducted by the U.S. Environmental Protection Agency (EPA) and others, provide little to no benefit to crop yields. Yet farmers who want to purchase untreated seeds have a hard time finding them since the seed market is dominated by the same chemical companies that make

**According to Henderson, neonicotinoids are a downstream, destructive solution to pest problems—to protect healthier crops, farmers should look upstream.**

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the neonic coatings. Mega-corporations—Bayer-Monsanto and Syngenta-ChemChina—have a tight grip on our food system, dictating how farmers farm and how the public eats. Organic farming offers a desperately needed alternative. Organic farmers look upstream to prevent pests and diseases before they become problems. On my farm, I cultivate a balance between pests and the “good” bugs that eat pest larvae and eggs, and I build healthy soil that grows crops with stronger immune systems that are less likely to succumb to pests and disease. As a result, I rarely need to use pesticides. When I do, I choose pesticides that cause the least harm and that break down rapidly in the environment, which is true of all pest products allowed under organic certification. To save our pollinators and the many crops that depend on bees, we need Congress to pass the Saving America’s Pollinators Act introduced by Rep. Earl Blumenauer (D-OR) to suspend the sale of most neonics and other systemic, pollinator-toxic insecticides. We should also support Rep. Nydia Velazquez’s (D-NY) bill to reverse the Trump administration’s decision to allow the use of neonics in wildlife refuges. To save us from the current pesticide treadmill, we need to adopt the precautionary principle (new materials have to be proven safe before they are commercialized) as the basic approach to any new agricultural material. This new study provides a method for the EPA to assess potential risks to biodiversity before introducing new pesticides. And most effective of all, and as quickly as possible, we need to transition agriculture to organic practices which grow abundant food without the use of neonics and some 900 other toxic pesticides. As a pioneer of organic agriculture, Sir Albert Howard said if a crop is attracting a lot of pests, there is something wrong with the way you are growing it. We can draw as clear a lesson from the looming insect apocalypse—if the tiny creatures that sustain life on Earth are disappearing, there is something alarmingly wrong with the way we are growing food. To protect the environment and the biodiversity on which our food system depends, we must become the students, rather than the masters, of the insect world.

Food Tank, 17 August 2019

<https://foodtank.com>

### Fracking boom tied to methane spike in Earth’s atmosphere

2019-08-21

Scientists have measured big increases in the amount of methane, the powerful global warming gas, entering the atmosphere over the last decade. Cows or wetlands have been fingered as possible sources, but new

**The chemical signature of methane released from fracking is found in the atmosphere, pointing to shale gas operations as the culprit.**

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research points to methane emissions from fossil fuel production—mainly from shale gas operations in the United States and Canada—as the culprit. The “massive” increase in methane emissions occurred at the same time as the use of fracking for shale gas took off in the U.S., says Robert Howarth, an ecologist at Cornell University and author of the study published Aug 14 in the journal *Biogeosciences*. “We know the increase is largely due to fossil fuel production and this research suggests over half is from shale gas operations,” Howarth says in an interview. This big methane increase matters because methane heats up the climate over 80 times more than an equivalent amount of carbon dioxide (CO<sub>2</sub>) in the first 20 years after it is released into the atmosphere, according to the Intergovernmental Panel on Climate Change. After 20 years most of the methane becomes CO<sub>2</sub>, which can last for hundreds of years. Methane released from shale gas production has a slightly different chemical fingerprint compared to methane from cow burps (not farts as commonly believed) and wetlands. Previous studies show that shale gas generally has less carbon-13 relative to carbon-12 (denoting the weight of the carbon atom at the centre of the methane molecule) than does methane from conventional natural gas and other fossil fuels such as coal, Howarth said. The study took previous data on the chemical composition of methane in the atmosphere and applied a series of equations to parse out how much of this lighter form of methane could be attributed to shale gas. That lighter form of methane released during fracking is a substantial component of the overall methane rise since 2008. However, he acknowledges that the chemical fingerprint of shale gas can vary depending on the locale and how the chemical analysis is done. While the study isn’t a “smoking gun,” it has found a link between recent increases in methane in the atmosphere and shale gas production. “It’s fuzzy, but the fingerprint is there,” Howarth says.

#### Signs point to fracking

Natural gas is mainly methane. Fracking involves drilling an oil or gas well vertically and then horizontally into a shale formation. A mixture of highly pressurised water, chemicals, and sand is injected to create and prop open fissures, or pathways for the gas to flow. Nearly all of the world’s fracking operations are in the U.S. and Canada. About two-thirds of all new gas production globally over the last decade has been shale gas produced in the U.S. and Canada using fracking, Howarth’s study found. The amount of methane added to the atmosphere in the past decade also corresponds to studies that show fracking operations leak, vent, or flare between 2 and 6 percent of the gas produced, Howarth said. A 2015 study estimated that North Texas’ Barnett Shale region leaked 544,000

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tons of methane a year using a conservative leakage rate of 1.5 percent. That's equivalent to 46 million tons of CO<sub>2</sub>, more than some states such as Nevada or Connecticut. A 2015 study led by John Worden of NASA's Jet Propulsion Laboratory found that methane levels were unchanged for years, but increased sharply after 2006, growing by 25 million tons a year. Using satellites and other measures they concluded that fossil fuels were responsible for between 12 and 19 million tons of this additional methane and the rest was likely biological sources. The Howarth study adds another piece to the extremely complicated methane puzzle, Worden said in an email, declining to elaborate. It's unlikely that the sharp rise in global methane levels at the same time as shale oil and gas operations increased dramatically is just coincidence, said Anthony Ingraffea, a Professor of Engineering at Cornell University and a colleague of Howarth's. The paper suggests shale gas's chemical fingerprint offers evidence of a direct link, said Ingraffea, who reviewed an early version of the paper. "Isotopic analysis of gas samples at wellheads across a number of fracking operations could easily prove or disprove Howarth's hypothesis," he says. "If Howarth is right then we know shale gas operations are making global warming worse, and upending efforts to stay well below 2C." Under the 2015 Paris Agreement, every country in the world agreed to keep global temperatures well below 2 degrees Celsius (3.6 degrees Fahrenheit), while low-lying island states and others lobbied for 1.5 Celsius. Although often forgotten in climate discussions, methane increases have added to the current warming and will continue to do so without action to cap them. "The atmosphere responds quickly to changes in methane emissions. Reducing methane now can provide an instant way to slow global warming," Ingraffea says. Ingraffea's own research has found that a small percentage of wells are responsible for the bulk of methane emissions either through leaks or deliberate venting. Retrofits and capturing the gas instead of venting could dramatically reduce emissions but would add to costs.

#### Environment and health

The Trump administration is trying to ramp up shale production by reversing rules for fracking operations on public lands. Those rules required companies to disclose the chemicals used in fracking, as well as more stringent standards on the construction of fracking wells and wastewater management. In addition, the Trump administration is auctioning off millions of acres of drilling rights to oil and gas developers. Environmental and health concerns have led France and Germany to ban fracking. New York State, Maryland, and Vermont also have bans. A

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2018 study in Pennsylvania found that children born within a mile or two of a fracked well were likely to be smaller and less healthy. In Arkansas researchers found water levels in 51 percent of its streams dangerously depleted due to water withdrawals for fracking operations. Fracking and the deep-well injection of its waste waters have been widely linked to earthquakes.

National Geographic, 15 August 2019

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

### Scientists Discover New Cure for the Deadliest Strain of Tuberculosis

2019-08-21

When she joined a trial of new tuberculosis drugs, the dying young woman weighed just 57 pounds. Stricken with a deadly strain of the disease, she was mortally terrified. Local nurses told her the Johannesburg hospital to which she must be transferred was very far away — and infested with vervet monkeys. “I cried the whole way in the ambulance,” Tsholofelo Msimango recalled recently. “They said I would live with monkeys and the sisters there were not nice and the food was bad and there was no way I would come back. They told my parents to fix the insurance because I would die.” Five years later, Ms. Msimango, 25, is now tuberculosis-free. She is healthy at 103 pounds, and has a young son. The trial she joined was small — it enrolled only 109 patients — but experts are calling the preliminary results ground-breaking. The drug regimen tested on Ms. Msimango has shown a 90 percent success rate against a deadly plague, extensively drug-resistant tuberculosis. Recently, the Food and Drug Administration effectively endorsed the approach, approving the newest of the three drugs used in the regimen. Usually, the World Health Organization adopts approvals made by the F.D.A. or its European counterpart, meaning the treatment could soon come into use worldwide. Tuberculosis has now surpassed AIDS as the world’s leading infectious cause of death, and the so-called XDR strain is the ultimate in lethality. It is resistant to all four families of antibiotics typically used to fight the disease. Only a tiny fraction of the 10 million people infected by TB each year get this type, but very few of them survive it. There are about 30,000 cases in over 100 countries. Three-quarters of those patients die before they even receive a diagnosis, experts believe, and among those who get typical treatment, the cure rate is only 34 percent. The treatment itself is extraordinarily difficult. A typical regimen in South Africa requires up to 40 daily pills, taken for up to two years. Other countries rely on even

**Once, a diagnosis of extensively drug-resistant TB meant quick death. A three-drug regimen cures most patients in just months.**

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older regimens that include daily injections of antibiotics that can have devastating side effects, including deafness, kidney failure and psychosis. But in the trial Ms. Msimango joined, nicknamed Nix-TB, patients took only five pills a day for six months. The pills contain just three drugs: pretomanid, bedaquiline and linezolid. (Someday, the whole regimen might come in just one pill, as H.I.V. drugs do, one expert said.) Until recently, some advocacy groups opposed pretomanid's approval, saying the drug needed further testing. But other TB experts argued that the situation is so desperate that risks had to be taken. Dr. Gerald Friedland, one of the discoverers of XDR-TB and now an emeritus professor at Yale's medical school, called Nix "a wonderful trial" that could revolutionize treatment: "If this works as well as it seems to, we need to do this now." News that tuberculosis had evolved a terrifying new strain first broke in 2006, when doctors at a global AIDS conference learned of a doomed group of tuberculosis patients in Tugela Ferry, a rural South African town. Of the 53 patients in whom the strain had been detected, 52 were dead — most within a month of diagnosis. They were relatively young: The median age was 35. Many of them had never been treated for TB before, meaning they had caught the drug-resistant strain from others who had been infected and had not developed it by failing to take their drugs. Several were health workers who were assumed to have caught it from patients. Within months, South Africa realized it had cases of the deadly infection in 40 hospitals. Alarmed, W.H.O. officials called for worldwide testing. The results showed that 28 countries, including the United States, had the deadly strain, XDR-TB, and that two-thirds of the cases were in China, India and Russia. It took far longer to determine how widespread it was in Africa, because most countries there could not do the sophisticated testing. H.I.V., the virus that causes AIDS, helped drive the epidemic. Anyone infected with it is 25 times as likely to get TB, according to the W.H.O. But many victims, including Ms. Msimango, catch this type of TB without ever having H.I.V. In the early years, XDR-TB was a death sentence. Doctors tried every drug they could think of, from those used to treat leprosy to those for urinary tract infections. "From 2007 to 2014, we threw the kitchen sink at it," said Dr. Francesca Conradie, a researcher at the University of the Witwatersrand, Johannesburg, and director of the Nix trial. The death rate was about 80 percent. Sometimes the drugs killed patients. In other cases, patients died of the disease, because they could not tolerate the drugs and stopped taking them. Tuberculosis germs burrow deep into the lungs and barricade themselves inside clumps of dead cells. Breaking those nodules apart and killing all the bacteria inside requires taking drugs for months. Nearly all antibiotics cause nausea and diarrhea. But some, especially the injections, are far tougher on patients. "Some get hallucinations," said Dr.

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Pauline Howell, a tuberculosis researcher who runs the Nix trial at Sizwe Tropical Diseases Hospital in Johannesburg, where Ms. Msimango was treated. "I had one patient who tried to cut open his skin because he thought bugs were crawling under it." The drugs may leave patients in wheelchairs with vertigo, or deaf in just a weekend. Nerves in their feet and hands may wither until they can no longer walk or cook. One of Dr. Howell's patients suffered so much from ringing in the ears that he tried to commit suicide. Ms. Msimango, too, veered close to death because the drugs were too much for her.

When she was 19, she said, she caught drug-resistant TB from another young woman — the temporarily homeless daughter of a friend of her mother. Her mother had generously taken in the young woman and had told her daughter to share her bed, a common arrangement in townships like Tsakane. "A few weeks after she left, I started coughing," Ms. Msimango said. "She had not told us that she had drug-resistant TB and had defaulted," she added, using a common term for dropping out of treatment. At first, Ms. Msimango got her injections at a hospital and took her pills under her mother's watchful eye. But they made her feel so awful that she secretly spat them out, stuffing them between the sofa cushions when her mother wasn't looking. After she defaulted twice herself, she was transferred to Sizwe, terrified that she would die alone.

New York Times, 14 August 2019

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

### **The misunderstood personality trait that is causing anxiety and stress**

2019-08-21

The desire to be perfect is something most of us have felt at some point in our lives. Studying for the perfect test result, searching for the perfect partner, working through the night to smash that perfect presentation. Often, having high standards can drive success, but for some people, diligence and motivation can shift into perfectionism, a sorely misunderstood personality trait that can have dangerous consequences. Perfectionism has increased significantly over the past three decades; a recent analysis shows. Young people in particular place higher demands on themselves and on others. Our dog-eat-dog world, full of impeccable images of what our bodies, careers and aspirations should look like, is creating a rising tide of millennials who may be putting themselves at risk of mental and physical illness in their search for the perfect life.

**Perfectionism is a hidden epidemic, and its rise is damaging individuals and society. We investigate how to escape the cult of perfect**

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An epidemic of perfectionism poses a serious, even deadly problem, according to those researching the trend. That sounds alarming, but there are solutions. So how can we learn when good is good enough, reach our goals without burning out and teach our children how to avoid the oncoming storm? "Perfection is hard to define," says Thomas Curran at the University of Bath, UK, who has been studying its rise. There is no fixed way of diagnosing it. However, many studies measure it using the Multidimensional Perfectionism Scale, which was developed three decades ago. It consists of 45 statements – such as "I strive to be the best at everything I do", "If I ask someone to do something, I expect it to be done flawlessly" and "People expect nothing less than perfection from me" – and people rate how much they agree with each of these on a scale of 1 to 7. If you very much identify with these kinds of statements, it is likely that you have perfectionist tendencies. "The scale also distinguishes between three different kinds of perfectionism. "Self-oriented" perfectionists set themselves high goals in their work and relationships. They can often experience anxiety from losing to a competitor, failing at a test or not getting a bonus at work. "Other-oriented" perfectionists hold those around them to exceptionally high standards. They are very critical and judgemental of others and risk social rejection and relationship problems. Finally, there are "socially prescribed" perfectionists, who feel immense pressure from others to be perfect, while also seeking their approval. "The impossibly high standards they set for themselves mean they often feel rejected or harshly scrutinised," says Curran. "As a consequence, their self-esteem takes a hit on a daily basis. It's a real battle involving lots of negative emotions, guilt and shame." Part of the difficulty in pinpointing perfectionism is that the line between having high standards and being a perfectionist is very blurred. "The difference between someone who sets high goals and a perfectionist comes at the time of success or failure," says Andrew Hill at York St John University, UK. For instance, someone who is hard-working and diligent will appreciate any success, and will adapt their goals when they fail. They will be able to put in just enough effort for a strategic benefit. A perfectionist will take much less pleasure from success. Even a perfect score will be met with a sense of pressure that they need to keep up this level of success or that the goalposts need to be placed further away. If the experts find perfectionism difficult to identify, it is also hard for many perfectionists. Take Jonathan Stern, a master's student at Florida State University in Tallahassee, who competes in cross-country races at a national level. For him, the word perfectionist was something that people without high standards used to describe people with them, to denigrate them. "That's the way I saw it for most of my life," he says. Although he didn't acknowledge them, his perfectionist tendencies

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drove him to run hundreds of miles a week and continually challenge his personal best. But he was still dissatisfied. "Even when I ran my fastest, it never felt like enough," he says. Eventually, it led to severe burnout. "I got to the end of the line. I realised it was perfectionism that was weighing me down."

### A wider toll

It is impossible to put an exact figure on how many people experience perfectionism, says Hill. However, a massive study published earlier this year leaves no doubt that perfectionist tendencies are on the rise. Curran and Hill analysed data from more than 41,000 US, Canadian and UK students who had completed the Multidimensional Perfectionism Scale between 1989 and 2016. They discovered increases in all dimensions of perfectionism. The most dramatic, however, was in socially prescribed perfectionism: almost two-thirds of students who took the test in 2016 scored above the 1989 average. "It was really alarming because that's the most harmful kind," says Curran. So, what has caused this upward trend? Perfectionism does have a genetic aspect. When Carmen Iranzo-Tatay at La Fe University Hospital in Valencia, Spain, and her colleagues analysed the DNA of 258 pairs of twins they were able to calculate that genes accounted for between 11 and 56 per cent of the variability in perfectionism between people. The team also found that a person's environment influences whether perfectionism emerges, and can push them towards expressing one type of perfectionism over another. It is these environmental factors that have changed in recent decades. "There are new pressures today that young people have to negotiate that young people in the past were not exposed to," says Curran. A generation ago, governments took more responsibility, he says. "Now students take on their own risk for success and failure. They have to pay for university, they have to take part in more standardised testing from a younger age and they have more competition for good schools and colleges," he says. On top of these academic pressures, social media sites set unrealistic targets for young people in all other aspects of their life, says Curran. "If you throw a dodgy economy into the mix, then you have an unprecedented storm of pressure to reach unattainable targets." Hill and Curran believe their research reveals a hidden "epidemic" of perfectionism, with alarming implications for the mental health of young people. Perfectionism isn't included in psychiatry's diagnostic bible, the DSM-5, as a syndrome in its own right. But it has strong links with mental health conditions that are. When Karina Limburg at Ludwig-Maximilians University in Munich, Germany, and her colleagues analysed 284 studies, which included more

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than 57,000 participants, they found that people with eating disorders, anxiety disorders, obsessive-compulsive disorder (OCD) and depression had higher levels of perfectionism compared with people who didn't have any of the conditions. Those with perfectionist tendencies were more likely to experience more than one condition at a time. Perfectionism has also been linked with suicide. Physical health may also be affected as a result of the stress that perfectionists subject themselves to, leading to an increased risk of things like cardiovascular disease. Additionally, they cope less well when they are ill because they experience higher levels of anger, depression and anxiety.

An epidemic of perfectionism among young people could be storing up trouble for the future. Martin Smith at York St John University and his colleagues have found that perfectionism becomes more problematic as we age. It sounds counter-intuitive, but perfectionists become less conscientious, less diligent, less productive, increasingly neurotic and more likely to experience burnout. "Those who strive for perfection perceive a high frequency of failures and low frequency of successes. In turn, they become increasingly disengaged with their work and increasingly emotionally unstable," says Smith. This helps explain why perfectionism is often associated with procrastination. "The slightest failure can be catastrophic to a perfectionist's motivation for subsequent efforts," says Curran. "So rather than opening themselves up to failure, they shut down and don't try in the first place." Are there any benefits to having exacting standards? Admittedly, perfectionists tend to achieve academically or in their career. But it comes at a price. Even among elite athletes and professional dancers, perfectionism is a double-edged sword, according to research by Sanna Nordin-Bates at the Swedish School of Sport and Health Science in Stockholm. Through a series of questionnaires and in-depth interviews, she found that perfectionism boosts performance in the short run, but then undermines it. "These dancers and athletes speak about the positive aspects of it, but there's always a 'but'. The elements of perfectionism that drive them to reach high standards always come at a cost," she says. That goes for all of us. Sarah Marshall-Maun, a teacher based in Devon, UK, has experienced the highs and lows of being a perfectionist. "I got promoted and promoted because I was so diligent and productive – perfect but quick. It meant I've had great opportunities," she says. "In that sense it has some positives, but the negatives end up outweighing it all." She was staying up until 1 am planning lessons two weeks in advance, then rising at 5 am so she would look immaculate for work. "I didn't question whether it was normal to cry every morning because some small detail wasn't right," she

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says. Eventually a tricky class, a tricky parent and a tricky boss created the perfect storm for her perfectionism to spiral out of control. She was diagnosed with severe stress, generalised anxiety disorder and depression, and was unable even to walk to the local shop. "We certainly shouldn't be promoting perfectionism as a positive trait in an uncritical manner," says Nordin-Bates. It isn't even true that you need it to be an elite athlete, she says. Hill goes further: "People who say there are positive attributes to perfectionism are probably confusing it with diligence, conscientiousness and hard work." Fortunately, there are ways we can combat perfectionism. But first we need to recognise it, which can be difficult. By the very nature of this condition, it is extremely hard for a perfectionist to admit that there might be something wrong, says Simon Sherry at Dalhousie University in Canada, who specialises in treating perfectionism. Acknowledging the problem is an excellent first step. "We usually see people at the end of the road, when they are in a bad way," he says. Depending on the extent of the problem, some people find that self-help books are enough. Others need professional help. This normally comes in the form of talking therapies or cognitive behavioural therapy (CBT), which give people tools to analyse why they are acting in certain ways and enable them to break out of negative patterns.

### Good is good enough

In the future, therapists may be able to better focus their treatments for those whose perfectionism is linked with other mental health conditions, after research found that different conditions are associated with distinct aspects of perfectionism. For example, self-criticism – "perfectionistic concerns" – is linked with OCD and anxiety, whereas "perfectionistic striving" is linked with eating disorders. For Stern, the key has been to step outside his comfort zone. He pushes himself to do things when he knows the conditions aren't perfect – from working out or writing an assignment when he is tired to saying hello to a stranger in a supermarket. Crucially, he acknowledges the effort he makes, rather than the outcome. "I now have a better understanding that it's not about everything being perfect," he says. "No action is too small. Good enough really is good enough." Marshall-Maun found that CBT helped. She now accepts that something doesn't have to be perfect to be great. "But it has taken a lot of work, lots of self-reflection and antidepressants to get to this point," she says. And she still has one big concern: "I'm always aware of how I might be unconsciously passing these tendencies on to my daughter." With perfectionism rising rapidly among young people, many parents will share Marshall-Maun's desire to protect their children. "We've been working on the role parents

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play and it's complex," says Smith. "In terms of preventing it in your children, we know that parental practices have an important influence." Extremely critical or demanding parents risk triggering perfectionism in their kids. "To avoid creating perfectionist tendencies, parents need to focus on loving their children in a more unconditional way, rather than focusing their love on specific successes," says Sherry. They can also help young people cope with the pressures of modern life. "It's incumbent on parents to coach their children on the potential hazards of social media. Teach them that it doesn't offer realistic images of lives, that they are often lofty and fake," he says. "It's a cliché, but we need to promote the idea of life-long learning as an attitude in our children – the sense that things are not over when one test has been done, one race has been won or lost," says Nordin-Bates. All of us can benefit from this approach to life. "It's not about being perfect," she says. "If you want to be happy and healthy for 80-plus years then you have to focus on what you gained from an experience, rather than what grade you achieved."

New Scientist, 14 August 2019

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

## Technical Notes

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Neuro-toxic and reproductive effects of BPA

Prenatal exposure to organochlorine compounds and lung function during childhood