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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

Revocation of Suspension of Label Approvals containing 2,4-D to allow Approval of new Label

2019-07-19

On 3 July 2019 the Australian Pesticides and Veterinary Medicine Authority (APVMA) revoked the suspension of the following 2,4-D product label approvals to allow approval of a new product label that has instructions consistent with the previous suspension instructions as published in 2018.

Table 1: Registered products containing 2,4-D and new approved labels

1.Product No	2.Product Name	3.Registrant	4.Label Approvals that have been cancelled	5.New approved Label Number that is not suspended
67109	Kenso Agcare Bucko 75-D Herbicide	Kenso Corporation (M) Sdn. Bhd	67109/55226	67109/118372
56339	Kenso Agcare Ken-Amine 625 Selective Herbicide	Kenso Corporation (M) Sdn. Bhd	56339/0310	56339/118948
68049	Ezycrop 2,4-D IPA 300 Herbicide	Ezycrop Pty Ltd	68049/57357 68049/59803	68049/118329
68558	Ezycrop 2,4-D Amine 625 Herbicide	Ezycrop Pty Ltd	68558/58572	68558/118238
85354	Kojak 75D Herbicide	Crop Culture Pty Ltd	85354/112996	85354/118157
64728	Agro-Essence 2,4-D 625SL	Agro-Alliance (Australia) Pty Ltd	64728/53443	64728/118037
67615	Agro-Essence 2,4-D Ester 680 Herbicide	Agro-Alliance (Australia) Pty Ltd	67615/56464	67615/118038
67261	Agro-Essence 2,4-D 300 Herbicide	Agro-Alliance (Australia) Pty Ltd	67261/55643	67621/118036

On 3 July 2019 the Australian Pesticides and Veterinary Medicine Authority (APVMA) revoked the suspension of the following 2,4-D product label approvals to allow approval of a new product label that has instructions consistent with the previous suspension instructions as published in 2018.

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1.Product No	2.Product Name	3.Registrant	4.Label Approvals that have been cancelled	5.New approved Label Number that is not suspended
84835	Submarino 2,4-D Amine 625 Herbicide	Submarino Pty Ltd	84835/111528	84835/118017
68480	Agmate 2,4-D 625 SL Herbicide	Agcare Pty Ltd	68480/58429	68480/118009
68475	Agmate 2,4-D 300 SL Herbicide	Agcare Pty Ltd	68475/58424	68475/118008
56719	Titan Amine 625 Selective Herbicide	Titan Ag Pty Ltd	56719/0214	56719/117929
70018	Kelpie Amine 625 Herbicide	Sinochem International Australia Pty Ltd	70018/62312	70018/117854
31536	Campbell Methar Tri-Kombi Herbicide	Colin Campbell (Chemicals) Pty Ltd	31536/57176	31536/117716
63813	Putra-Amine 625 Selective Herbicide	Hextar Chemicals Pty Ltd	63813/59543	63813/117572
65224	Kenso Agcare Ken-Ester LV 680 Selective Herbicide	Kenso Corporation (M) Sdn. Bhd.	65224/50453	65224/119426
65638	Kenso Agcare Ken-Amine 720 Selective Herbicide	Kenso Corporation (M) Sdn. Bhd.	65638/0214	65638/51482
54950	Kenso Agcare Ken-Star 300 Herbicide	Kenso Corporation (M) Sdn. Bhd.	54950/0214 54950/0805	54950/119257
68049	Ezycrop 2,4-D IPA 300 Herbicide	Ezycrop Pty Ltd	68409/57357 68409/59803	68049/118329

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1.Product No	2.Product Name	3.Registrant	4.Label Approvals that have been cancelled	5.New approved Label Number that is not suspended
68558	Ezycrop 2,4-D Amine 625 Herbicide	Ezycrop Pty Ltd	68558/58572	68558/118328
63412	Titan LV Ester 680 herbicide	Titan Ag Pty Ltd	63412/0214	63412/117927

The suspension of the above label approvals listed in Table 1 has been revoked to allow the approval of new labels with instructions consistent with those issued by the APVMA.

APVMA Gazette, 16 July 2019

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

Proposal to update the GHS under the model WHS laws – consultation closes 28 July

2019-07-18

The consultation on the proposal to adopt an updated edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for workplace hazardous chemicals, closes Friday 26 July. Safe Work Australia is seeking feedback from manufacturers, importers, suppliers, users and other stakeholders that have an interest in hazardous chemicals in the workplace, about moving from GHS 3 to GHS 7. A Consultation Paper has been prepared, which outlines the key changes from GHS 3 to GHS 7 and the particular topics we would like to receive feedback on. To provide your feedback and to access the Consultation Paper register to our consultation platform, [Engage](#) or email GHS@swa.gov.au

Safe Work Australia, 15 July 2019

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

The consultation on the proposal to adopt an updated edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for workplace hazardous chemicals, closes Friday 26 July.

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State and territory governments continue to regulate fluoridated drinking water in Australia

2019-07-19

The Therapeutic Goods Administration (TGA) has clarified that state and territory governments will continue to be responsible for regulating fluoride in reticulated drinking water. Legislative amendments made on 11 July 2019 put an end to any uncertainties about regulatory responsibility by explicitly excluding fluoridated drinking water from the scope of Australia's therapeutic goods legislation. In Australia, the *Therapeutic Goods Act 1989* sets out the legal requirements for supplying therapeutic goods, such as medicines and medical devices. Following an amendment to the *Therapeutic Goods (Excluded Goods) Determination 2018*, fluoridated water is now an 'excluded good' for the purposes of the Act. The exclusion applies for any reticulated drinking water that contains fluoride, regardless of the original source of the fluoride. Adjusting the level of fluoride in drinking water is a safe and effective way of preventing tooth decay in the community. In Australia, state and territory water authorities adjust the amount of fluoride in community water supplies using strict controls, which are set out by regulations in each jurisdiction. The National Health and Medical Research Council (NHMRC) has also stated 'there is no reliable evidence of an association between community water fluoridation at current Australian levels and any health problems.' Thus, there is little risk that fluoridated reticulated drinking water would cause harm to the public if it were not regulated by the TGA. State and territory governments established regulations for drinking water fluoridation as early as 1957, all before the *Therapeutic Goods Act 1989* came into force. State and territory regulations are appropriate, so there is no need to apply a national system of control. There is no indication in the *Therapeutic Goods Act 1989* that it was intended to apply to fluoridated drinking water. By specifically excluding fluoridated drinking water from the scope of the Act, ambiguity has been removed. For more information about fluoridation of drinking water in your area, contact your state or territory health department.

TGA, 15 July 2019

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

The Therapeutic Goods Administration (TGA) has clarified that state and territory governments will continue to be responsible for regulating fluoride in reticulated drinking water.

Regulatory Update

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Japan hits South Korea with controls on key electronic materials

2019-07-19

Samsung's South Korean semiconductor operations could be affected by the export controls. The Japanese government has imposed controls on exports to South Korea of three categories of materials that are critical to producing semiconductors and organic light-emitting diode (OLED) displays. The materials are advanced photoresists, hydrogen fluoride, and fluorinated polyimides. The controls will likely impact the operations of Korean chip makers because of Japan's near monopoly on advanced photoresists needed to produce the latest generations of chips. Japan is also a major producer of the grades of HF and fluorinated polyimides used in electronic manufacturing. Two South Korean firms, SK Hynix and Samsung, are among the world's five largest and most sophisticated producers of computer chips, particularly memory chips. "Production of semiconductors in Korea will be affected," says Mikiya Yamada, a chemical and textile analyst at Mizuho Securities, a large Japanese stockbroker. South Korean firms also dominate the production of OLED displays. The measures were introduced because of a deterioration in the "relationship of trust" between Japan and South Korea, according to Japan's Ministry of Economy, Trade and Industry. The Japanese media is reporting that Japan's move is in retaliation for a South Korean court decision in October ordering Japanese firms to pay compensation to Koreans who were forced laborers during World War II. Japanese companies will need to ask their government's permission to export the chemicals affected by the controls. By the time Japan authorises the sales, the delay to users could add up to three months. JSR, a major Japanese producer of electronic materials, says it is reviewing how to best serve its South Korean customers. South Korean firms could get around the ban by ordering from non-Japanese plants, but that won't be easy. An official at the Japanese hydrogen fluoride producer Stella Chemifa, for instance, notes that while the firm operates a 10,000-metric-ton-per-year plant in Singapore, capacity in Japan is far larger at 95,000 metric tons per year. In contrast, the impact of the measures on Japanese chemical producers will likely be limited. Hisashi Moriyama, head of Japan research at the investment bank J.P. Morgan, noted in a Japanese TV interview that while South Korea produces 26% of the world's microchips, companies in other countries will likely step in if Korea is unable to supply the market. Japanese chemical producers would

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likely offset a fall in demand from South Korea by increasing shipments to other countries.

Chemicals & Engineering News, 12 July 2019

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

Japan and UN Environment announce new efforts to prevent mercury tragedy

2019-07-19

Japan's Ministry of the Environment and the United Nations Environment Program recently announced a new project to protect the environment and human health from adverse impacts of mercury. Up to \$3 million will be allotted to the project, which will help establish a regional mercury monitoring laboratory network in Asia and the Pacific and provide for capacity building and training for countries around the region. With its first-hand experience of Minamata disease, a serious illness caused by mercury poisoning and named after the Japanese city where it was first discovered, Japan has played a leading role in global mercury reduction. UN Environment Programme hosts the Minamata Convention on Mercury, a global treaty designed to safeguard the planet from the dangers of mercury. Dechen Tsering, UN Environment's Regional Director for Asia and the Pacific, said, "The dangerous effects of mercury on the environment and human health are now well documented, and the global community is acting to protect people and planet. Japan has long been an important leader on this issue, and this new contribution only serves to underline their commitment." Tamami Umeda, Director General for Environmental Health Department of the Ministry of the Environment Japan, said, "In the implementation of the Minamata Convention, we need effective and timely actions. We also need to bring wider stakeholders on board. With that in mind, Japan has launched the new project to enhance mercury monitoring as a basis for enhanced science-based policy-making in towards global mercury pollution." Mercury is used in a wide variety of applications and finds its way into the environment through industrial emissions and channels like artisanal gold mining. From the environment, it can be accumulated by some species that are then eaten by humans – with health concerns for high risk populations. Approximately half of the global mercury consumption and emissions occur in Asia and the Pacific. In addition to the monitoring network and capacity building, the funding will also support the creation of a scientific database with information

Japan's Ministry of the Environment and the United Nations Environment Program recently announced a new project to protect the environment and human health from adverse impacts of mercury.

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that governments and institutions can apply toward effective mercury management.

UN Environment, 9 July 2019

<https://www.unenvironment.org>

AMERICA

EPA to allow use of pesticide considered 'very highly toxic' to bees

2019-07-19

The United States Environmental Protection Agency (EPA) approved broad new applications Friday for a controversial insecticide, despite objections from environmental groups and beekeepers who say it is among the compounds responsible for eviscerating the nation's bee populations. Alexandra Dunn, head of the EPA office that oversees pesticides, said the agency was "thrilled" to be able to approve new uses and lift past restrictions on sulfoxaflor, which she called a "highly effective" tool for growers around the country — but which the agency itself considers "very highly toxic" to bees. The decision will allow the chemical to be applied to a wide array of crops, including citrus and corn, soybeans and strawberries, pineapples and pumpkins. "EPA is providing long-term certainty for U.S. growers to use an important tool to protect crops and avoid potentially significant economic losses, while maintaining strong protection for pollinators," Dunn said. The agency's critics, some of whom successfully sued the EPA in federal court during the Obama administration to restrict use of the pesticide, were anything but thrilled with the announcement. "At a time when honeybees and other pollinators are dying in greater numbers than ever before, EPA's decision to remove restrictions on yet another bee-killing pesticide is nothing short of reckless," Greg Loarie, an attorney for the environmental advocacy group Earthjustice, said in an email. The news comes during a time that commercial honeybee colonies have been declining at a startling rate. The annual loss rate for honeybees during the year ending in April rose to 40.7 percent, up slightly over the annual average of 38.7 percent, according to the Bee Informed Partnership, a non-profit group associated with the University of Maryland. Some of the losses have been associated with events such as massive wildfires in the west, the wet winter in the Midwest and hurricanes in the Southeast. But the bee losses documented over the past decade are often blamed in no small part on the increased use of fungicides, herbicides

The agency says sulfoxaflor poses less risk than alternatives and is a critical tool for farmers.

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and certain pesticides. Sulfoxaflor was initially approved by the EPA in 2013, but a collection of beekeepers and other opponents sued the agency over its use, saying studies made it clear that it was highly toxic to honeybees. In 2015, the U.S. Court of Appeals for the 9th Circuit ruled that federal regulators lacked adequate data to show the pesticide did not pose serious risk to pollinators, and the court vacated the agency's approval of sulfoxaflor. In 2016, the EPA approved use of the pesticide for crops that do not attract bees, as well as for use on certain plants after blooming was complete. The agency also has repeatedly granted emergency waivers to states to allow the use of sulfoxaflor on certain crops because of a lack of effective alternatives for farmers — including more than a dozen such exemptions this year alone for sorghum and cotton. "That helps you see how important a tool this is," Dunn told reporters. In deciding to grant broad approval to sulfoxaflor, Dunn said the agency relied on a host of new, industry-backed studies that showed the insecticide dissipates in the environment more quickly than widely used alternatives, thereby lowering the risk to bees. In addition, the agency said sulfoxaflor often requires fewer applications than other insecticides, resulting in reduced risks to wildlife. "Our data on this insecticide is among EPA's largest data sets on the effects of a pesticide on bees," Dunn told reporters, saying the agency had carefully considered its risks and benefits. "EPA highly values pollinator protection." She added that farmers must still abide by numerous restrictions when using the pesticide. For instance, it can be applied to certain tree fruits, berries and other crops only after they have bloomed. Restrictions also exist to prevent drifting of the pesticide in windy conditions. Corteva, the agricultural division of DowDuPont, welcomed the EPA's approval for what it called "critical" uses of the pesticide, saying in a statement Friday that "growers should have access to tools that can be used safely according to the product label." The Agricultural Retailers Association, which represents suppliers of seed and other products to farmers and ranchers, also praised the EPA's decision. "It is encouraging to see EPA take a hard look at the science about sulfoxaflor and its effects on pollinators and issue a science-based decision on its permitted use," the group's president, Daren Coppock, said in a statement. "This is how the system is supposed to work: scientific experts making science-based decisions." But Lori Ann Burd, director of the Centre for Biological Diversity's environmental health program, called Friday's decision little more than a gift to industry, and one that did not come with public input. "Their failure to provide any notice of this decision is a new low for this administration," Burd said in an interview. "But the worst part of this is that they know the effect; they know how significant this is. And yet they are allowing this even with the full knowledge we are in a pollinator

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extinction crisis." Burd said she expects opponents to soon take EPA to court once again over the pesticide. "Their job is to weigh the risks versus the benefits," she said. "But they are just touting the benefits and sweeping the risks under the rug."

Washington Post, 12 July 2019

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

California Launches App for Reporting Pesticide Incidents

2019-07-19

With a newly launched app, people in California can now report pesticide incidents from the palm of their hand. California is the nation's top agricultural producing state and receives approximately 300 pesticide complaints a year. With studies showing links between certain pesticides and severe health effects such as developmental delays and autism, people are on high alert. Developed by the California Department of Pesticide Regulation, with funding from the United States Environmental Protection Agency, the free app allows anyone who may have been exposed to pesticides to report the incident from their smartphone or tablet. The app, California's System for Pesticide Incident Reporting, better known as CASPIR, enables users to pinpoint the specific location of the incident using GPS. Users can also add photos, videos and other details that may be helpful for authorities responding to the report. While people can submit their contact information, submitting anonymously is also an option in the app. The state is moving toward banning chlorpyrifos, a pesticide that's been in use since 1965 but is now believed to cause brain development issues in babies. In a 2012 study by the University of California—Berkeley, "87% of umbilical-cord blood samples tested from newborn babies contained detectable levels of the pesticide," according to The Associated Press. The pesticide has been found to be chemically similar to a nerve gas developed by Nazi Germany before World War II, the AP said. The pesticides not only affect people directly exposed to the gas, but can also have implications on people who ingest produce that have been sprayed with the chemicals. Other states, including Hawaii and New York, have also taken measures to ban chlorpyrifos. California employs more than 420,000 agricultural workers, many of whom are exposed to pesticides on a daily basis. However, more than half of all pesticide-related illnesses in California occur in non-agricultural settings, according to a CDPR press release. "Pesticide problems can happen all over the state," DPR Acting Director Val Dolcini said in the release. "This new phone app will

The nation's top agricultural producing state receives hundreds of pesticide complaints a year.

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help farmers, farmworkers, restaurant workers, and others report pesticide incidents 24 hours a day, seven days a week. Available in both English and Spanish, this tool will help all Californians.”

U.S News, 11 July 2019

<https://www.usnews.com>

New York bill banning 1,4-dioxane would prohibit many cleaning products, industry warns

2019-07-19

Two trade groups representing the cleaning product industry are urging the governor of New York, Andrew Cuomo (D), not to sign a bill (S4389B) that would ban 1,4-dioxane in cleaning and personal care products sold in the state. High levels of 1,4-dioxane have been found in the groundwater in Long Island, New York, from former industrial and military facilities in the area. The legislation would limit 1,4-dioxane in household cleaning products to a level of 1 ppm by the end of 2023, in an effort to protect water quality. The chemical is an impurity in ethoxylated compounds in some household detergents. “Unfortunately, this bill will have no measurable impact on groundwater and it will not have the intended effect for Long Island’s residents,” the coalition of cleaning products trade groups says in a statement. The CEOs of those groups argue that the bill would lead to the removal of many household cleaning products from store shelves in New York and “prices for laundry and dish detergent could dramatically increase.”

Chemical & Engineering News, 12 July 2019

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

Two trade groups representing the cleaning product industry are urging the governor of New York, Andrew Cuomo (D), not to sign a bill (S4389B) that would ban 1,4-dioxane in cleaning and personal care products sold in the state.

EUROPE

EU Court Upholds Toxic Designation for Chemical BPA

2019-07-19

Recently, a trade group for the plastics industry failed to persuade the European General Court that the industrial chemical BPA should not be classified as toxic. The European Commission labelled Bisphenol A, as the compound is otherwise known, as “toxic for reproduction” in 2016, and the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) issued a recommendation shortly thereafter to have

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the compound listed under a regulation known as REACH, short for Registration, Evaluation, Authorisation and Restriction of Chemicals. BPA is ubiquitous in plastic products, and the group PlasticsEurope reacted swiftly when the European Chemicals Agency updated the candidate list of REACH substances to include BPA in 2017. The European General dismissed the challenge Thursday, finding that a substance cannot be exempted from the REACH Regulation just because it has intermediate uses, such as in the manufacture of polymers. (The ruling offers the example of thermal paper /manufacturing as a nonintermediate purpose of BPA.) "The contested decision is consistent with the objective of sharing information on substances of very high concern within the supply chain and with consumers," the opinion states. "The fact that certain substances of very high concern used as intermediates may benefit from the special conditions for registration ... does not call into question the need to subject such substances to the information-sharing regime." Even if intermediate uses cannot be the subject of an authorisation, the court rejected the argument that the designation with respect to all BPA's uses triggers significant legal obligations for suppliers. "In so far as the applicant has doubts as to the proportionality of the contested decision because intermediate uses do not play a role in the [REACH designation] of a substance, ... it should be recalled that the contested decision is intended to achieve the objective in connection with the sharing of information on substances within the supply chain," the opinion states. "The legal effects of the contested decision do not go beyond what is appropriate and necessary to achieve that aim."

Courthouse News Service, 11 July 2019

<https://www.courthousenews.com>

MSC unanimously agrees that HFPO-DA is a substance of very high concern

2019-07-19

The Member State Committee (MSC) unanimously agreed to identify 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propionic acid, its salts and its acyl halides (covering any of their individual isomers and combinations thereof) (denoted as HFPO-DA) as substances of very high concern (SVHCs). The European Chemicals Agency (ECHA) will include the newly identified SVHCs in the Candidate List by mid-July 2019. The substances are used as processing aids for producing fluoro-polymers with many applications, such as fluoropolymer resins, wire cables and coatings. They were proposed by the Netherlands due to their properties which cause

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probable serious effects to human health and the environment, giving rise to an equivalent level of concern to carcinogenic, mutagenic and reprotoxic (CMR), persistent, bioaccumulative and toxic (PBT) and very persistent and very bioaccumulative (vPvB) substances. At its meeting recently, the MSC acknowledged that HFPO-DA has a high potential to cause effects in wildlife and in humans through the environment due to its very high persistence, mobility in water, potential for long-range transport, accumulation in plants and observed effects on human health and the environment. Furthermore, the committee noted the lack of known natural removal of HFPO-DA once released, leading to a continuous presence in water and resulting in the continuous bioavailability of these substances. It also noted the expected exposure through the food chain and drinking water, as well as difficulties to remediate polluted media and remove HFPO-DA from drinking water. Together, these contribute to a high potential of these substances for continuous, increasing and widespread exposure which would be difficult to reverse. While in isolation none of these observations may be of equivalent level of concern, the MSC unanimously agreed that in combination they show that there is scientific evidence of probable serious effects to the environment and humans. The MSC also noted that co-exposure to other contaminants with similar effects may occur, which strengthens the concern for HFPO-DA.

CIRS News, 28 June 2019

<http://www.cirs-reach.com>

EU Restricted the Harmful Substances in Disposable Plastics

2019-07-19

On 12 June 2019, the Official Journal of European Union released the directive (EC) 2019/904 to restrict the disposable plastics and products. It aims to prevent and reduce the impact of certain plastic products on the environment, in particular the aquatic environment, and on human health, as well as to promote the transition to a circular economy with innovative and sustainable business models, products and materials, thus also contributing to the efficient functioning of the internal market. This Directive is addressed to the member states and shall enter into force on 1 July 2019. The directive calls for reducing and limiting the consumption of disposable plastics, including beverage cups, beverage mixers, other food contact containers and tableware such as fast food packaging, sanitary towels (pads), tampons, wet wipes and other disposable sanitary products, balloons, Tobacco products with filters and other plastic

On 12 June 2019, the Official Journal of European Union released the directive (EC) 2019/904 to restrict the disposable plastics and products.

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products or plastic parts. For the sake of women's health, manufacturers are required to avoid adding harmful chemicals to sanitary napkins, tampons and tampon applicators. Regulations for food contact plastic materials and metal products is (EU) No 10/2011, China general standard GB 4806.1-General safety requirements for food contact materials and products, and in view of the disposable sanitary products mandatory standard is GB 15979-the health standard for disposable sanitary products. C&K Testing can provide related consulting services and project testing services for enterprises. C&K Testing reminds enterprises to pay attention to the related regulation, fulfil the corresponding obligations in time and prevent the subsequent risks effectively. Further information is available at:

- [OJ Directive EC 2019/904 to Restrict Disposable Plastics](#)

CIRS, 17 June 2019

<http://www.cirs-reach.com>

Mapping of best practices and development of testing methods and procedures for identification of characterising flavours in tobacco products. Final report

2019-07-19

The new EU Tobacco Product Directive 2014/40/EU (TPD) prohibits cigarettes and roll-your-own tobacco having a characterising flavour other than one of tobacco. Although some other jurisdictions have legislation on tobacco flavour, no methods are currently available to assess characterising flavours. The overall aim of this project was to deliver a test approach for the assessment of characterising odours in tobacco products, by a combination of sensory profiling, chemical-analytical measurements, other methods, or a combination of methods. The tobacco industry and the food industry in general conduct expert panel and consumer research to test the flavour and other sensory characteristics of a product for purposes of successful product development. In summary, the project consisted of carrying out four work packages (WP), in the time period August 2014-June 2015:

- WP1: Review the literature, with the aim to draft a review of the current methods and approaches that may be suitable for the objective determination of characterising flavours in tobacco products.
- WP2: Identify concept profiles, with the aim to draft three testing approaches, based on the output of WP1, for sensory analysis of

The new EU Tobacco Product Directive 2014/40/EU (TPD) prohibits cigarettes and roll-your-own tobacco having a characterising flavour other than one of tobacco.

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tobacco products (including chemical-analytical measurements) applicable to tobacco product regulation.

- WP3: Optimise and peer-review the procedure, with the aim to test, refine and finalise the methodology that had been proposed based on the outcomes of WP1 and WP2.
- WP4: Assess the feasibility and impact, with the aim to check whether the overall aim, to deliver a method to decide whether a tobacco product imparts a characterising flavour other than tobacco, has been reached.

Further information is available at: publications.europa.eu

Chemycal, 16 July 2019

<http://chemycal.com>

Endocrine disrupting properties to be added for four phthalates in the Authorisation List

2019-07-19

The European Chemicals Agency (ECHA) has submitted a recommendation to the European Commission to amend Authorisation List (Annex XIV of REACH) entries by adding the endocrine disrupting properties of four phthalates. Once the Commission decides on the amendment, some previously exempted uses will require authorisation. ECHA has prepared a recommendation to amend the Authorisation List to include endocrine disrupting properties into the respective entries of:

- bis(2-ethylhexyl) phthalate (DEHP) (EC 204-211-0, CAS 117-81-7)
- benzyl butyl phthalate (BBP) (EC 201-622-7, CAS 85-68-7)
- dibutyl phthalate (DBP) (EC 201-557-4, CAS 84-74-2)
- diisobutyl phthalate (DIBP) (EC 201-553-2, CAS 84-69-5).

They were identified as substances of very high concern (SVHCs) due to endocrine disrupting properties with effects on human health. DEHP was also identified for its effects on the environment. The Candidate List entries for these substances were updated accordingly in 2014 and 2017. These four phthalates had already earlier been identified as SVHCs (in 2008 and 2009) and subsequently added to the Authorisation List in 2011 and 2012 due to their classification as toxic for reproduction. A public consultation on the draft amendment recommendation was held between December 2018 and March 2019. A previous consultation on behalf of the European Commission on the same issue was held between June and August 2018. The Member State Committee (MSC) considered the comments received and adopted its opinion on 26 June 2019. ECHA took into account the comments and the MSC's opinion when finalising the recommendation. Latest application and sunset dates were recommended for uses, which until now have been exempted, but will require authorisation as a result of the amendment, such as:

- uses of the four phthalates in mixtures in concentrations above or equal to 0.1 % w/w (so far, the concentration limit has been 0.3 % w/w);
- some uses of DEHP (e.g. in food contact materials or medical devices) that will no longer fall under the 'generic exemptions from the authorisation requirement' as it has now been identified as an SVHC also because of hazards to the environment. For the same reason, ECHA recommends to remove the exemption for uses of DEHP in immediate packaging of medicinal products from the Authorisation List.

The European Chemicals Agency (ECHA) has submitted a recommendation to the European Commission to amend Authorisation List (Annex XIV of REACH) entries by adding the endocrine disrupting properties of four phthalates.

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In addition, ECHA invites the European Commission to review the existing exemption for uses of BBP and DBP in immediate packaging of medicinal products. The actual amendment of the entries including the final decision on the dates, by which companies will need to apply for authorisation to ECHA and on exemptions of uses, will be made by the European Commission in collaboration with the Member States and the European Parliament. Further information is available at:

- [Amendment recommendation](#)
- [Member State Committee's opinion](#)
- [Details on the substances under Submitted recommendations](#)
- [General approach for preparation of draft Annex XIV entries for substances to be included in Annex XIV](#)
- [Generic exemptions from the authorisation requirement](#)
- [Candidate List for authorisation](#)
- [Authorisation List](#)
- [An overview of the authorisation process under REACH](#)

ECHA, 10 July 2019

<http://echa.europa.eu>

ECHA starts work on persistent organic pollutants

2019-07-19

Under the revised POPs Regulation, the European Chemicals Agency (ECHA) has new tasks to support controlling some of the most hazardous pollutants. The aim is to protect our health and the environment from the effects of these toxic chemicals. ECHA starts working on scientific, technical and administrative tasks to identify and regulate persistent organic pollutants (POPs). These substances remain in the environment, bioaccumulate through the food chain, and pose a risk to the environment and human health. Due to their intrinsic properties, they can be transported across long distances, far from the locations where they have been produced or used. The POPs Regulation bans or severely restricts the production and use of persistent organic pollutants in the European Union. The Agency will support the identification of new POPs substances. It will also act as an interface for reporting duties on implementing the regulation. This includes compiling and publishing information from the Member States on uses, volumes, releases, monitoring data, stockpiles and waste related to POPs, as well as supporting the Commission to review and update the future activities to further progress in combatting

Under the revised POPs Regulation, the European Chemicals Agency (ECHA) has new tasks to support controlling some of the most hazardous pollutants.

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the risks caused by POPs. Other tasks include promoting an exchange of information on POPs between various EU actors and third countries, helping the Commission's work in the Stockholm Convention's POPs Review Committee and supporting EU enforcement activities through ECHA's Enforcement Forum. In 2020, ECHA will integrate data on POPs to its chemicals database. This enables easier access to regulatory and hazard-related information on the substances that are being proposed as POPs and the substances that are already listed under the POPs Regulation. POPs are regulated worldwide by the Stockholm Convention and the Aarhus Protocol. These pieces of legislation are implemented in the European Union by the POPs Regulation. Further information is available at:

- [Understanding POPs](#)
- [List of substances subject to the POPs regulation](#)
- [List of substances proposed as POPs](#)
- [Persistent organic pollutants – a new family of substances for ECHA](#)

ECHA, 15 July 2019

<http://echa.europa.eu>

Advice on how to comply with NMP restriction

2019-07-19

A new guideline is available for industrial users of 1-methyl-2-pyrrolidone (NMP) to help them comply with the substance's restriction requirements. The guideline is needed because this is the first restriction of its kind that is based on Derived no Effect Levels (DNEL). NMP is used as a solvent or surface deposition medium during manufacturing and is therefore a critical substance for various industries producing batteries, semiconductors, fibres, pharmaceuticals and wire coatings. NMP users in these sectors will have to comply with the restriction by 9 May 2020. For NMP used in wire coatings, the deadline is 9 May 2024. In close cooperation with stakeholders, ECHA has prepared the guideline to help companies, including SMEs, to manage the risks when using NMP at industrial sites. NMP is a reproductive toxicant (may damage the unborn child), it causes serious eye and skin irritation and it may cause respiratory irritation. Several consultations and round table workshops have been organised to identify good practice and find illustrative examples on how users of NMP can control exposure to NMP and comply with the restriction. The general approach described in this guideline can also be applied to other aprotic solvents similar to NMP, such as DMF and DMAC,

A new guideline is available for industrial users of 1-methyl-2-pyrrolidone (NMP) to help them comply with the substance's restriction requirements.

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if similar REACH restrictions are introduced for other aprotic solvents at a later stage. The guideline will be published in 23 EU languages. The translations will be available in autumn 2019. Further information is available at:

- [How to comply with REACH Restriction 71, guideline for users of NMP \(1-methyl-2-pyrrolidone\)](#)
- [Restriction](#)
- [More information about NMP](#)

You can express your views on the NMP Guideline [here](#).

ECHA, 17 July 2019

<http://echa.europa.eu>

Four new substances added to the Candidate List

2019-07-19

The European Chemicals Agency (ECHA) has added four new substances to the Candidate List due to their toxicity to reproduction, endocrine disruption and a combination of other properties of concern. The latter causes probable serious effects to human health and the environment, giving rise to an equivalent level of concern to carcinogenic, mutagenic and reprotoxic (CMR), persistent, bioaccumulative and toxic (PBT) and very persistent and very bioaccumulative (vPvB) substances, respectively. The decision to include two of the substances, number 2 and 3 in the table below, was taken with the involvement of the Member State Committee (MSC). One further substance, the last in the table below, has been added to the list having been identified as an SVHC by the European Commission due to its endocrine-disrupting properties. The MSC referred this SVHC proposal to the Commission in 2016.

Substances included in the Candidate List for authorisation on 16 July 2019 and their SVHC properties:

#	Substance name	EC number	CAS number	Reason for inclusion	Examples of use(s)
1	2-methoxyethyl acetate	203-772-9	110-49-6	Toxic for reproduction (Article 57 (c))	Not registered under REACH.

The Candidate List of substances of very high concern (SVHCs) for authorisation now contains 201 substances.

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#	Substance name	EC number	CAS number	Reason for inclusion	Examples of use(s)
2	Tris(4-nonylphenyl, branched and linear) phosphite (TNPP) with $\geq 0.1\%$ w/w of 4-nonylphenol, branched and linear (4-NP)	-	-	Endocrine disrupting properties (Article 57(f) – environment)	Primarily used as an antioxidant to stabilise polymers.
3	2,3,3,3-tetrafluoro-2-(heptafluoropropoxy) propionic acid, its salts and its acyl halides (covering any of their individual isomers and combinations thereof)	-	-	Equivalent level of concern having probable serious effects to the environment (Article 57(f) - environment) Equivalent level of concern having probable serious effects to human health (Article 57(f) – human health)	Processing aid in the production of fluorinated polymers.
4	4-tert-butylphenol	202-679-0	98-54-4	Endocrine disrupting properties (Article 57(f) – environment)	Used in coating products, polymers, adhesives, sealants and for the synthesis of other substances.

The Candidate List is a list of substances that may have serious effects on human health or the environment. Substances on the Candidate List are also known as substances of very high concern and are candidates for eventual inclusion in the Authorisation List. Once they are on the Authorisation List, industry will need to apply for permission to continue using the substance after the sunset date. Companies may have legal obligations resulting from the inclusion of the substance in the Candidate List. These obligations may apply to the listed substance on its own, in mixtures or in articles. In particular, any supplier of articles containing a Candidate List substance above a concentration of 0.1 % (weight by weight) has communication obligations towards customers down the supply chain and to consumers. In addition, importers and producers of articles containing the substance have six months from the date of its inclusion in the Candidate List (16 July 2019) to notify ECHA. Information on these obligations and related tools are available on ECHA's website. Further information is available at:

- [The Candidate List for authorisation](#)

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- Summary of obligations resulting from inclusion in the Candidate List
- Agreements of MSC on SVHC identification proposals
- How to submit substances in articles notifications
- Integrated Regulatory Strategy

ECHA, 16 July 2019

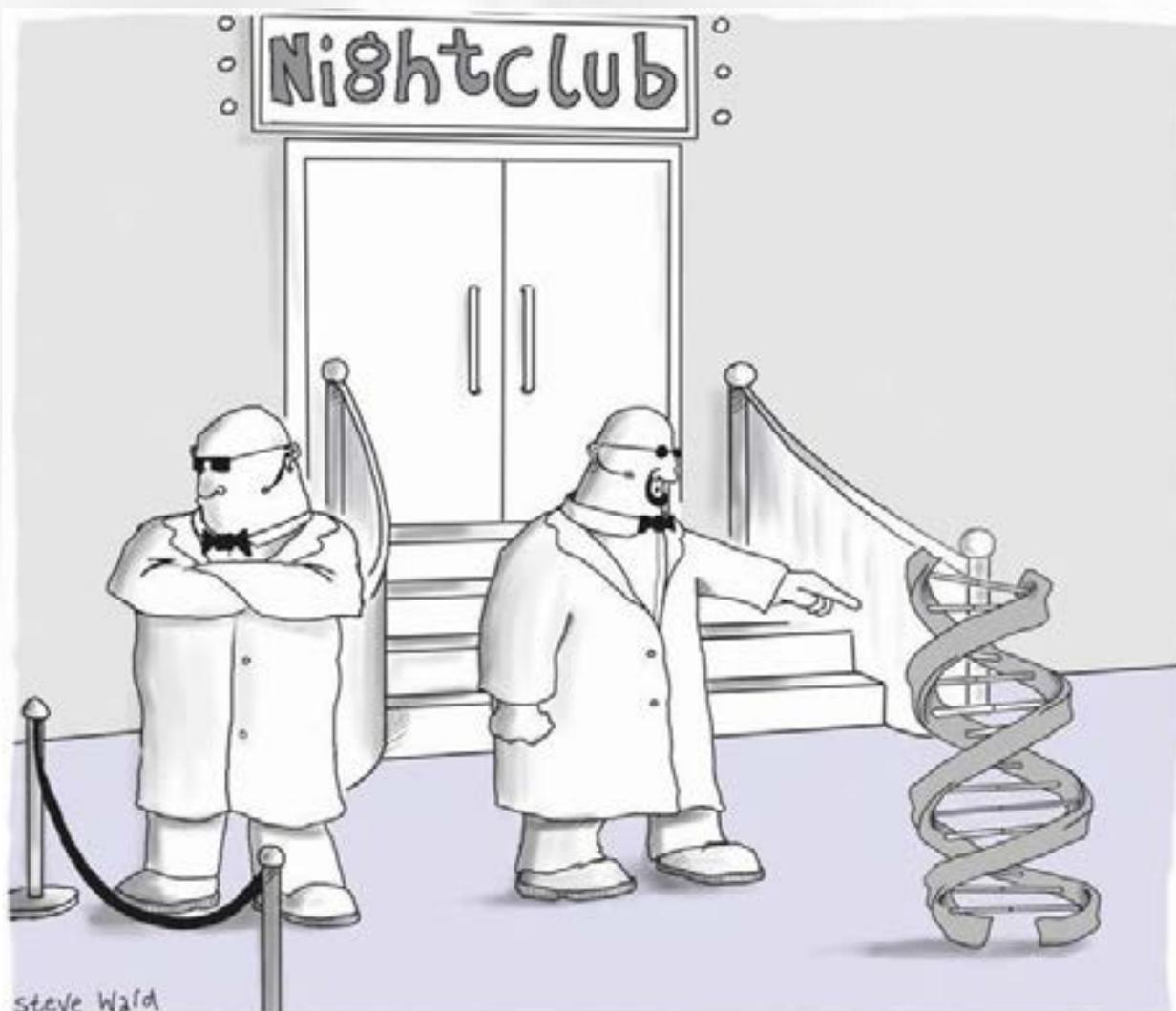
<http://echa.europa.eu>

Janet's Corner

CHEMWATCH

No Genes

2019-07-18



"Sorry mate... no Genes"

Hazard Alert

CHEMWATCH

Phenanthrene

2019-07-12

Phenanthrene, also known as phenanthrin, is a polycyclic aromatic hydrocarbon (PAH) with three aromatic rings derived from coal tar. It has a chemical formula of $C_{14}H_{10}$, a molecular weight of 178.22, and exists as a colourless to white crystalline substance with a bluish fluorescence. It has a melting point of 100°C , a boiling point of 340°C , a density of 1.179 at 25°C . Phenanthrene is almost insoluble in water (1-1.6 mg/L), but is soluble in glacial acetic acid and a number of organic solvents including ethanol, benzene, carbon disulfide, carbon tetrachloride, diethyl ether, and toluene. [1,2]

USES [2,3]

Phenanthrene is used to make dyes, plastics and pesticides, explosives and drugs. In addition, it has been used to make bile acids, cholesterol and steroids. Phenanthrene can be used as a feed stock of carbon black. It is a raw material of phenanthrenequinone, which is widely used in the synthesis of dyes, agrochemical and preservatives.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

Exposure to PAH including phenanthrene can occur via fumes from vehicle exhaust, coal, coal tar, asphalt, wildfires, agricultural burning and hazardous waste sites. In addition, exposure also occurs by breathing cigarette and tobacco smoke, eating foods grown in contaminated soil or by eating meat or other food that have been grilled. Grilling and charring food actually increases the amount of PAHs in the food. Occupational exposure also occurs for people working in a plant that makes coal tar, asphalt and aluminium, or that burns trash. Furthermore, exposure may also occur for people working in a facility that uses petroleum or coal or where wood, corn and oil are burned.

Routes of Exposure

One of the most common ways phenanthrene can enter your body is through breathing contaminated air. It can get into your lungs when you breathe it. If you work in a hazardous waste site where PAHs are disposed, you are likely to breathe phenanthrene and other PAHs. If you eat or drink food and water that are contaminated with PAHs, you could be exposed. Exposure can also occur if your skin comes into contact with contaminated

Phenanthrene, also known as phenanthrin, is a polycyclic aromatic hydrocarbon (PAH) with three aromatic rings derived from coal tar.

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soil or products like heavy oils, coal tar, roofing tar or creosote where PAHs have been found. Creosote is an oily liquid found in coal tar and is used to preserve wood. Once in your body, the PAHs can spread and target fat tissues. Target organs include kidneys, liver and fat. However, in just a matter of days, the PAHs will leave your body through urine and faeces.

HEALTH EFFECTS [4]

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to phenanthrene:

- Contact can irritate the skin and eyes. If skin contaminated with Phenanthrene is exposed to sunlight a rash or skin burn may occur, sometimes with blisters.
- Inhaling Phenanthrene can irritate the nose and throat.

Carcinogenicity

- While phenanthrene has been tested, it is not classifiable as to its potential to cause cancer.

Other Effects

- Phenanthrene may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.

SAFETY

First Aid Measures [5]

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

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- Inhalation: Allow the victim to rest in a well ventilated area. 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.

Workplace Controls & Practices [4]

Control measures include:

- Enclosing chemical processes for severely irritating and corrosive chemicals;
- Using local exhaust ventilation for chemicals that may be harmful with a single exposure; and
- Using general ventilation to control exposures to skin and eye irritants.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

Personal Protective Equipment [5]

Gloves and Clothing

- Avoid skin contact with phenanthrene.

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- Wear personal protective equipment made from material which can not be permeated or degraded by this substance.
- The recommended glove materials are Nitrile, Neoprene and Barrier® for Coal Tar Extract.
- The recommended protective clothing material for solid phenanthrene is Tyvek®, or the equivalent.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear eye protection with side shields or goggles.
- If additional protection is needed for the entire face, use in combination with a face shield. A face shield should not be used without another type of eye protection.

Respiratory Protection

- Where the potential exists for exposure over 0.1 mg/m³, use a NIOSH approved respirator with an organic vapour cartridge and particulate N, R or P100 prefilters. Increased protection is obtained from full facepiece powered-air purifying respirators.
- Leave the area immediately if:
- While wearing a filter or cartridge respirator you can smell, taste, or otherwise detect phenanthrene,
- While wearing particulate filters abnormal resistance to breathing is experienced, or
- Eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapour and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over 1 mg/m³, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus or an emergency escape air cylinder.

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REGULATION

United States

The following exposure limits are for Coal Tar Pitch Volatiles:

- OSHA: The legal airborne permissible exposure limit (PEL) is 0.2 mg/m³ (as the Benzene soluble fraction) averaged over an 8-hour workshift.
- NIOSH: The recommended airborne exposure limit (REL) is 0.1 mg/m³ (as the Cylohexane extractable fraction) averaged over a 10-hour workshift.
- ACGIH: The threshold limit value (TLV) is 0.2 mg/m³ (as the Benzene soluble aerosol) averaged over an 8-hour workshift.

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4. <http://nj.gov/health/eoh/rtkweb/documents/fs/3004.pdf>
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Gossip

CHEMWATCH

Industrial ammonia production emits more CO₂ than any other chemical-making reaction. Chemists want to change that

2019-07-10

The Siemens green ammonia test plant uses wind power to convert hydrogen and nitrogen to ammonia. The Haber-Bosch process, which converts hydrogen and nitrogen to ammonia, could be one of the most important industrial chemical reactions ever developed. The process made ammonia fertiliser widely available, helping cause a world population boom as yields from agriculture increased rapidly in a short time. Globally, ammonia production plants made 157.3 million metric tons (t) of the compound in 2010, according to the Institute for Industrial Productivity's Industrial Efficiency Technology Database. Between 75 and 90% of this ammonia goes toward making fertiliser, and about 50% of the world's food production relies on ammonia fertiliser. The rest of the ammonia helps make pharmaceuticals, plastics, textiles, explosives, and other chemicals. Almost every synthetic product we use containing nitrogen atoms comes to us through the Haber-Bosch process in some way, says Karthish Manthiram, a chemical engineer from the Massachusetts Institute of Technology. "All those nitrogen atoms came from ammonia, which means that there is this enormous carbon dioxide footprint embedded in all the different products that we use." That massive carbon footprint exists because although the Haber-Bosch process represents a huge technological advancement, it's always been an energy-hungry one. The reaction, which runs at temperatures around 500 °C and at pressures up to about 20 MPa, sucks up about 1% of the world's total energy production. It belched up to about 451 million t of CO₂ in 2010, according to the Institute for Industrial Productivity. That total accounts for roughly 1% of global annual CO₂ emissions, more than any other industrial chemical-making reaction. The carbon footprint of ammonia synthesis goes well beyond its energy demands. Hydrogen used for the reaction comes from natural gas, coal, or oil through processes that release CO₂. According to a 2013 joint report from the International Energy Agency, the International Council of Chemical Associations, and the Society for Chemical Engineering and Biotechnology, CO₂ emissions from hydrogen production account for more than half of those from the entire ammonia production process. In total, from hydrocarbon feedstocks to NH₃ synthesis, every NH₃ molecule generated releases one molecule of CO₂ as a coproduct. And our hunger for ammonia fertiliser is increasing. According to the Food and Agriculture Organisation of the United Nations, nitrogen fertiliser demand

Scientists around the world are working to reduce how much greenhouse gas the ammonia-making process emits

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is projected to increase from 110 million tons in 2015 to almost 119 million tons by 2020. Chemists and engineers across the world are trying to make ammonia synthesis sustainable. Some are working to power the reaction with renewable energy sources and to generate hydrogen without fossil fuels. Others want to find a more efficient reaction than Haber-Bosch to synthesize ammonia. The researchers admit that progress has been slow but worth it. "Ammonia as it's produced today for fertilisers is effectively a fossil-fuel product," says Douglas MacFarlane, an electrochemist from Monash University. "Most of our food comes from fertilisers. Therefore, our food is effectively a fossil-fuel product. And that's not sustainable." At green ammonia plants around the world, including in Japan, England, Australia, and the US, researchers have been experimenting with using renewable energy and feedstocks to make the valuable chemical on small scales. These companies mostly use the conventional Haber-Bosch process, but instead of relying on fossil fuels to generate hydrogen and power the reactions, they're using water electrolysis and alternative energy sources. Since last year, the Japanese company JGC has been trying these approaches at a trial plant at the Fukushima Renewable Energy Institute. Through a national program called the SIP Energy Carriers, the company has teamed up with the National Institute of Advanced Industrial Science and Technology (AIST) to get the green ammonia demonstration plant up and running. It can run on solar power, produces hydrogen through water electrolysis, and operates a Haber-Bosch-type reaction using a new ruthenium catalyst that JGC developed with AIST. "The major advantage of our process is that hydrogen is produced at a much lower pressure than the conventional process," says Mototaka Kai, project manager at the plant. The hydrogen pressure is around 5 MPa, Mototaka says, which is around one-third to one-quarter that of a traditional Haber-Bosch plant. This lower pressure has two advantages. The reaction is safer because it's operating at a lower pressure. Plus, the plant requires less energy to pressurize the system. Currently, the plant produces 20–50 kg of ammonia per day.

Siemens in the UK is working with researchers at the University of Oxford, the UK's Science and Technology Facilities Council, and Cardiff University to run a demonstration plant using the typical Haber-Bosch process, powering it with wind. Ian Wilkinson, program manager in corporate technology at Siemens, names two reasons the firm chose to use only mature technology available today to run its plant. First, Siemens wants to show that it can produce ammonia renewably, in a way that it can quickly scale up. The company also views the plant as a test system for ongoing technology development, including Haber-Bosch catalyst development and ammonia combustion tests. The plan has worked so

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far. The small plant, set up in shipping containers, takes electricity from a wind turbine, runs it through a hydrogen electrolysis unit, and then uses the resulting hydrogen to synthesize ammonia. If the company runs the plant continuously, it gets 30 kg of ammonia a day, Wilkinson says. "It's a small-scale, proof-of-principle system," he says, noting that the only thing in the plant that the firm didn't buy off the shelf is the synthesis loop in which the actual Haber-Bosch reaction takes place. "We had to build our own. You can't buy them this small," he says. Ammonia synthesis at a wind farm could help solve one of the biggest problems with renewable energy sources—they produce energy intermittently. The sun doesn't always shine and the wind doesn't always blow, so how do you generate electricity consistently? Burning ammonia produced renewably may be one answer, Wilkinson says. Both Siemens and JGC are interested in green ammonia production not just to make fertilizer but also to synthesize a carbon-free fuel. Similar to gasoline, ammonia can be shipped and stored, and it is easier to deal with than gaseous hydrogen, another possible carbon-free fuel. "Ammonia is what I like to call a nexus molecule," Manthiram says. "It's useful as a fertilizer. It's useful for food. It's useful for energy storage." Electricity generated through renewable sources can combine nitrogen from the air and hydrogen from water to make a transportable fuel, he says. And companies already ship ammonia across oceans for current uses, MacFarlane says. "That technology is well understood in large quantities of ammonia." But no matter how these companies plan to use the ammonia produced by their green plants, they're still mostly using Haber-Bosch to synthesize the molecule. The reaction involves combining hydrogen and nitrogen gas over an iron catalyst, at high temperatures and pressures. And it isn't efficient, MacFarlane says. Each metric ton of ammonia packs about 5 MW h of energy. "The best, most efficient Haber-Bosch plants work at around 10 MW h per metric ton of ammonia," MacFarlane says. "So, we're approximately only 50% efficient. It's wasting a lot of energy for what you get." Switching to renewable feedstocks and energy sources is a good solution in the short term, Manthiram says, because companies can effectively combine current renewable energy technologies with Haber-Bosch. But to improve the sustainability of ammonia synthesis over the long term, scientists have to change the game entirely. "Many people are looking at alternatives to Haber-Bosch," says Shelley Minteer, a bioelectrochemist at the University of Utah. "How can we do something at low temperatures and atmospheric pressure or near atmospheric pressure?" Research in the field has taken off since about 2015, perhaps because of expanded funding availability as federal agencies have started to focus on the topic, says Lauren Greenlee, a chemical

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engineer at the University of Arkansas. Researchers are trying a wide range of approaches: electrochemistry, electrocatalysis, photocatalysis, and photoelectrocatalysis. And they're even taking inspiration from biochemistry. "That diversity as a field that's growing so quickly is actually fantastic because then you're able to learn from each other what works and what doesn't," Minter says. Electrochemical reduction of nitrogen to ammonia over a catalyst has captured the imagination of many scientists. The chemists apply a voltage across an electrochemical cell to drive both water oxidation and nitrogen reduction simultaneously. The catalyst at the anode oxidises water to form hydrogen ions, which migrate to the cathode, where a different catalyst reduces nitrogen to ammonia. Scientists have developed numerous electrochemical ammonia-synthesis catalysts, including noble-metal nanostructures, metal oxides, metal nitrides, metal sulfides, nitrogen- and boron-doped carbon, and lithium metal. "What's enticing about [electrochemistry] is that you can get your hydrogen atoms directly from water molecules without having to go through molecular hydrogen," Greenlee says. "If, in theory, your electrochemical process is being driven by renewable energy, you eliminate the need for fossil fuels both from an energy input standpoint for electricity, but also from a hydrogen production standpoint." This method also avoids the need to do electrolysis as a separate step and has the potential to operate at low pressure and possibly low temperature, she says. There are "a lot of pieces of it that are really positive, if we can get it to work." Electrochemistry also presents a good way to solve a trade-off between reaction rates and yields that chemists must face when running the Haber-Bosch reaction, Manthiram says. The reaction has good yields at very low temperatures, he says, but the rate is sluggish. To speed it up, chemists raise the temperature. But at those high temperatures, the reaction's thermodynamics change, and the yield goes down. So, chemists raise the pressure to bring the yields back up. What's special about an electrochemical system is that chemists can increase voltage instead of pressure, Manthiram says. "What normally takes hundreds of bar pressure to achieve can be done with fractions of a volt."

Current process

Today, ammonia synthesis starts with generating hydrogen gas from fossil-fuel feedstocks. A reformer turns the feedstocks into a mixture of gases called synthesis gas (syngas), which includes hydrogen. A CO shift converter combines water and the carbon monoxide from syngas to form CO₂ and more hydrogen, and then acid gas removal isolates the hydrogen for ammonia synthesis. This process releases CO₂ at various steps along

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the way. One of the other possible advantages of the electrochemical approach is that the reaction system can be small. A device under development in MacFarlane's lab is about the size of a cell phone. The idea is that it could synthesise ammonia for fertiliser on the scale of a farm or greenhouse, so the material could be used right where it's made, eliminating the need for transport, MacFarlane says. Meanwhile, other researchers are looking to nature to understand how to efficiently reduce nitrogen to ammonia. Some bacteria use large protein complexes called nitrogenases to grab nitrogen out of the air and make ammonia. Minter and her team have been studying this system to connect these bacterial enzymes to electrodes to create new electrocatalysts. But they still have a long way to go, Minter says. Their systems do more proton reduction than ammonia production. The goal is to get to the point where they're making 99% ammonia and 1% hydrogen. Right now, their systems make about 40% ammonia and 60% hydrogen, she says. Scientists throughout the field face this problem with catalyst yield and selectivity. As a result, the ammonia coming out of these non-Haber-Bosch systems is a trickle, not a torrent. It's easier, chemically, to make hydrogen gas than ammonia. "Most catalysts that would be active for nitrogen reduction are also really active for hydrogen evolution," Greenlee says. "The catalyst needs to be able to break the nitrogen triple bond, which is a very strong and inert bond," Manthiram says. Once the bond breaks, the catalyst needs to form the three nitrogen-hydrogen bonds, all at ambient conditions without high temperatures to accelerate the kinetics. That's a tall order and something that hasn't yet been accomplished, he says. But maybe chemists have accomplished it and just didn't notice, Minter says. Scientists have been intensely studying hydrogen-evolution catalysts for about the past 20 years. "We've learned a lot about how to make good hydrogen-evolution catalysts." It's possible, she thinks, that some of the catalysts that failed at hydrogen evolution were actually good at making ammonia. "We need to essentially learn about all those catalysts that people made that didn't work, that don't produce hydrogen, and see if they are useful for producing ammonia," she says. Greenlee points out that the solutions have to go beyond catalyst design. Scientists need to figure out how to control, reduce, or eliminate the hydrogen-evolution reaction. "It's going to be some combination of catalyst design and controlling the surface environment of the catalyst or the interface to be able to control or suppress hydrogen," she says.

Besides this selectivity issue, scientists also have to worry about. How long these catalysts last, MacFarlane says, and it's something that many groups are not thinking about yet. For a new ammonia production system to

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be practical, such as in an electrochemical device like the one his group is working on, catalysts will need to remain active and viable for years, even if the system could be taken apart and refurbished, he says. "Catalyst lifetime is a challenge that's yet to be clearly identified and understood." Most people are not publishing data on lifetimes, but the longest he's seen is about a day, he says. The road to Haber-Bosch-free ammonia is long, Minter says. Whether it's an electrocatalysis, photocatalysis, or biocatalysis system, any promising lab-scale reaction will still take at least a decade or two to make commercial scale, she says. Searching for alternatives to Haber-Bosch is also risky, Manthiram says, because what scientists are pursuing now may not pan out. But with ammonia production touching so many things that we use every day, including our food and pharmaceuticals, scientists need to find a way to make these lab-scale systems work on larger scales, he says. "It's hard to imagine a world where we're just going to be OK with the way that we make ammonia today."

Chemical & Engineering News, 15 June 2019

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

New metalloenzyme-based system allows selective targeting of cancer cells

2019-07-10

RIKEN researchers have developed a promising method to deliver a drug to cancer cells without affecting surrounding tissues, involving a clever combination of an artificial metalloenzyme that protects a metal catalyst, and a sugar chain that guides the metalloenzyme to the desired cells. In the field of organic synthetic chemistry, many metal catalysts have been developed with the capacity to synthesise molecules such as drugs and functional materials. Recently, researchers have begun to focus on chemical reactions in living bodies catalysed by transition metals —elements belonging to groups three to 11 on the periodic table. However, they have run into difficulties: Transition metal catalysts are easily quenched—meaning they are inactivated by substances such as antioxidants—so it has been difficult to get them to perform chemical reactions in actual organisms. The international research team including Chief Scientist Katsunori Tanaka of the RIKEN Cluster for Pioneering Research and RIKEN Baton Zone Program and Special Postdoctoral Researcher Kenward Vong developed an artificial metalloenzyme that contains a metal ion and is able to save the ion from being quenched, making it possible for the chemical reaction to take place in vivo. The

RIKEN researchers have developed a promising method to deliver a drug to cancer cells without affecting surrounding tissues, involving a clever combination of an artificial metalloenzyme that protects a metal catalyst, and a sugar chain that guides the metalloenzyme to the desired cells.

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metal ion in this case was ruthenium, which catalyses a “pro-drug” into umbelliprenin, a plant-derived compound known to have anti-cancer activity. Further, by attaching a sugar “delivery tag” to the surface of the artificial metalloenzyme, they were able to target it specifically to cancer cells where the drug was needed. To perform the work, the group worked with a protein called human serum albumin, which is abundant in the human body. The researchers introduced a ruthenium catalyst into the hydrophobic “pocket” inside the protein. They found that in vitro, the ruthenium was able to carry out chemical reactions. “We were pleasantly surprised that our newly developed metalloenzyme worked well in the presence of glutathione, an antioxidant that is abundant in actual cells and can inactivate ruthenium. This told us that the ruthenium catalyst is well protected from hydrophilic components such as glutathione in the hydrophobic pocket of the albumin molecule, while hydrophobic compounds can come in contact with the catalyst within the pocket and undergo catalysis,” says Tanaka, who led the group. After determining that the catalysis would work, the researchers modified the surface of the albumin, attaching sugar chains that allowed it to be transported to specific cells of interest. Target cells are recognised by the pattern of sugar chains. Doing this, they successfully delivered the catalyst to cancer cells, and used it to produce umbelliprenin, which they determined actually had cytotoxic effects on the cancer cells. “We confirmed that the method we developed can be applied to metal-catalysed reactions using other catalysts such as gold, and the artificial metalloenzyme could be generally used in vivo,” adds Tanaka. “If transition metal catalysis can be performed on specific organs or diseased cells in the body, it will allow us to rapidly and stably synthesise drugs there, minimising side effects. Our findings could become a key in the fight against such diseases. Furthermore, we can consider using other natural compounds, which show strong anti-cancer activity but have not been used so far. We have opened a door to a new era where we can synthesize and activate natural chemical compounds in actual organisms.” The study is reported in Nature Catalysis.

Phys.org, 1 July 2019

<http://phys.org>

New Cost-effective Way for Graphene Production Using Eucalyptus Trees ~w2019-07-10

Graphene is the thinnest and strongest material known to humans. It's also flexible, transparent and conducts heat and electricity 10 times better than copper, making it ideal for anything from flexible nanoelectronics to

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better fuel cells. The new approach by researchers from RMIT University (Australia) and the National Institute of Technology, Warangal (India), uses Eucalyptus bark extract and is cheaper and more sustainable than current synthesis methods. RMIT lead researcher, Distinguished Professor Suresh Bhargava, said the new method could reduce the cost of production from USD 100 per gram to a staggering USD 0.5 per gram. "Eucalyptus bark extract has never been used to synthesise graphene sheets before and we are thrilled to find that it not only works, it's in fact a superior method, both in terms of safety and overall cost," said Bhargava. "Our approach could bring down the cost of making graphene from around USD 100 per gram to just 50 cents, increasing its availability to industries globally and enabling the development of an array of vital new technologies." Graphene's distinctive features make it a transformative material that could be used in the development of flexible electronics, more powerful computer chips and better solar panels, water filters and bio-sensors. Professor Vishnu Shanker from the National Institute of Technology, Warangal, said the 'green' chemistry avoids the use of toxic reagents, potentially opening the door to the application of graphene not only for electronic devices but also biocompatible materials. "Working collaboratively with RMIT's Centre for Advanced Materials and Industrial Chemistry we're harnessing the power of collective intelligence to make a lot more useful discoveries," he said. Chemical reduction is the most common method for synthesising graphene oxide as it allows for the production of graphene at a low cost in bulk quantities. This method however relies on reducing agents that are dangerous to both people and the environment.

Special Chem, 25 June 2019

<https://www.specialchem.com>

New antibiotics effective without triggering resistance, mouse study shows

2019-07-10

Not only are they effective against Gram-positive and negative multi-resistant bacteria, they also appear not to trigger resistance when used to treat infection in mice. Such are the promises of the two new antibiotics created by Prof. Brice Felden and his team at the Inserm and Université de Rennes 1 'Bacterial Regulatory RNAs and Medicine' joint laboratory (U1230), in conjunction with a team from the Rennes Institute of Chemical Sciences (ISCR). This French advance could bring both fresh impetus and new possibilities for fighting antibiotic resistance worldwide. Details on

Researchers have developed two new antibiotics that are effective against Gram-positive and negative multi-resistant bacteria, and they also appear not to trigger resistance when used to treat infection in mice.

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this research will be published July 9 in PLOS Biology. Antibiotics have saved so many lives over the previous century of their use in humans that they are considered to be one of the major breakthroughs of contemporary medicine. Unfortunately, growing resistance is gradually rendering them ineffective, with the threat of catastrophic public health consequences should this trend continue much longer. The few new antibiotics being brought to market essentially consist of so-called me-too drugs -- meaning that they are derived from existing classes of antibiotics. Researchers from Inserm and Université de Rennes recently identified a new bacterial toxin which they transformed into potent antibiotics active against various bacteria responsible for human infections, whether Gram-positive or negative. "It all started with a fundamental discovery made in 2011," explains Brice Felden, Director of the Bacterial Regulatory RNAs and Medicine laboratory in Rennes. "We realised that a toxin produced by *Staphylococcus aureus* whose role is to facilitate infection is also capable of killing other bacteria present in our body. What we had identified was a molecule with dual toxic and antibiotic properties. We thought that if we could separate these activities, we would be able to create a new antibiotic non-toxic to the body. A challenge that we accepted!" In conjunction with the team of ISCR chemist Michèle Baudy Floc'h, a new family of so-called peptidomimetics was synthesised. As their name suggests, these peptides are inspired by the existing natural bacterial peptides but have been shortened and modified. Out of the twenty molecules created, two proved effective against resistant *Staphylococcus aureus* and *Pseudomonas aeruginosa* in mouse models of severe sepsis or skin infection. In addition, no toxicity to the other cells and organs, whether in animals or human cells was observed. These new compounds are well tolerated at their active doses -- and even beyond -- and are devoid of the renal toxicity issues often encountered with this type of compound. "We tested them at doses 10 to 50 times higher than the effective dose without seeing toxicity" specifies Felden, adding that "the participation and imagination of the team and our chemist colleagues was needed to devise the most active molecules possible."

Little resistance observed under experimental conditions

Important to note was that the bacteria that the researchers had left in contact for several days in the animals with these antibiotics showed no signs of resistance. In order to go further, the researchers created conditions favourable to the development of resistance in vitro and in vivo -- with nothing happening. However, caution is still required here given the short experimental time periods (up to 15 days). The antibacterial

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activity of these peptidomimetics is partially due to the capacity of its non-natural amino acids to reinforce the association of these compounds with the membranes of the infectious bacteria. This strong binding leads to membrane permeability and the death of the bacteria. "We think these new molecules represent promising candidates for the development of new antibiotics that can provide alternative treatments to antimicrobial resistance." The next step involves launching phase I clinical trials in humans. The patent has been licensed and a start-up created.

Science Daily, 9 July 2019

<http://www.sciencedaily.com>

Producing graphene from carbon dioxide

2019-07-10

The general public knows the chemical compound of carbon dioxide as a greenhouse gas in the atmosphere and because of its global-warming effect. However, carbon dioxide can also be a useful raw material for chemical reactions. A working group has now reported on this unusual application. They are using carbon dioxide as a raw material to produce graphene, a technological material which is currently the subject of intense study. The general public knows the chemical compound of carbon dioxide as a greenhouse gas in the atmosphere and because of its global-warming effect. However, carbon dioxide can also be a useful raw material for chemical reactions. A working group at Karlsruhe Institute of Technology (KIT) has now reported on this unusual application in the ChemSusChem journal. They are using carbon dioxide as a raw material to produce graphene, a technological material which is currently the subject of intense study. The combustion of fossil fuels such as coal and oil produces energy for electricity, heat and mobility, but it also leads to an increase of the amount of carbon dioxide in the atmosphere and therefore to global warming. Cutting this causal chain is what motivates scientists to search for alternative energy sources but also for alternative uses of carbon dioxide. One possibility could be to see carbon dioxide as an inexpensive raw material for the synthesis of valuable materials, feeding it back into the reusability cycle -- maybe even in a profitable way. An example can be found in nature. During photosynthesis in the leaves of plants, the combination of light, water and carbon dioxide creates biomass, closing the natural material cycle. In this process, it is the job of the metal-based enzyme RuBisCo to absorb the carbon dioxide from the air and make it usable for the further chemical reactions in the plant. Inspired by this metal enzyme-based natural conversion, researchers at

In a new study, researchers are using carbon dioxide as a raw material to produce graphene.

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KIT are now presenting a process in which the greenhouse gas carbon dioxide together with hydrogen gas is converted directly into graphene at temperatures of up to 1000 degrees Celsius with the help of specially prepared, catalytically active metal surfaces. Graphene is the two-dimensional form of the chemical element carbon, which has interesting electrical properties and is therefore an option for new future electronic components. Its discovery and workability in 2004 led to worldwide, intensive research and earned the discoverers, Andre Geim and Konstantin Novoselov, the Nobel Prize for Physics in 2010. The two removed the graphene manually from a block of graphite using tape. Several working groups at KIT have collaborated to present a method in the ChemSusChem journal for separating graphene from carbon dioxide and hydrogen by means of a metal catalyst. "If the metal surface exhibits the correct ratio of copper and palladium, the conversion of carbon dioxide to graphene will take place directly in a simple one-step process," explains the head of the study, Professor Mario Ruben, from the Molekulare Materialien working group at the Institute of Nanotechnology (INT) and the Institute for Inorganic Chemistry (AOC) at KIT. In further experiments the researchers were even able to produce graphene several layers thick, which could be interesting for possible applications in batteries, electronic components or filter materials. The working group's next research goal is to form functioning electronic components from the graphene thus obtained. Carbon materials such as graphene and magnetic molecules could be the building blocks for future quantum computers, which enable ultra-fast and energy-efficient calculations but are not based on the binary logic of today's computers.

Science Daily, 8 July 2019

<http://www.sciencedaily.com>

New imaging method aids in water decontamination

2019-07-10

A breakthrough imaging technique developed by Cornell University researchers shows promise in decontaminating water by yielding surprising and important information about catalyst particles that can't be obtained any other way. Chemistry professor, Peng Chen has developed a method that can image nonfluorescent catalytic reactions -- reactions that don't emit light -- on nanoscale particles. An existing method can image reactions that produce light, but that applies only to a small fraction of reactions, making the new technique potentially significant in fields ranging from materials engineering to nanotechnology and energy

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sciences. The researchers then demonstrated the technique in observing photoelectrocatalysis -- chemical reactions involving interactions with light -- a key process in environmental remediation. "The method turned out to be actually very simple -- quite simple to implement and quite simple to do," said Chen, senior author of "Super-Resolution Imaging of Nonfluorescent Reactions via Competition," which published July 8 in Nature Chemistry. "It really extends the reaction imaging to an almost unlimited number of reactions." Catalytic reactions occur when a catalyst, such as a solid particle, accelerates a molecular change. Imaging these reactions at the nanoscale as they happen, which the new technique allows scientists to do, can help researchers learn the optimal size and shape for the most effective catalyst particles. In the paper, the researchers applied the new technique to image the oxidation of hydroquinone, a micropollutant found in water, on bismuth vanadate catalyst particles, and discovered previously unknown behaviours of catalysts that helped render hydroquinone nontoxic. "Many of these catalysed reactions are environmentally important," Chen said. "So, you could study them to learn how to remove pollutants from an aqueous environment." Previously, Chen's research group pioneered the application of single-molecule fluorescence imaging, a non-invasive, relatively inexpensive and easily implemented method that allows researchers to observe chemical reactions in real time. Because the method was limited to fluorescent reactions, however, his team worked for years on a more widely applicable method. The technique they discovered relies on competition between fluorescent and nonfluorescent reactions. The competition suppresses the fluorescent reaction, allowing it to be measured and mapped, which in turn provides information about the nonfluorescent reaction. The researchers named their method COMPetition Enabled Imaging Technique with Super-Resolution, or COMPEITS. "This highly generalisable technique can be broadly applied to image various classes of nonfluorescent systems, such as unlabelled proteins, neurotransmitters and chemical warfare agents," Peng said. "Therefore, we expect COMPEITS to be a breakthrough technology with profound impacts on many fields including energy science, cell biology, neuroscience and nanotechnology."

Science Daily, 8 July 2019

<http://www.sciencedaily.com>

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A closer look a magnesium shows very small samples are much more ductile than thought

2019-07-10

A team of researchers affiliated with several institutions in China and the United States has found that very small samples of magnesium are much more ductile than thought. In their paper published in the journal *Science*, the group describes their study of the metal using an electron microscope and what they found. Gwénaëlle Proust, with the University of Sydney, has published a Perspective piece on the work done by the team in the same journal issue. As engineers around the world look for ways to make more efficient cars, planes and other vehicles, they are studying new, lighter materials. One such material, magnesium, is interesting because it is just as strong as aluminium, but 35 percent lighter. Up until now, the metal has rarely been used because it is too difficult to process into parts. It is also much less resistant to corrosion. Still, interest in the metal persists—many in the field believe it is only a matter of finding the right elements to mix with it. In this new effort, the researchers report that they have found very small samples of magnesium are more ductile than previously thought. The reason that magnesium is less amenable to conformity than other bendable metals is because of the way its atoms arrange themselves. Atoms such as aluminium are arranged in a cubic structure, which makes it relatively easy to make desired deformities. Magnesium atoms, in sharp contrast, are arranged in a hexagonal pattern. Prior research has shown that when a metal such as aluminium is deformed at room temperature, atoms are displaced along a line in the crystal allowing for dislocations in multiple ways. With magnesium, the possibilities are more limited. To better understand those limitations, the researchers used electron microscopy mechanical testing techniques on a micron-sized sample of magnesium. The technique allowed them to see exactly what happened while applying shear forces at the atomic level and at room temperature. The researchers report that the crystal showed surprising ductility—they were able to force dislocations along two planes, something not seen in larger samples. They plan to keep working with the metal to see if they can find a way to force similar dislocations in larger samples—possibly paving their way for use in real-world applications.

Phys.org, 9 July 2019

<http://phys.org>

A team of researchers affiliated with several institutions in China and the United States has found that very small samples of magnesium are much more ductile than thought.

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Fusion scientists have developed a 'nano-scale sculpture technique'

2019-07-10

A research team of fusion scientists has succeeded in developing a “nano-scale sculpture technique” to fabricate an ultra-thin film by sharpening a tungsten sample with a focused ion beam. This enables the nano-scale observation of a cross-section very near the top surface of the tungsten sample using a transmission electron microscope. The sculpture technique developed by this research can be applied not only to tungsten but also to other hard materials. Hardened materials such as metals, carbons and ceramics are used in automobiles, aircraft and buildings. In a fusion reactor study, tungsten, which is one of the hardest metal materials, is the most likely candidate for the armour material of the device that receives the plasma heat/particle load. This device is called a divertor. In any hardened materials, nanometre scale damages or defects can be formed very near the top surface of the materials. For predicting material lifetime, it is necessary to know the types of damage and their depth profiles in a material. To do this, we must observe a cross-section of the region very near the top surface of the material at the nano-scale level. For the observation of the internal structure of materials at the nano-scale level, transmission electron microscope (TEM), in which accelerated electrons are transmitted through the target materials, is commonly used as a powerful tool. In order to observe a cross-section very near the top surface of the tungsten with TEM, we firstly extract a small piece of the tungsten sample from its surface and then fabricate an ultra-thin film by cutting the extracted sample. The thickness of the film must be below ~100 nm to obtain high resolution due to the high transmission of the electron beam. However, it has been extremely difficult to fabricate such an ultra-thin film for hard materials such as a tungsten. Therefore, it has been almost impossible to obtain the ~100 nm thickness level by using conventional thin-film fabrication techniques. The research team of Dr. Masayuki Tokitani and Daisuke Nagata et al of the National Institutes of Natural Sciences (NINS) National Institute for Fusion Science (NIFS) have developed a superior nano-scale fabrication technique for tungsten, by using a focused ion beam—electron beam (FIB-SEM) device. They call this technique the “nano-scale sculpture technique.” The FIB-SEM device enables us to cut materials by irradiating them with a focused Ga ion beam of ~30 nm in diameter. The research team previously tried to fabricate an ultra-thin film by sharpening a small piece of tungsten with FIB-SEM. However, they had the problem that the topmost surface was unfortunately lost because the beam intensity had to be relatively strong

A research team of fusion scientists has succeeded in developing a “nano-scale sculpture technique” to fabricate an ultra-thin film by sharpening a tungsten sample with a focused ion beam.

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for the hard tungsten. To solve this problem, they have now produced a special Ga beam operation to maintain the topmost surface by adjusting the beam irradiation positions and directions. They also gradually sharpen the region near the surface, creating a shape that becomes thinner toward the bottom. Consequently, they obtain an ultra-thin film with the thickness of ~100 nm or less and with the top surface remaining intact. In the image obtained by the TEM observation of the fabricated ultra-thin film, we can clearly identify the atomic level damage formed near the top surface of the tungsten sample. Thus, the “nano-scale sculpture technique” developed by this research team makes it possible to observe a cross-section near the top surface of tungsten sample at an atomic-scale. This sculpture technique can be applied not only to tungsten but also to other hard materials such as hardened alloys and ceramics. Currently, we are considering this sculpture technique for application in the automotive industry.

Phys.org, 9 July 2019

<http://phys.org>

Vitamin C is key to protection of exciting new nanomaterial

2019-07-10

In work that could open a floodgate of future applications for a new class of nanomaterials known as MXenes (pronounced “Maxines”), researchers from Texas A&M University have discovered a simple, inexpensive way to prevent the materials’ rapid degradation. Two-dimensional MXene nanosheets have promise in applications ranging from energy storage to water purification. However, MXenes have an Achilles’ heel: they rapidly degrade when kept in the open. According to the Texas A&M team, the solution to this problem involves exposing MXenes to anything in a family of compounds best represented by a natural dietary supplement such as vitamin C. “With these findings, shelf-stable MXenes become possible and engineering-grade MXene-based materials can become a practical reality,” the researchers wrote in a paper for the upcoming issue of the online journal Matter.

Interesting Properties

Discovered in 2011 by a team at Drexel University, MXenes are sheets of materials only a few atoms thick that are mostly composed of layers of metals like titanium interleaved by carbon and/or nitrogen. Due to their

In work that could open a floodgate of future applications for a new class of nanomaterials known as MXenes, researchers have discovered a simple, inexpensive way to prevent the materials’ rapid degradation.

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nanothickness and the variety of elements they can be composed of (other nanomaterials like graphene contain only carbon), “these materials tend to have really interesting properties, like high electrical conductivity and high catalytic activity,” said Dr. Micah Green, an associate professor who led the work and has joint appointments in the Artie McFerrin Department of Chemical Engineering and the Department of Materials Science and Engineering at Texas A&M. As a result of those properties, MXenes have generated a great deal of interest and enthusiasm in the research community with potential applications in everything from batteries to electronic sensors. “But there has been one problem lurking in the background,” said Green. MXenes degrade, or oxidise, quickly. “They fall apart and stop being nanosheets. This happens in a matter of days.” Although other researchers have found that techniques like drying or freezing MXenes can delay their degradation, “They’re still not going to last for years,” he said. “And no one wants a material that doesn’t have a long shelf life.” Texas A&M tackled the problem through an interdisciplinary team of experts in nanomaterials, ceramics and polymers. The other faculty members involved in the work are Dr. Miladin Radovic, professor in the Department of Materials Science and Engineering, and Dr. Jodie Lutkenhaus, associate professor in the Department of Materials Science and Engineering and the Department of Chemical Engineering.

Toward a Solution

The team ultimately found that exposing a typical MXene to a solution of sodium L-ascorbate stopped the nanosheet from degrading. Plus, several related compounds, including vitamin C, also worked. According to Green, the effect lasts. He also noted that the team made the discovery about a year ago and the treated MXenes are still stable. To further investigate the phenomenon leading to the improved stability, the team completed molecular dynamics simulations of the interactions between the MXenes and the antioxidants. They found that the ascorbate molecules appear to associate with the MXene nanosheet, preventing it from interacting with water molecules and as a result, shielding it from oxidation. The team is excited because their “method appears to work with a variety of different MXenes,” Green said. The Matter paper focuses on the most common MXene (Ti_3C_2Tx), but other types of MXenes are even more unstable. So much so that “people have doubted whether those materials could ever find applications. With this technique, that could change.” The researchers are currently exploring the stability of these additional MXenes using the same approach. “Our hope is that everybody who works on MXenes,

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including people in industry, will use our technique to protect their materials," said Green.

Science Daily, 9 July 2019

<http://www.sciencedaily.com>

Activity of fuel cell catalysts doubled

2019-07-10

An interdisciplinary research team at the Technical University of Munich (TUM) has built platinum nanoparticles for catalysis in fuel cells: The new size-optimised catalysts are twice as good as the best process commercially available today. Fuel cells may well replace batteries as the power source for electric cars. They consume hydrogen, a gas which could be produced for example using surplus electricity from wind power plants. However, the platinum used in fuel cells is rare and extremely expensive, which has been a limiting factor in applications up to now. A research team at the Technical University of Munich (TUM) led by Roland Fischer, Professor for Inorganic and Organometallic Chemistry, Aliaksandr Bandarenka, Physics of Energy Conversion and Storage and Alessio Gagliardi, Professor for Simulation of Nanosystems for Energy Conversion, has now optimised the size of the platinum particles to such a degree that the particles perform at levels twice as high as the best processes commercially available today. In fuel cells, hydrogen reacts with oxygen to produce water, generating electricity in the process. Sophisticated catalysts at the electrodes are required in order to optimise this conversion. Platinum plays a central role in the oxygen-reduction reaction. Searching for an ideal solution, the team created a computer model of the complete system. The central question: How small can a cluster of platinum atoms be and still have a highly active catalytic effect? "It turns out that there are certain optimum sizes for platinum stacks," explains Fischer. Particles measuring about one nanometre and containing approximately 40 platinum atoms are ideal. "Platinum catalysts of this order of size have a small volume but a large number of highly active spots, resulting in high mass activity," says Bandarenka.

Interdisciplinary collaboration

Interdisciplinary collaboration at the Catalysis Research Centre (CRC) was an important factor in the research team's results. Combining theoretical capabilities in modelling, joint discussions and physical and chemical knowledge gained from experiments ultimately resulted in a model showing how catalysts can be designed with the ideal form, size and size

Modelling leads to the optimum size for platinum fuel cell catalysts

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distribution of the components involved. In addition, the CRC also has the expertise needed to create and experimentally test the calculated platinum nano-catalysts. "This takes a lot in terms of the art of inorganic synthesis," says Kathrin Kratzl, together with Batyr Garlyyev and Marlon Rück, one of the three lead authors of the study.

Twice as effective as the best conventional catalyst

The experiment exactly confirmed the theoretical predictions. "Our catalyst is twice as effective as the best conventional catalyst on the market," says Garlyyev, adding that this is still not adequate for commercial applications, since the current 50 percent reduction of the amount of platinum would have to increase to 80 percent. In addition to spherical nanoparticles, the researchers hope for even higher catalytic activity from significantly more complex shapes. And the computer models established in the partnership are ideal for this kind of modelling. "Nevertheless, more complex shapes require more complex synthesis methods," says Bandarenka. This will make computational and experimental studies more and more important in the future.

Science Daily, 3 July 2019

<http://www.sciencedaily.com>

Tiny supersonic jet injector accelerates nanoscale additive manufacturing

2019-07-10

By energising precursor molecules using a tiny, high-energy supersonic jet of inert gas, researchers have dramatically accelerated the fabrication of nanometre scale structures. The rapid additive manufacturing technique also allows them to produce structures with high aspect ratios. Now, a theory developed to describe the technique could lead to new applications for additive nanomanufacturing and new nanoscale materials. Based on focused electron beam deposition, the technique allows structures to be fabricated from gas-phase precursors at rates approaching what could be expected in the liquid phase -- all without raising the temperature of substrates. That could lead to manufacturing of the nanometre-scale structures at rates that could make them practical for use in magnetic memory, high-frequency antennas, quantum communication devices, spintronics and atomic-scale resonators. "We are controlling matter on the atomic scale to bring about new modes of additive manufacturing," said Andrei Fedorov, a professor in the

By energising precursor molecules using a tiny, high-energy supersonic jet of inert gas, researchers have dramatically accelerated the fabrication of nanometre scale structures.

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George W. Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. "This new science could bring about additive manufacturing applications that might otherwise be impossible. The resulting new technology will open up new dimensions for additive manufacturing at the atomic scale." The work grew out of frustration with trying to create small structures using the electron beams, which can be just a few nanometres in diameter. The research was supported by the U.S. Department of Energy's Office of Science, and was reported May 28 in the journal *Physical Chemistry Chemical Physics*. "When we went to the lab to use nanofabrication with focused electron beams, which are the size of a few nanometres, we could not grow structures that were just a few nanometres. They grew to be 50 or 100 nanometres," Fedorov explained. "And it also took a long time to produce the structures, which meant that, without improvements, we'd never be able to produce them at high volume." Fedorov and collaborators Matthew Henry and Songkil Kim realised the reactions producing the structures were slow, and tied to the thermodynamic state of the substrate on which they are being grown. They decided to add some energy to the process to speed things up -- as much as a hundred times faster. The result was the invention of a micro-capillary injector just a few micrometres in diameter that could introduce tiny jets of gaseous molecules into the deposition chamber to activate the precursors for the nanometre-scale structures. Partly because the jet is entering a vacuum chamber, the gas accelerates to supersonic speeds. Energy from the supersonic jet excites the precursor molecules that are adsorbed to the substrate. "This energetic thermal state allows the electrons from the beam to much more easily break chemical bonds, and as a result, structures grow much faster," Fedorov said. "All of this amplification, both the molecule transport and the rate of reaction, are exponential, meaning a small change can lead to a dramatic increase in outcome." That much has been observed experimentally, but to understand how to control the process and expand its applications, the researchers wanted to create a theory for what they were seeing. They used nano-scale thermometric techniques to measure the temperature of the adsorbed atoms -- also known as adatoms -- subjected to the jet, and used that information to help understand the basic physics at work. "Once we have a model, it essentially becomes a design tool," Fedorov said. "With this understanding and the capabilities, we have demonstrated, we can expand them to other fields such as directed self-assembly, epitaxial growth and other areas. This could enable a whole host of new capabilities to use this kind of direct-write nanofabrication." Development of the model and understanding of the first-principles physics behind it could also allow other researchers to find new applications. "With this,

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you can have almost the same order of magnitude growth rate as you'd have with liquid phase precursors, but still have access to the richness of possible precursors, the ability to manipulate alloying, and all the experience that has been developed over the years with gas phase deposition," Fedorov said. "This technology will allow us to do things at a scale that is meaningful from a practical standpoint and cost-effective." The ability to rapidly produce small, three-dimensional structures could open up a range of new applications. "If you can adapt additive direct-write techniques, this could bring a lot of unique capabilities for magnetic memory, superconducting materials, quantum devices, 3D electronic circuitry, and many more things," he said. "These structures are currently very hard to make using conventional methods." Beyond using the jets to accelerate deposition of precursor materials already on the substrate, the researchers have also created hybrid jets that contain both high-energy inert gas and precursor gases, which allow not only dramatic acceleration of nanostructure growth but also precisely control the material composition during growth. In future work, the researchers plan to use these hybrid approaches to enable formation of nanostructures with phase and topology that cannot be achieved by any existing nanofabrication techniques.

Science Daily, 2 July 2019

<http://www.sciencedaily.com>

Most powerful and mildest reagents obtained based on eco-friendly iodine

2019-07-10

An international collaboration of chemists from Tomsk Polytechnic University, USA, Great Britain, Canada, Belgium, and France has developed a line of polyvalent iodine-based reagents for organic synthesis. This is an eco-friendly replacement of conventional reagents based on toxic compounds such as vanadium and nitrous oxide. The line includes both the most powerful reagent and the mildest one. They are promising for the synthesis of new polymers and in more extent for the pharmaceutical industry that uses reagents based on heavy metals in producing medications. As reported by the Press Office of the Ministry of Science and Higher Education of the Russian Federation, the latest results were published in the journal Chemical Communications of the Royal Society of Chemistry. Polyvalent iodine as proposed by TPU scientists and their foreign colleagues can replace toxic heavy and transition platinum metals in reagents. Compared to a normal state whereby iodine forms

An international collaboration of chemists from Tomsk Polytechnic University, USA, Great Britain, Canada, Belgium, and France has developed a line of polyvalent iodine-based reagents for organic synthesis.

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a bond with only one carbon atom in organic synthesis, in a polyvalent state it can form a bond with a few atoms, i.e. it becomes more active. Project supervisor Mekhman Yusubov, who is also TPU First Vice-Rector for Science, says, "Chemical Communications published a whole series of articles authored by scientists of our collaboration. Moreover, they were featured as an independent entry on Chemistry World of the Royal Society of Chemistry. To expand further prospects for applying reagents based on polyvalent iodine, we purposefully derived a whole line of reagents with different activity ranging from the mildest and most selective to the most powerful ones. In our opinion, they have an unmatched advantage that they are non-toxic when taken separately, do not produce harmful by-products and allow the reaction to take place under very simple conditions. If synthesis with common reagents needs high temperature of about 350-500 °C and therefore special conditions, polyvalent iodine makes it possible to work at room temperature." The mildest reagent in the series is called tosylate, a derivative of 2-iodoxybenzoic acid, and the most powerful is 2-iodoxybenzoic acid ditriflate. "It was a non-trivial challenge to synthesise them. In the first case, polyvalent iodine was combined with a triflate group, and in the second—with a tosylate group. This was difficult to do because these groups themselves are very powerful acids. When we managed to combine them with iodine, they became 'mild', they do not cause any side processes during the reaction," explains the scientist. As a result, the most powerful reagent allows the synthesis, for example, of fluorinated alcohols. They are widely used to obtain biologically active compounds that are the basis for perfluorinated polymers. Previously they could only be synthesised with the use of agents based on toxic vanadium oxide and nitric oxide. According to the authors, theoretically, it is possible to create an even more powerful reagent. The international collaboration will develop this direction as well. "The mildest reagent is suitable for oxidising natural compounds such as complex organic compounds which are part of living bodies. The reagent does not damage initial compounds nor does it cause any side processes. In addition, the entire reaction takes no more than 5 minutes at room temperature. This is a high rate for organic synthesis," notes Professor Mekhman Yusubov.

Phys.org, 9 July 2019

<http://phys.org>

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Self-assembling materials can form patterns that might be useful in optical devices

2019-07-10

Self-assembling materials called block copolymers, which are known to form a variety of predictable, regular patterns, can now be made into much more complex patterns that may open up new areas of materials design, a team of MIT researchers say. The new findings appear in the journal *Nature Communications*, in a paper by postdoc Yi Ding, professors of materials science and engineering Alfredo Alexander-Katz and Caroline Ross, and three others. "This is a discovery that was in some sense fortuitous," says Alexander-Katz. "Everyone thought this was not possible," he says, describing the team's discovery of a phenomenon that allows the polymers to self-assemble in patterns that deviate from regular symmetrical arrays. Self-assembling block copolymers are materials whose chain-like molecules, which are initially disordered, will spontaneously arrange themselves into periodic structures. Researchers had found that if there was a repeating pattern of lines or pillars created on a substrate, and then a thin film of the block copolymer was formed on that surface, the patterns from the substrate would be duplicated in the self-assembled material. But this method could only produce simple patterns such as grids of dots or lines. In the new method, there are two different, mismatched patterns. One is from a set of posts or lines etched on a substrate material, and the other is an inherent pattern that is created by the self-assembling copolymer. For example, there may be a rectangular pattern on the substrate and a hexagonal grid that the copolymer forms by itself. One would expect the resulting block copolymer arrangement to be poorly ordered, but that's not what the team found. Instead, "it was forming something much more unexpected and complicated," Ross says. There turned out to be a subtle but complex kind of order—interlocking areas that formed slightly different but regular patterns, of a type similar to quasicrystals, which don't quite repeat the way normal crystals do. In this case, the patterns do repeat, but over longer distances than in ordinary crystals. "We're taking advantage of molecular processes to create these patterns on the surface" with the block copolymer material, Ross says. This potentially opens the door to new ways of making devices with tailored characteristics for optical systems or for "plasmonic devices" in which electromagnetic radiation resonates with electrons in precisely tuned ways, the researchers say. Such devices require very exact positioning and symmetry of patterns with nanoscale dimensions, something this new method can achieve. Katherine Mizrahi Rodriguez, who worked on the project as an undergraduate, explains that the team prepared many

Self-assembling materials called block copolymers, which are known to form a variety of predictable, regular patterns, can now be made into much more complex patterns that may open up new areas of materials design, a team of MIT researchers say.

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of these block copolymer samples and studied them under a scanning electron microscope. Yi Ding, who worked on this for his doctoral thesis, “started looking over and over to see if any interesting patterns came up,” she says. “That’s when all of these new findings sort of evolved.” The resulting odd patterns are “a result of the frustration between the pattern the polymer would like to form, and the template,” explains Alexander-Katz. That frustration leads to a breaking of the original symmetries and the creation of new subregions with different kinds of symmetries within them, he says. “That’s the solution nature comes up with. Trying to fit in the relationship between these two patterns, it comes up with a third thing that breaks the patterns of both of them.” They describe the new patterns as a “superlattice.” Having created these novel structures, the team went on to develop models to explain the process. Co-author Karim Gadelrab Ph.D. ‘19, says, “The modelling work showed that the emergent patterns are in fact thermodynamically stable, and revealed the conditions under which the new patterns would form.” Ding says “We understand the system fully in terms of the thermodynamics,” and the self-assembling process “allows us to create fine patterns and to access some new symmetries that are otherwise hard to fabricate.” He says this removes some existing limitations in the design of optical and plasmonic materials, and thus “creates a new path” for materials design. So far, the work the team has done has been confined to two-dimensional surfaces, but in ongoing work they are hoping to extend the process into the third dimension, says Ross. “Three dimensional fabrication would be a game changer,” she says. Current fabrication techniques for microdevices build them up one layer at a time, she says, but “if you can build up entire objects in 3-D in one go,” that would potentially make the process much more efficient.

Phys.org, 5 July 2019

<http://phys.org>

Turning food waste into bioplastics

2019-07-10

An ingenious new solution being engineered at the University of Canterbury (UC) aims to turn food waste into valuable chemical components that could be used to make bioplastics. An ingenious new solution being engineered at the University of Canterbury (UC) aims to turn food waste into valuable chemical components that could be used to make bioplastics. At UC’s Department of Chemical and Process Engineering, Dr. Alex Yip is leading research into food waste conversion. He is working collaboratively with Hong Kong Polytechnic University to

An ingenious new solution being engineered at the University of Canterbury (UC) aims to turn food waste into valuable chemical components that could be used to make bioplastics.

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design and develop a catalyst to achieve this. "The ultimate objective is to produce a high-value product from food waste," Dr. Yip says. "To date, we have completed a proof-of-concept showing that it's feasible." The project's goal is to extract three key chemical components, including polylactic acid (PLA) and the organic compound 5-HMF, from the food-waste-stream. These could then be used as building blocks to make sustainable bioplastics with various properties to suit consumer needs. If this innovative project is successful, food waste could have a new use as raw material for valuable bioplastics. Bioplastics produced from food waste would be 100% recyclable or fully biodegradable. They could be used for products such as biodegradable bin-liners. "This waste stream carries both opportunity and financial costs," Dr. Yip says. "What we're trying to do is add value to that waste by converting it into something useful while at the same time responding to another environmental problem in Aotearoa New Zealand, which is the plastic waste problem." Being able to convert food waste into bioplastics would deliver the dual benefit of lowering greenhouse gas emissions while reducing the amount of non-biodegradable plastics going into landfills. The research would be a pioneering breakthrough for catalytic conversion of food waste for this purpose. Long term, the objective is to scale-up the process for commercial application. "We're convinced that our process with this specific catalyst is very promising," says Dr. Yip.

Phys.org, 5 July 2019

<http://phys.org>

Development of 3D particle model for single particles in battery electrodes

2019-07-10

A model that can have a 3D observation of micrometre-sized particles in a cell has been developed. Through the analysis and research of micrometre-sized particles in a cell, this model is expected to enhance energy efficiency of cells. DGIST announced that Professor Yong Min Lee's team in the Department of Energy Science & Engineering developed 'micron1 single particle electrochemical model' that can estimate the electrochemical properties of a single particle of electrode active materials² in 3D. The 3D observations of the single particles of electrode active materials, which are difficult to be identified in an experiment, are expected to be applied to research electrochemical phenomena and particle designs that enhance cell efficiency. Although a secondary cell is commonly used as the power source of electric vehicles, it is still not as

Development of 3D electrochemical model to improve battery energy density and efficiency of electric vehicles

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efficient as internal combustion engine. Its efficiency can be improved by increasing the energy density of the cells, R&D has not been actively carried out due to the limitations in precise analysis technology. Professor Lee's team thought that the energy density of a cell can be enhanced through the design optimisation of electrode active materials in a cell. Then, they sought a way to examine the micrometre-sized single particles of electrode active materials and developed electrochemical model that can conduct 3D analysis on the single particles. Unlike the existing model that focused on cell electrode, the model developed by Professor Yong Min Lee's team focused on the single particles of active materials that compose electrode. By doing so, the team took another step closer to a research to fundamentally increase cell efficiency through accurate analysis on the properties and characteristics of 3D single particles in a model. Since it can have 3D analysis of particles, the model is especially expected to be applied widely in research to design the single particles of electrode active materials in a cell. Regarding this research, Professor Yong Min Lee in the Department of Energy Science and Engineering said "Comparing to previous works, our model can look into what happens within a single particle. As a result, it provides an innovative way in designing micrometre-sized particles. Our next goal is to apply this electrochemical model to improve the cell efficiency of electric vehicles."

EurekAlert, 8 July 2019

<http://www.eurekalert.org>

A new rare metals alloy can change shape in the magnetic field

2019-07-10

Scientists from Peter the Great St. Petersburg Polytechnic University (SPbPU) with their colleagues developed multifunctional metal alloys that emit and absorb heat at the same time and change their size and volume under the influence of a magnetic field. This effect is caused by changes in the structure of the substance. The alloys may be used in medicine and industry. The results of the study were published in the Key Engineering Materials journal. The project was supported by the Russian Foundation For Basic Research and carried out as a part of the state assignments of the Federal Agency for Scientific Organisations and the Ministry of Education and Science of the Russian Federation. When magnetised, certain bodies change their volume and linear dimensions. This phenomenon is called magnetostriction. The shape changes depend both on the properties of the magnetic field and on the substance structure. The biggest changes

Scientists developed multifunctional metal alloys that emit and absorb heat at the same time and change their size and volume under the influence of a magnetic field

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usually occur in strongly magnetic materials such as nickel, iron, and cobalt oxide alloys. However, the magnetic properties of rare metals require additional studies and are of great interest today. A team of scientists from Peter the Great St. Petersburg Polytechnic University calculated the combination of components in an alloy that would allow for heat absorption and emission and shape and size changes within a wide variety of temperatures including those close to human body temperature. In such an alloy terbium, dysprosium, gadolinium, and cobalt should be combined as 0.2:0.8-x:x:2, and aluminium should be added to them to reach the ratio of 0.2:0.8-x:x:0.9:0.1 (where x is a variable). The alloys were manufactured in the Institute of Electrical Engineering at Leibniz University Hannover. The obtained material may be used to develop magnetostrictive transducers. They serve as sensors, filters, and resonators that transform the magnetic field into mechanical oscillations and vice versa. This is an important function for various devices, such as material integrity controllers that help find air bubbles within constructions. If such bubbles are not identified and removed, they may cause cracks and damage. Moreover, a transducer can serve as a basis for developing sensitive vibration gauges used to register earthquake shocks, as well as a source and a receiver of sound waves for underwater works. A team of specialists from the Institute of Metallurgy and Material Science of the Russian Academy of Sciences studied the effect of the magnetic field on the alloy. The surface of the substance was probed with a thin needle able to detect every indent or mount. The system worked a lot like a phonograph, but the data was transformed not in music, but in an image. The scientists demonstrated that the surface of the alloy is covered in stripes and that their layout changes under the influence of the magnetic field. Thus, they were able to see the restructuring of the metal that explains the magnetostriction effect. "Transducers based on our alloys are going to be more durable and long-lasting than the existing analogues and will work in a wide range of magnetic fields. Moreover, the alloys may be used in medicine as they can change their shape under the influence of magnetic fields that are safe for human health. For example, one can develop arterial stents that would flow in the bloodstream in a compact form and then unfold in a given place. This is possible because the operating temperature range of our materials is close to human body temperature," said Alexey Filimonov, the head of the Department of

Physical Electronics at Peter the Great St. Petersburg Polytechnic University (SPbPU).

EurekAlert, 8 July 2019

<http://www.eurekalert.org>

Window film could even out the indoor temperature using solar energy

2019-07-10

A window film with a specially designed molecule could be capable of taking the edge off the worst midday heat and instead distributing it evenly from morning to evening. The molecule has the unique ability to capture energy from the sun's rays and release it later as heat. This is shown by researchers at Chalmers University of Technology, Sweden, in the scientific journal *Advanced Science*. On sunny summer days it can be little short of unbearable to stay indoors or in cars. The heat radiates in and creates an unpleasantly high temperature for people, animals and plants. Using energy-intensive systems such as air conditioning and fans means combating the thermal energy with other forms of energy. Researchers at Chalmers University of Technology are proposing a method that utilises the heat and distributes it evenly over a longer period instead. When their specially designed molecule is struck by the sun's rays it captures photons and simultaneously changes form - it isomerised. When the sun stops shining on the window film the molecules release heat for up to eight hours after the sun has set. "The aim is to create a pleasant indoor environment even when the sun is at its hottest, without consuming any energy or having to shut ourselves behind blinds. Why not make the most of the energy that we get free of charge instead of trying to fight it," says chemist Kasper Moth-Poulsen, who is leading the research. At dawn when the film has not absorbed any solar energy it is yellow or orange, since these colours are the opposite of blue and green, which is the light spectrum that the researchers have chosen to capture from the sun. When the molecule captures solar energy and is isomerised, it loses its colour and then becomes entirely transparent. As long as the sun is shining on the film it captures energy, which means that not as much heat penetrates through the film and into the room. At dusk, when there is less sunlight, heat starts to be released from the film and it gradually returns to its yellow shade and is ready to capture sunlight again the following day. "For example, airports and office complexes should be able to reduce their energy consumption while also creating a more pleasant climate with our film, since the current heating and cooling systems often do not

A window film with a specially designed molecule could be capable of taking the edge off the worst midday heat and instead distributing it evenly from morning to evening.

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keep up with rapid temperature fluctuations," says Moth-Poulsen. The molecule is part of a concept the research team calls MOST, which stands for 'Molecular Solar Thermal Storage'. Previously the team presented an energy system for houses based on the same molecule. In that case - after the solar energy had been captured by the molecule - it could be stored for an extended period, such as from summer to winter, and then used to heat an entire house. The researchers realised that they could shorten the step to application by optimising the molecule for a window film as well, which would also create better conditions for the slightly more complex energy system for houses. What the researchers still have to do is to increase the concentration of the molecule in the film whilst also retaining the film's properties, and bring down the price of the molecule. But according to Moth-Poulsen they are very close to this innovation. "The step to applying our film is so short that it could happen very soon. We are at a very exciting stage with MOST," he says.

EurekaAlert, 8 July 2019

<http://www.eurekaalert.org>

Synthesising chemical-sensing cells from scratch

2019-07-10

Baking a cake from scratch is a task deemed difficult for many. Constructing an artificial cell-like system from scratch, well that's another story. "Synthesising cells from scratch is of fundamental importance to understand what life is," said Prof. Yohei Yokobayashi, leader of the Okinawa Institute of Science and Technology Graduate University (OIST) Nucleic Acid Chemistry and Engineering Unit. Scientists around the world are beginning to create simple artificial cells that conduct some basic biological functions and that contain small strands of DNA or RNA. However, getting these snippets of genetic material to express their encoded proteins in response to precise signals has been a challenge. Now, Yokobayashi and other researchers from OIST and Osaka University have found a way to make artificial cells interact with a wide range of chemicals. They developed a riboswitch -- a gene switch that senses chemical signals -- that can respond to histamine, a chemical compound that is naturally produced in the body. In the presence of this chemical, the riboswitch turns on a gene inside the artificial cells. Such a system, could one day be used as a new way of administering medicine, said Yokobayashi, a corresponding author on a recent study in Journal of the American Chemical Society, which describes the approach. "We want the cells to release drugs based on their detection of histamine," Yokobayashi

Scientists create artificial cells that can express distinct genes in response to specific chemical signals, opening the door to new ways of delivering drugs.

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said. "The ultimate goal is to have cells in your gut use histamine as a signal to release the appropriate amount of drug to treat a condition."

Signal selection

The scientists chose histamine as the chemical signal for their artificial cells because it is an important biological compound in the immune system. If you feel an itch, histamine is the likely culprit. It is also released by the body during allergic reactions and helps defend against foreign pathogens by spurring inflammation. To detect histamine, they created a molecule called an RNA aptamer. RNA aptamers are small segments of RNA building blocks that can be engineered to act as binding agents to specific target molecules. It took Yokobayashi and his colleagues, former OIST postdocs Dr. Mohammed Dwidar and Dr. Shungo Kobori and OIST PhD student Charles Whitaker, two years to create an aptamer that targeted histamine. Next, the team developed a so-called riboswitch that would turn this signal detection into action -- specifically, translating a gene to produce a protein. Normally, cells produce proteins when templates made of messenger RNA (mRNA) bind to cellular structures called ribosomes. Here, the scientists used the histamine aptamer to design a riboswitch that alters the shape of the mRNA upon binding histamine. In the absence of histamine, the shape of the mRNA prevents the ribosome from binding, and no protein is produced. Histamine-bound mRNA, however, allows ribosome to bind and synthesise proteins. "We demonstrated that riboswitches can be used to make artificial cells respond to desired chemical compounds and signals," Yokobayashi said. The next step resulted from a collaboration with senior author Prof. Tomoaki Matsuura and graduate student Yusuke Seike of the Department of Biotechnology at Osaka University. Matsuura and Seike put the cell-free riboswitch created by Yokobayashi's team into lipid vesicles to create artificial cells. The Osaka team attached the riboswitch to a gene expressing a fluorescent protein, so that when the riboswitch was activated by histamine, the system glowed. Then, they controlled another protein by the riboswitch -- one that makes nanometre-scale pores on the cell membrane. When the aptamer sensed histamine, a fluorescent compound encapsulated in the vesicles was released out of the cells through the pores, modelling how the system would release a drug. The scientists also created a 'kill switch', which instructs the cell to self-destruct -- creating a control for the technology. The technology is in the early stages of development. The next step is to make the artificial cells more sensitive to a smaller amount

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of histamine. Medical use may be in the distant future, but the potential exists, the scientists say.

Science Daily, 2 July 2019

<http://www.sciencedaily.com>

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Naples Rolls Out A Fine-Tuned Dough, And The New 'Cloud Pizza' Is Born

2019-07-11

Ever since the quasimythic birth of margherita pizza in Naples in 1889, Neapolitan pizzaioli have regarded their variety as the only true pizza, looking down upon differing styles in Brooklyn, Chatham, Chicago, Detroit, Kansas City, Melbourne, New Haven, Stockholm and Tokyo. For more than a century, they have seen anything beyond their Neapolitan borders as little more than nuanced blasphemy, the squabbling dialects of errant heretics. To them, non-Naples pies have counted as pizza about as much as Rob counts as a Kardashian. But as Naples doubled down on tradition decade after decade, its prestige pies took on a dusty flavour amid a global renaissance. "My father and grandfather never strayed," 29-year-old Vincenzo Capuano, a fourth-generation Neapolitan pizzaiolo, said in Italian by way of a translator. "Tradition strengthened us but it also held us back." So, Capuano did something his ancestors never did: He listened to the heretics, despite not becoming a convert. "I can learn from any pizza — even Chicago deep dish," he said. "My family and my Naples never thought that before." This year, a handful of young upstarts — including Capuano — are changing Naples' habits, bolstered by a new flour developed by Italian miller Caputo, a gold standard in pizza flour backed by Vera Pizza Napoletana, Naples' governing authority on pizza authenticity ("Naples is married to Caputo," said Capuano.) Caputo regularly makes new flours — Americana, for U.S.-style dough, debuted in 2016 — but the Neapolitan version hasn't changed much since 1889. Until now. "I feel like a rebel now, a radical," said Capuano. "People in Naples told me my pizzeria would be closed in two months. Now I'm opening my third." The new flour is called Nuvola (Italian for "cloud"). To harvest it, the combines aren't sent into fields until rainy season, late in the game, so the grains are very mature and rustic, almost aged. Antimo Caputo, the third-generation CEO of the flour producer, likens it to passito, a raisin wine. The chemical effect, he said, is that the grain is higher in fibre, with more bran, minerals, germ, protein and amylase, a sugar enzyme that allows a crème brûlée sense of character, deeply charred but not bitter. Broadly, the maturation enables faster natural fermentation, although the dough needs roughly 24 hours of proofing (mass-market pizza companies, like Domino's, turbo-boost their fermentation for same-day results with added sugar, an accelerant for yeast.) A lactic acid build-up in Nuvola's natural fermentation process gives the end product some creaminess. It notably has no need for potassium bromate, a carcinogen that is used in the U.S. but is banned in Canada, China, the European Union and many

A handful of young upstarts are changing Naples' traditional pizza-making habits, bolstered by a new flour called Nuvola (Italian for "cloud"), developed by Italian miller Caputo.

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other nations (it is regulated in California). And, whereas most pizza doughs have a hydration point of 62, Nuvola's higher concentration of soluble starch allows for a wider hydration range, as high as 100, creating a charred, crispier, puffier, lighter crust that is melty, more digestible and yields a more bouncy, chewy cornicione (pizza-speak for the pie's raised rim). "The starting point is a new generation of pizza-makers. More exact. More specific. This is a tough grain that was previously used for breads, not pizza. It was not in the older generations' mind to approach the dough on this exact level. Nuvola is only possible because of this increase in skill and specifics," said Caputo, who added that it took almost a year to create a pizza-ready adaptation of the grain. "The traditional approach was a Mercedes with automatic shifting. Nuvola is a Ferrari with manual shift. It's the Ferrari of flours: hard to drive but a beautiful experience if you know what you're doing." Caputo's criticism of Italy's long-celebrated quanto basta (as needed) approach to culinary technique is striking. He sounds downright Brooklynite, where bespoke experimentation is mainstream. "I've experimented with basically everything and it's just the most versatile, high-performance flour I've ever seen: rum cakes, fried doughnuts, 500 degrees, 900 degrees, anything," said Nicole Russell, the YouTube-trained pizzaiola behind a rarefied pizza spot in New York City that uses 100% Nuvola: her word-of-mouth, pickup-only Last Dragon Pizza, which she runs out of her home. "It's a 45-minute drive for me to the Jericho Turnpike off Cross Island and it's double the cost, but I kept my pizza prices the same. That's how much I want it. That's how much of a difference it delivers." Nino Coniglio's The Woodstock, a pizzeria in Manhattan's trendy Meatpacking District, sells a modified 90% Nuvola slice. "We lost something in Italy and America that we're able to rediscover," said Coniglio, who field-tested Nuvola with bagels and focaccia. And Roberto Caporuscio, who runs Kesté in Greenwich Village's who's-who hood of pizza royalty, gave his dough a cloudy kick by mixing in 25% Nuvola. "I was not sure about Nuvola, of course, but then I tasted it. There are two people: unsure people and people who have tasted it," said Caporuscio. "You can do Neapolitan pizza with it, of course, but also New York or Roman. It's very versatile, which is important to me because we teach pizza-making classes." Caporuscio raises an interesting point: What do people without a dog in the fight think? "It doesn't taste at all like a Neapolitan pizza," says pizza blogger Miriam Weiskind, after taking her first bite of Coniglio's Woodstock margherita. "It has cloudiness," she said, sticking most of her index finger into a large, charred crust bubble, "but with a New York chew, a dense taste. It's gummy. It's a lot of mixed messages." She inspected it with her phone's flashlight and took a few photos. Because Nuvola involves food in 2019, it also involves Instagram.

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As much as it's about taste and chemistry, it's also about visuals and novelty. For all its supporters, it is lifted highest by the power of now and the accompanying wow factor. It seems tailored for likes, if not love. "I took the unloved crust and it made it my trademark," said Carlo Sammarco, in Italian through a translator. He is the 28-year-old pizza rookie who was the first to use Nuvola in the Neapolitan outskirts of Frattamaggiore. He dubbed the resulting pie pizza canotto (dinghy pizza, for its resemblance to a toroidal life raft.) "It takes a new person to do that. And a new flour. Nuvola made both of us lovable." A common refrain among the Neapolitan pizza powers that be is that Nuvola is less of a rebellion or revolution than it is an evolution. In that sense, traditional Neapolitan pizza had become a flightless bird, as wondrous as an ostrich or penguin but incapable of much migration. With cloud pizza, Naples' pizza scene finally is taking flight again.

NPR, 17 June 2019

www.npr.org

How banning dangerous chemicals could save the US billions

2019-07-11

The Trump administration has argued that environmental regulations hold back economic productivity. Yet history suggests that the opposite is the case. Look at phasing out lead in gasoline. To this day, the US receives a \$200bn annual economic stimulus package each year because lead levels in children plummeted when the US Environmental Protection Agency moved to protect children. Now, we realise that a larger suite of chemicals can disrupt hormones and cost our economy. We're talking not just about chemicals in cosmetics, but also in food packaging, aluminium cans, agriculture, electronics, carpeting and furniture. Endocrine disrupting chemicals (EDC) are recognized as a major public health threat by the Endocrine Society, the World Health Organisation, United Nations Environment Program, the International Federation of Gynecologists and Obstetricians and the American Academy of Paediatrics. But what's not recognised is that these chemicals cost the US \$340bn each year, according to research I was part of, published in the *Lancet Diabetes and Endocrinology* journal. Yes, that's 2.3% of the US gross domestic product. The key drivers of these costs in the US are the effects of flame retardants and pesticides on the developing brains of children. If one child loses IQ points, the parent or teacher may not even notice. But if, for example, 100,000 children lose an IQ point, the entire economy notices. Each IQ

It's a myth that environmental regulations stifle economic productivity.

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point in a child is worth about 2% of their lifetime economic productivity. So, if the average child makes \$1m over her or his lifetime, this means an IQ point is worth about \$20,000. Add up an IQ point across all of the 4,000,000 children born in the US each year, and the long line of zeros means big costs. Getting lead out of gasoline shows the power of IQ points and the economic impact of doing the right thing and preventing these exposures. I tell the undergraduates I teach at NYU that they are four to seven IQ points smarter because we got lead out of gasoline and paint. That reduced lead levels in kids by about 15 micrograms per decilitre, producing cohorts of kids who are \$200bn more productive over their lifetimes than kids born in the 1970s. That equates to a tax refund of roughly \$700 a person that we still get today as more children are born free of this exposure. Unfortunately, these benefits are undermined by newer exposures that disrupt brain development, and prevent gains in cognitive potential that we otherwise achieve through stronger education and other social changes for the better. Add in costs due to increases in obesity, diabetes, endometriosis, fibroids, infertility, cardiovascular disease and even some forms of cancer, and you get to that large total. But what's also striking is the impact of policy on these exposures, and how they differ across the Atlantic. It turns out these policies can have big impacts on people's exposure. Take flame retardants as an example. California required that brominated flame retardants be sprayed into furniture going back to the 1970s, and the law only changed in 2013. In Europe, these chemicals were banned much sooner, producing an entire generation of children with much lower levels of chemicals that disrupt thyroid hormone, which is crucial for healthy brain development. In the US, the average American has levels that would be in the 95th percentile of Europeans or anyone else in the world for that matter. That's why brominated flame retardants cost the US over \$266bn each year, while in Europe those same chemicals cost only \$13bn. The frightening part of that story is how literally chemical exposures can undermine our competitive advantage with other countries, undermining our educational talent. And, these economic estimates don't include the costs of having fewer children with genius IQs. The researchers only measured the costs of children who were pushed into the intellectually disabled range. The good news is that US policymakers' efforts on pesticides in food have produced the opposite situation. According to our research, Europe loses \$194bn in economic productivity due to organophosphate pesticide exposure, whereas the US loses closer to \$45bn.

Solutions

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You'll be delighted to know that the changes that are needed don't necessarily require regulation. Just look at the impact recently of a small study that found perfluoroalkyl compounds in the linings of food packaging in two major supermarket chains. These major purchasers got rid of the offending packages, and insisted that their producer change their ways, and document the absence of these thyroid-disrupting compounds. Organic food is showing near double-digit annual percentage gains, and is now starting to appear in big-box stores. Now we see companies proudly displaying products documented to be free of bisphenol A and phthalates. Clayton M Christensen coined the phrase disruptive innovation back in 1995 to describe innovation that fundamentally changes the value system, creating a new set of winners and losers. Consumers win when disruptive innovations for all sorts of products reset the competitive landscape for product characteristics, price and other factors. When these disruptions happen, the market becomes more efficient, providing greater value to the consumer. These changes don't always work for chemicals, especially when they are replaced with structurally similar analogues. But green chemistry is now bringing us to a point where newer alternatives are able to be tested and replace those with health concerns. And there's a global competitiveness issue to keep in mind for those companies that don't evolve. If companies in the US don't do the right thing, companies in other countries might recognise the threat ahead first. The countries that lead the way in making the changes will eventually win by being more competitive in the eyes of the public that increasingly values avoiding EDC exposures. The change we need to address endocrine disrupting chemicals EDCs is broad in scale – ideally, policy change would address it all. But if we start to rise up, speak out and act in our homes and our workplaces, with our family, friends and colleagues, we can start to produce the change that is needed, whoever is in the White House or in Congress.

The Guardian, 25 June 2019

<http://www.guardian.com>

Does Spontaneous Human Combustion Really Happen?

2019-07-11

Is it possible for someone to burst into flames? That may sound like a strange question, but many people say the answer is yes. They point to examples throughout history when people had been found burned to ashes with their surroundings left untouched by fire. Sceptics say that it's impossible, and that every one of those examples can surely be traced

Is it possible for someone to burst into flames? That may sound like a strange question, but many people say the answer is yes.

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back to a flame of some sort. Who's right? Stories of spontaneous human combustion (SHC) date as far back as the 1400s; the knight Polonus Vorstius was said to have drunk two ladles of wine before vomiting a flame and becoming consumed by fire. But one of the earliest written accounts came in 1633 when Danish anatomist Thomas Bartholin described how a woman in Paris "went up in ashes and smoke" while she slept but left her straw mattress unaffected by the flames. SHC really got its time in the spotlight when Charles Dickens used it to kill off a character named Krook in his novel "Bleak House." News accounts of people becoming engulfed in flames, seemingly without an outside cause, have also cropped up many times in the last century. Most of these examples have a few things in common: the person is usually immobile — often because they're passed out drunk or on other drugs, but sometimes it's due to a physical disability. The body is usually completely reduced to ashes, but sometimes the extremities remain intact. And as we mentioned before, the person's surroundings are often unmarred by smoke or fire, save for a few mysterious grease stains on the walls or ceiling. How would that even be possible? Proponents have a few theories. Some say that it happens when digestive enzymes ignite a build-up of methane in the intestines. That doesn't explain why most victims experience the most damage on the outside of their body, not the inside. Other, more far-out hypotheses say it's a result of too much static electricity in the body, some external geomagnetic force, or even a new subatomic particle called the pyroton. But so far, there hasn't been any good science to back up these ideas.

What Does the Science Say?

But even if a flame came from some other source — an electric spark or a lit cigarette, for instance — that doesn't explain why victims of so-called SHC burn so completely. Science has a possible explanation, though. It's called the wick effect. Fair warning, this gets pretty gruesome. A candle is made up of a wick surrounded by wax — an ignition and a fuel source. When you light the wick with an external flame, the heat melts the wax closest to the wick. That liquid wax is then drawn up the wick by capillary action until it reaches the flame and is vaporised, creating more heat that keeps the cycle going. That's why a candle can burn for so long. The human body can be thought of as an inside-out candle: flammable clothing or hair acts as the wick, and body fat acts as the fuel source. As heat from the flame reaches the fat, it melts and soaks into the "wick," vaporising and creating more heat to keep the body burning continuously. All the fuel the fire needs is right there, which could be why a victim's

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surroundings are left untouched save for a few grease stains — the leftovers from burning fat. We told you it was gruesome.

Curiosity, 2 September 2017

<https://curiosity.com>

The Scientific Reason You Shouldn't Pee in the Pool (And You Should Shower Before Swimming)

2019-07-11

Swimming is good, clean, summer fun. When we say “clean,” we mean that in the wholesome sense, not the sanitary one. Sorry to burst your bubble, but commercial swimming pools are flooded with urine. Though you hopefully know not to pee in the pool (come on), you're probably committing another serious pool-time crime without even realizing it.

We All Put the “P” in Pool

We don't care what you tell us — the data says that you're probably, definitely peeing the pool. Everyone does it, pretty much. In a 2017 study, scientists found that the average commercial swimming pool contains about 20 gallons of urine. They determined this by measuring levels of artificial sweetener in swimming pools. These sweeteners are designed to go right through you and are not easily broken down by chlorine. “I think you can assume that if people are using your pool, they're peeing in it,” Ernest Blatchley III, an environmental engineer at Purdue University, tells NPR. “I view it like second-hand smoke. It's disrespectful and potentially dangerous.” Besides just being objectively gross, pee-filled pools pose certain health risks.

Shower Power

Not showering before swimming exacerbates the problem caused by pee in pools. Surely, you've seen signs at public swimming holes recommending (or even demanding) a pre-swim rinse-off. No judgment if you've never done it yourself; it seems counterproductive, no? According to a survey, about 44 percent of adults skip the showers before swimming. Pools have chlorine in order to kill germs, but the organic compounds you're adding to the mix create a whole new set of problems. Sorry. The chlorine in pools interacts with organic compounds like sweat, lotion, sunscreen, and (duh) urine to create “disinfection by-products” like chloramines, cyanogen chloride, and nitrosamines. These by-products can irritate the skin, eyes, and the respiratory tract, according to the CDC.

Swimming is good,
clean, summer fun.

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Don't blame chlorine alone; eyeball redness after a summer dip is caused by these by-products, by the way. These irritants can be airborne, too. This is why proper ventilation is an important requirement for indoor pools and waterparks. We found that one out the hard way in 2015, after patrons at an Ohio waterpark started experiencing some undesirable side effects (eye burning, nose irritation, difficulty breathing, and vomiting) from the ill-ventilated resort. The takeaway? Don't pee in the pool, for goodness sake, and take even just a one-minute rinse before setting foot on the high dive, too.

Curiosity, 13 November 2017

<https://curiosity.com>

A failed high school chemistry experiment results in nearly \$60 million in damages

2019-07-11

A New York jury granted nearly \$60 million in civil damages to a high school student who was severely burned in a 2014 class chemistry experiment. The award is the culmination of a years-long lawsuit by the family of Alonzo Yanes, who was a student at New York's Beacon High School at the time of the experiment. Yanes is still being treated for his injuries, requiring autografts to replace tissue, his lawyer said. "He hasn't had a day without pain," lawyer Ben Rubinowitz said. "They are more than just scars on his face." The lawsuit accused the New York City Department of Education and the Board of Education of failing to alert teachers to the dangers of the experiment, known as the rainbow demonstration. The experiment was intended to demonstrate colours of flame produced by the combustion of various metals or salts. When Yanes attempted it in his sophomore chemistry class, it generated an explosion that caused a fire, the lawsuit states. Several months after the incident, the American Chemical Society's Committee on Chemical Safety put out a safety alert recommending that schools no longer use the experiment. "We find it unfortunate that the Department of Education and the teacher did not step up to the plate and admit that they were careless," Rubinowitz said. "The bottom line is that the teacher completely controlled the demonstration and was responsible for the safety of all the children in that class." The explosion left Yanes with severe burns and injuries to his upper body that required numerous operations, leaving him disfigured and with permanent scars, according to the lawsuit. The jury awarded approximately \$29 million for pain and suffering, including his surgeries, and another \$29 million for future rehabilitation, Rubinowitz said. The

A New York jury granted nearly \$60 million in civil damages to a high school student who was severely burned in a 2014 class chemistry experiment.

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rainbow demonstration is no longer used in the classroom, said Nick Paolucci, director of public affairs and press secretary for the New York City Law Department. The department is also looking at its “legal options to reduce the award to an amount that is consistent with awards that have been upheld by the courts in similar cases,” Paolucci said. In March 2014, three months after the explosion, the Committee on Chemical Safety released a statement citing a video that the US Chemical Safety and Hazard Investigation Board put out in December 2013, warning of the experiment’s dangers. “When carried out on an open bench using a flammable solvent, the rainbow demonstration is a high-risk operation,” committee Chairman Robert Hill Jr. said at the time. The jury’s award will help Yanes continue receiving treatment, potentially plastic surgery, his lawyer said. But it can’t fix the past. “Needless to say, the injuries suffered by Alonzo were horrific. They were life-changing and, unfortunately, disfiguring.”

CNN, 6 July 2019

<http://www.cnn.com/health>

Scientists have found a way to use stem cells to grow new hair

2019-07-11

Scientists from Sanford Burnham Prebys recently discovered a way to use stem cells to create natural-looking hair that grows through the skin. According to the American Academy of Dermatology, the hair loss of 80 million American men and women is due to genetics—other causes include stress, diseases and medical treatments. Stemson Therapeutics, a newly formed company, has licensed the technology to use stem cells to reverse hair loss. “Now we have a robust, highly controlled method for generating natural-looking hair that grows through the skin using an unlimited source of human iPSC-derived dermal papilla cells,” Alexey Terskikh, an associate professor in Sanford Burnham Prebys’s Development, Aging and Regeneration Program and the co-founder and chief scientific officer of Stemson Therapeutics, said in a statement. So how does it work? There is a type of cell in your hair follicle called dermal papilla, which controls hair growth, thickness, length, and growth cycle. The scientists combined mouse epithelial cells with a biodegradable scaffold to help strengthen the human dermal papilla. The scaffold controls the direction of hair growth and integrates the stem cells into the skin. So, when will you be able to take advantage of this ground-breaking

The technology won’t be commercially available anytime soon, though.

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discovery? Not anytime soon, but Stemson Therapeutics is exploring how to commercialise it.

Muscle and Fitness, July 2019

<https://www.muscleandfitness.com/athletes-celebrities/news/scientists-have-found-way-use-stem-cells-grow-new-hair>

How antioxidants can hasten the spread of lung cancer

2019-07-11

A few years ago, scientists in Sweden sparked a heated debate when they published research suggesting that taking antioxidant supplements, such as vitamin E, could make cancer more invasive. Their revelations challenged the belief that antioxidants can help fight cancer. New research shows how antioxidants fuel the spread of lung cancer. Now, two independent Cell studies, one from the United States and the other from Sweden, reveal how lung cancer cells can use antioxidants to help them fuel their spread to other parts of the body. The researchers anticipate that these findings will lead to new treatments for lung cancer, which kills more people worldwide than any other cancer. Cancer cells need lots of sugar, or glucose, to help them grow rapidly and metastasise, or spread. To meet this need, they use an energy-making process that is faster than the one that noncancerous cells use. The downside of having this faster energy mechanism is that it produces lots of molecules called free oxygen radicals that place significant chemical stress on cells. The new studies, which the researchers carried out using human tissue and mice, reveal how lung cancer cells use antioxidants to withstand oxidative stress and thrive. The U.S. study shows how two genetic mutations help the lung cancer cells make their own antioxidants to overcome oxidative stress and metastasise. The Swedish study shows how lung cancer cells use antioxidants from the diet to achieve the same outcome.

Medical News Today, 1 July 2019

<http://www.medicalnewstoday.com>

Spinach chemical should be put on doping ban list, say researchers

2019-07-11

A study released by Freie Universitat Berlin suggests that ecdysterone, a chemical found in the leafy green vegetable, has a similar effect to steroids and should be added to the list of substances banned in sport,

New research shows how antioxidants fuel the spread of lung cancer.

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CNN affiliate RTL reported. The researchers ran a study involving 46 athletes who trained three times per week for 10 weeks. Some were given ecdysterone and others a placebo. Those who took ecdysterone saw their performance improve by three times as much as those who did not. "We saw drastic increases in maximum performance in bench press in the group that took ecdysterone," co-author Maria Parr, a doping researcher at the university's Institute of Pharmacy, told CNN via telephone. Researchers had expected to see some impact on performance, but were surprised by the extent of the change, she added. The study was partly funded by the World Anti-Doping Agency (WADA), and researchers recommend that ecdysterone be included on the agency's banned list. Parr emphasised that ecdysterone can currently be bought legally as a dietary supplement. Co-author Francesco Botrè, director of the Italian anti-doping agency (FMSI), told CNN that the team are now investigating ways to test for ecdysterone. Anti-doping agencies are currently not allowed to test for ecdysterone because it isn't on the list of banned substances, he explained. This, combined with its greater than expected effect on performance, is a worry. "It's very powerful because it's invisible," said Botrè. "It's not on the list." Any decision on a future ban would be made by a special committee of WADA experts. The agency has recently been embroiled in controversy over the September 2018 reinstatement of the Russian anti-doping agency RUSADA. It was suspended in 2015 following accusations of state-sponsored doping up to and including the 2014 Winter Olympics in Sochi. This meant Russian athletes were banned from competing under their national flag, but the suspension was lifted following a controversial WADA vote. One of the conditions of that decision stipulated RUSADA had to hand over data from its Moscow laboratory by December 31 2018. However, the agency missed that deadline, leading to accusations that WADA had been "played by the Russians."

CNN, 25 June 2019

<http://www.cnn.com/health>

The hidden way cabs could promote healthier cities

2019-07-11

Right now, most modern cities are able to track urban conditions like air pollution, noise levels, traffic, road conditions, and weather using either fixed monitoring stations or the occasional moving sensor mounted on municipal vehicles. But both of these are methods expensive for cities to operate and maintain. Enter MIT Senseable City Lab, which has discovered that an accurate and cost-effective way to monitor cities is actually cabs.

An MIT research team has discovered that taxi rides could give urban planners a cheap, effective way to monitor the health of a city.

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In a paper published this spring, researchers say that if you equipped cabs with the right sensors, you could monitor the health of half the island of Manhattan, with only 0.3% of all cabs trips. In fact, just 10 taxis can monitor one-third of Manhattan streets in one day. "The sensing power of taxi fleets is unexpectedly large," the paper introduction says. Gaining an accurate picture of urban conditions is crucial for city planners and administrators who must decide how to allocate scarce resources. Knowing the pollution and traffic level for every street in a city could allow policy makers to regulate car access to certain areas. Knowing how loud streets are throughout the day could lead to measures against business that are noise polluters. The more cities know about their streets, the better they're able to enact policies that redound to the benefit of citizens. Intriguingly, from a data collection standpoint, cities aren't terribly different from one another. The team created a computer model before running experiments on real cabs in Singapore, Chicago, New York, San Francisco, Vienna, and Shanghai. They found that the sensing power of taxis is similar in cities around the world. While in New York you need only 0.3% of the taxi rides to cover half the city's regular grid of streets, in Vienna it takes 9%. The reason for this variation is that there are many more cab rides in New York than in Vienna, but 9% of all rides would still be a small number of cars overall. The researchers say that the model could help city officials build a system that uses low-cost sensors and a small fraction of cabs to constantly monitor their cities. The research had just been published, and there has not been feedback from any cities yet, but there may be soon. The health of our cities could depend on it.

Fast Company, 8 July 2019

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

Children's lives could be cut short by air pollution

2019-07-11

Air pollution could shorten a child's life by up to seven months, a study on one of the largest UK cities has suggested. An eight-year-old child born in 2011 may die between two to seven months early if exposed over their lifetime to projected future pollution concentrations, Kings College London researchers studying Birmingham have found. It is the first-time new Government guidance on "mortality burdens" of air pollution has been applied in practice in a large city area. The study looked at the combined impact of two pollutants – particulate matter and nitrogen dioxide – two of the leading causes of poor health from air pollution. It looked at the effect of air pollution on deaths and loss of life-expectancy

The study looked at the combined impact of two pollutants – particulate matter and nitrogen dioxide.

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but did not include non-fatal health conditions such as asthma. The impact was considered to be worse than some other major cities in the UK – with the report finding a higher loss of life expectancy in Birmingham than Manchester. It calculated the annual health cost of air pollution in Birmingham as between £190 million to £470 million per year. These are not actual costs but a measure of the amount of money society believes it would be reasonable to spend on policies to reduce air pollution, the authors said. A network of local leaders is calling for clean air zones to be established in major cities across the country. Polly Billington, director of the UK100 network, which commissioned the research, said: “This report should be a wake-up call to policymakers not just in Birmingham but across the country. “We need to tackle this invisible killer, which is cutting the lives of children and causing health misery for thousands of adults. “By working together, local councils and central government can put in place ambitious and inclusive clean air zones to tackle the most polluting sources of dirty air and let us breathe freely.” The excess mortality cost to the UK of air pollution has been estimated at between £8.5 billion and £20.2 billion a year. Sue Huyton, co-ordinator of the Clean Air Parents’ Network, said: “It’s awful that children living in the UK are breathing air that may shorten their lives. “As a parent, you want to do everything you can for your children, but when it comes to air pollution you can feel helpless – that’s why those in power must step up. “We need the Government and Birmingham City Council to take ambitious action to tackle the toxic air in this city, and we need them to do it now.” A spokeswoman for the Department for Environment, Food and Rural Affairs said: “Air quality has improved significantly in recent years, but air pollution continues to shorten lives which is why we are taking concerted action to tackle it. “We are working hard to reduce transport emissions and are already investing £3.5 billion to clean up our air, while our Clean Air Strategy has been commended by the World Health Organisation as an ‘example for the rest of the world to follow.’ “In the Strategy we committed to setting an ambitious long-term air quality target and we are examining action needed to meet the WHO annual guidelines to significantly reduce PM2.5 levels. “Our Environment Bill will give legal force to that strategy and put environmental accountability at the heart of government.” Simon Stevens, chief executive of NHS England said: “2.6 million children in England are breathing in toxic fumes every day and now there is clear and frightening evidence that this could also shorten their lives. “The NHS is taking practical steps to reduce our effect on the environment, as well as treating those suffering the consequences of air pollution, yet we cannot win this

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fight alone and the growing consensus on the need for wider action across society is welcome.”

The London Economic, 8 July 2019

<https://www.thelondoneconomic.com>

The search for a cleaner, greener plastic

2019-07-11

New kinds of plant-based plastic are beginning to permeate our lives. Supermarkets stock biodegradable bags to carry our groceries home, cafes serve coffee in compostable cups, and this year London Marathon runners could refuel with seaweed-based edible bubbles filled with sports drink. But if we just replace one kind of throwaway packaging with another, are we really solving the bigger problem? There’s no denying that we have a plastic crisis on our hands. A 2017 study found that, of the 8.3bn tonnes of plastic produced since 1950, 6.3bn tonnes has been thrown away. And whether it ends up in landfill or in the sea, that plastic – thanks to the stability and durability that it is prized for – is not going anywhere fast. Next year, a ban on single-use plastics including plastic straws, drink stirrers and cotton buds will come into effect in the UK. Canada recently announced it will ban “harmful” single-use plastics by 2021, becoming the latest in a long list of countries and states to limit the use of disposable plastics. This year Glastonbury banned the sale of single-use plastic bottles on site by replacing them with aluminium cans and offering water refills to festivalgoers. But ditching single-use plastics by replacing them with biodegradable or compostable versions could be causing more problems than it’s fixing. “What worries me is that this isn’t really a solution, it’s just swapping one polymer for another,” says Mark Miodownik, professor of materials and society at University College London. “If they end up in the environment, then it really does depend on the conditions that they find themselves in as to whether they biodegrade in any reasonable time.” “If you’re putting your nappies and your wipes in [your home compost bin], you’re going to be disappointed.” Deciphering the many labels applied to these plastics is no easy task. Many products described as “compostable” actually only break down in industrial composters that maintain high temperatures for weeks at a time. Some are certified for home composting, but how long that takes will depend on the conditions of your individual compost heap. Plastics that are labelled “biodegradable” typically can’t be composted, but can be broken down by microorganisms – though the exact method and timescale for this process varies. A recent study found that biodegradable carrier bags

Finding solutions to prevent harmful plastic waste is far from simple

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could still hold shopping after having been buried in soil or left in the sea for three years. Biodegradable plastics can be made from fossil fuels like traditional plastics, but in recent years the focus has been on those made from plants or other renewable resources, collectively called bioplastics. Not all bioplastics are biodegradable – Coca-Cola's PlantBottle is partially made from plants but otherwise acts like a typical PET (polyethylene terephthalate ie regular plastic) bottle. Blends of plant-based starches account for nearly half of bioplastics, but other starting materials include fungi, milk and even leftover lobster shells. While making plastics out of renewable materials is undoubtedly a step in the right direction, it won't stop plastic piling up in landfill sites and in our oceans. The problem, says Miodownik, is that there's no such thing as a sustainable material – only a sustainable system. And in the UK, we don't have a sustainable system to deal with the increasing number of compostable plastics finding their way into our daily lives. Take the compostable coffee cup made by companies like Edinburgh-based Vegware. They are lined with a bioplastic called polylactic acid – or PLA – made from corn starch. Their lids are made with CPLA, crystallised polylactic acid, designed to withstand high heat. And they are certified with the Seedling logo, showing they meet a European standard for compostability known as EN 13432. This means the packaging will break down within 12 weeks to water, CO₂ and biomass, leaving no more than 10% of the original material in pieces bigger than 2mm – but only under industrial-scale composting conditions. PLA makes up around a quarter of all compostable plastics sold worldwide, and is used for transparent cold drinks cups, clear windows on food packaging like sandwich boxes, drinking straws and more. A home compost heap won't reach the high temperatures needed to break it down. You might be tempted to put it in the recycling but there, PLA is often indistinguishable from traditional PET plastic bottles and can contaminate the recycling process. Council waste collections vary across the UK but few if any accept PLA in anything other than general waste. Most people will be left with only one option: the bin. Vegware argues that when they are sent to landfill, its products are still the better choice because they're made from plants and use lower carbon, recyclable or renewable sources. "These sustainability benefits still apply no matter what happens to them after use," says Lucy Frankel, the company's communications director. But if it ends up in the ocean, PLA is bad news. "PLA is basically nondegradable in sea water," says Dr Frederik Wurm of the Max Planck Institute for Polymer Research in Mainz, Germany, which means if it goes into the sea, "it's not better than any other plastic". In fact, Vegware's website points out that compostables are not a solution to marine plastic pollution – but in the rush to replace plastic with more environmentally friendly packaging, it's

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a caveat that seems to have got lost. Plastics that are certified for home composting fare better. Those include the potato-based wrapping for the Saturday Guardian, and a starch-based material called Mater-Bi made by bioplastics company Novamont, which the Co-op uses for its compostable carrier bags. For people who don't have a compost bin, some councils that collect food waste will accept compostable bags. But when food waste is processed, the bag may be separated out and sent to landfill or incinerated before your leftovers are composted. That's because, as things stand, compostable plastics can't just be sent to any industrial composter. "In-vessel" composters are best suited to breaking down these plastics – but lots of food waste is sent to anaerobic digesters, most of which can't process compostable plastics at all. If they are discarded in the environment, research has shown that compostable bags can survive for two years in soil. In sea water they could disappear in as little as three months, although exactly what products they release into the marine environment is not yet clear. There are some new materials that do claim to totally break down in the environment. Pods made from seaweed by London-based Skipping Rocks Lab are not just biodegradable or compostable, but edible. As well as using the bubbles to deliver hits of Lucozade Sport to marathon runners this year, the company has been trialling edible sauce sachets with takeaways from 10 restaurants in a partnership with Just Eat. If you choose not to eat the packaging after you're done with the sauce inside, the company says it breaks down in six weeks without needing any special treatment. "There probably are niche applications for those where it's the right thing to do," says Miodownik, but he doesn't see the edible pods as a big part of the plastics solution. A cofounder of the company has said they are focusing on sports events, festivals and takeaways.

In proposals published earlier this year, Defra said that it was aware of the trend for compostable packaging but that "appropriate treatment infrastructure" needed to exist before it could add compostables to a core list of materials that every council must collect for recycling. Frankel says Vegware would like to see compostables added to that list. In the meantime, it is working with the waste sector to set up composting collections for its clients, and says its products are now accepted by 27 industrial composting facilities around the UK covering 38% of postcodes. This summer, it's also starting to offer collection by courier costing £10 for small cafes and individuals using Vegware at parties, in partnership with recycling company First Mile. To make compostable collections available for everyone, though, as well as making in-vessel composters that can break down these plastics more widespread, helping the machines that

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sort our rubbish identify what is compostable plastic and what is not will be key. "We're looking into the possibility of putting some sort of marker into biodegradable plastic that you could then have a detector for," says Miodownik. In the short term, it would also be helpful to make the labels we use for plastics clearer. Wurm says that the label "biodegradable" should come with a time limit and information on what environment the plastic will break down in, to help bust the myth that biodegradable littering is no big deal. He'd also like to see manufacturers think about the life cycle of their products before they decide what to make them from – including how long they're likely to be used for, and what would happen if they were discarded. If you think it's likely your drinking straws will end up in the sea, for example, you should not make them out of PLA. "It's something that in many cases is not considered," says Wurm. A more radical solution would be for companies to rethink products so that they don't require plastic packaging in the first place. "What most companies are doing is saying, we don't want to redesign our system, we're going to swap out one material for another, and then it's someone else's problem to deal with this down the line," says Miodownik. "And that's a disaster." As consumers, we could go all-in on reusables, carrying around our own coffee cups and cutlery, and even taking containers to stock up on pasta and cereal at the supermarket. But there are some situations where demand for throwaway packaging will remain. "Even with a major shift to reusable containers, some disposables will always be needed, especially for serving food," says Frankel. In that case, unless your packaging is part of a closed loop system with a dedicated compostables collection – as exists at the Houses of Parliament, for example, which switched to compostable packaging last year – recyclable bioplastics could be the more sustainable choice. "For millions of people in their everyday lives, the best thing is to have plastics that don't biodegrade, that have long lives – that's the whole brilliant point of them – and that get collected and recycled back into new things," says Miodownik. Until compostables are widely collected, encouraging companies to make more packaging recyclable, as well as reducing and reusing where you can, is the best way to make an impact on the future of plastics, he says: "Every time you choose not to buy something because the thing it's wrapped in is not recyclable, you've made a difference."

The Guardian, 7 July 2019

<http://www.guardian.com>

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Here Are 7 Mildly Disturbing Facts You Wish Weren't True But Actually Are

2019-07-11

What is a mildly disturbing fact? It may seem like a perfectly safe thing to ask, but it's a question that's guaranteed to raise some disturbing revelations, some less mild than others. And there's really no shortage of such revelations when that exact question becomes a mega-thread on Reddit (with over 37,000 responses and counting). But which of those mildly disturbing facts are in fact the most mildly disturbing? We thought we'd take a sneak peek and gathered some of our favourite facts below - with evidence to boot.

1. "The farthest point on the planet you can be from civilisation in any direction is a blip in the Pacific Ocean called Point Nemo." This is true - although it's more about distance from 'land', as opposed to 'civilisation'. But that fact doesn't stop things living there, either.
2. "In toddlers, their adult teeth are right underneath their eyes."
Pretty much so. Yikes.
3. "There are over 200 corpses on Mount Everest and they are used as way points for climbers." Scarily true. There's a lot of stuff on Mount Everest that really shouldn't be there; in fact, this dangerous problem is as bad as it's ever been right now.
4. "In France, a pig was dressed in human clothes, tried in court and was sentence[d] to death." This is totally true. Once upon a time, animal trials were a thing. This included not just common pests, but also insects. We're basically in stitches imagining a weevil trial as they've decimated someone's pantry! (They were actually tried for decimating crops.)
5. "Have you ever thought about how whales and dolphins die? When they get too old and weak to swim to the surface to breathe, they start sinking into the cold, dark depths of the ocean, and suffocate." This may be mildly disturbing, but it's all a part of the cycle of life. As these large bags of nutrients sink to the ocean floor, it's a life-giving feast for many, and a much better end than crashing ashore due to human influences.
6. "If you live to become the oldest person alive, the entire human population has been replaced in your lifetime. Except you." Arguably, this goes beyond mildly disturbing. Let's just call it disturbing.

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7. "You're a brain inside of a skull. You don't have a skeleton inside of you; you are inside of a skeleton." Well, yeah... but are you just your brain? Seems a little reductive? In a broader sense, you are you, all of your body, even the nails and hair arguably. But in a mildly disturbing way, yes, this does make the skull seem like a prison for the brain, not just a protective helmet for your most complicated organ.

If you're not mildly disturbed enough yet, there's plenty more mildly disturbing miscellany at the original Reddit thread.

Science Alert, 8 July 2019

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

This Is When You Should Work Out Each Day to Keep The Weight Off, Study Suggests

2019-07-11

Finding time to commit to exercise can be a real challenge, forcing many of us to squeeze in a quick run or gym session whenever there's a spare moment. It might be time to rethink those habits. New evidence suggests if you really want to make the most of your exercise, you should do it at the same time each day. It's a schedule your body will thank you for. A study lead by researchers from Brown Alpert Medical School in the US has shown it really doesn't matter if you're a dawn jogger or a twilight cyclist; it's the consistency that's key if it's weight-loss you're after. The US Department of Health and Human Services suggests two and a half hours of moderate physical activity each week is the least we should be doing to keep healthy. And not just a minute here or there, but at least 10 minutes of heart-pounding exercise in each session. Needless to say, if you're fairly fit and in a good state of health, you're probably meeting this requirement. But many of those who have problems keeping their weight down often struggle to get the exercise they need. Using survey results on the physical activity of 375 individuals exercising for weight loss, the researchers identified a strong relationship between a moderate-to-vigorous level of exercise at the same time of day and the amount of time spent exercising. Roughly half of the volunteers were morning people, which, when taken in context with a previous study by some of the same scientists, could indicate physical activity before you start your day is the way to go. This preference for regularity might all come down to the way we think about our diary. Activities we expect to do at set times – such as picking up the kids, going to work, or attending social meetings – aren't really things we give a great deal of conscious thought to. This mindless repetition is

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referred to as automaticity in psychology circles, and has already been shown to be important when it comes to sticking to an exercise regime. By actively considering how we could slot in quick walk or a treadmill session, we're more likely to cut back minutes of pulse-raising activity rather than commit to the exercise. The secret is to therefore associate exercise with some pre-existing mental 'cue' for an appointment that you won't avoid, reducing the effort required if you had to plan an activity and then motivate yourself to see it through. You might catch the 7:30 train, manage a short cardio workout at the gym near the office, and then be at your desk for that daily 9 am meeting. Or, if you're a night owl, going for a late run the moment you get home. That walk to the train station might be a habit, but it doesn't count. Incidental exercise can be worked into a routine, but only if it's of a kind that makes your heart noticeably pump harder and demands effort. "Repeatedly exercising in the presence of consistent cues, such as at the same time of day or in the same location, may help to establish cue exercise relationships," write the researchers. On its own, a survey such as this can only go so far in demonstrating what causes something as complicated as an exercise habit. Individual motivators can't be dismissed, and more research is needed before any definitive claims can be made. "It will also be important to determine whether there is a specific time of day that is more advantageous for individuals who have initial low physical activity levels to develop a physical activity habit," says the study's first author, Leah Schumacher. Around the globe, just under a third of women and nearly a quarter of all men aren't engaging in a level of physical activity that will keep them on the right side of healthy. The reasons are no doubt complex and varied, and also seem to be linked with how much leisure time we actually have at our disposal. It's hard, especially for busy folks, but getting your 150 minutes a week is important. Pick a time and stick to it. This research was published in *Obesity*.

Science Alert, 6 July 2019

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

Chlamydia may spread through the gut to infect new parts of the body

2019-07-11

Chlamydia may cause rectal infections in some people by spreading through the gastrointestinal tract after oral sex, according to a study of heterosexual men. Past research has found that some women contract rectal chlamydia without ever engaging in anal sex, and it has been thought that the infection may have passed from the vagina to the

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rectum. To distinguish the pathways this sexually transmitted infection can take, David Nelson at Indiana University in Bloomington and his colleagues studied chlamydia in men at risk for the infection. "One of the main reasons we looked in heterosexual men was to reduce the possibility of auto-inoculation which seems more likely in women," says Nelson. The team analysed rectal swabs from 197 men with a median age of 28, and each man completed a questionnaire on their sexual history and health. There were 135 men who identified as heterosexual in the study. Of these, 84 said they had performed cunnilingus in their lifetime and but had not engaged in other sexual acts that could expose the rectum to the infection, such as anal sex. Out of these 84 men, two tested positive for rectal chlamydia. This suggests that the infection may have entered their body through the mouth, given that their only exposure was the urethra and the oral cavity, Nelson says. Previous work has shown that chlamydia can survive the low pH levels common in the gastrointestinal tract, and chlamydia DNA has been detected in the appendix and colon, which supports the idea that the infection may be passed through oral sex.

New Scientist, 9 July 2019

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

Social stress linked to bone density loss in postmenopausal women

2019-07-11

Social stress may release hormones that affect bone loss, a finding that might be linked to the higher incidence of bone fractures after the menopause. In a study of more than 8000 women aged 50 to 79, researchers found that those who reported higher levels of social stress – defined as strained relationships or stress related to social ties – were also at higher risk of bone fractures. The team, led by Shawna Follis at the University of Arizona in Tucson, used data from the Women's Health Initiative that collected survey responses from clinical trials and observational studies of postmenopausal women in the US between 1993 and 1998. Using standard psychological measures, the women were asked about their social support and psychological strain. The participants also had their bone density measured in their lower spine and hip at the beginning of the studies and six years later. Women who reported high social strain and poorer quality relationships – and therefore, higher levels of stress – were found to have a larger decline in their bone density measurements over these years. After adjusting for age, race, education, and other life style effects such as smoking and hormone therapy use, the

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team found that for each point of higher social strain as measured by the questionnaires, there was an associated increase of about 0.08 per cent loss of bone mineral density at the femoral neck – a portion of the hip. They also saw about 0.1 per cent greater loss across the whole hip, and about 0.7 per cent greater loss at the lower spine. Previous research found that higher levels of stress hormones such as cortisol were associated with lower bone mineral density in the spine, and the team suggests that social stress may increase fracture risk by altering bone-regulating hormones. Postmenopausal women may be more likely to experience social stress than their male peers. “There is research showing that social stress is higher in aging women than in men and this may be attributed to women being more likely to be caregivers in older age,” says Follis. The team found that women with low social strain tended to be more educated and more physically active than those with high social strain. Black, Latina, and Native American women were more likely to report high social strain than White and Asian women. However, the data did not include a questionnaire on social stress at the end of the six-year study period, so stress levels in these women may have changed over time.

New Scientist, 9 July 2019

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

Weightlifting better at reducing heart fat than aerobic exercise

2019-07-11

Obese people who engaged in resistance training were more likely to see reductions in a type of heart fat that has been linked to cardiovascular disease, a new study finds. In the small study, researchers determined that a certain type of heart fat, pericardial adipose tissue, was reduced in patients who did weight lifting, but not in those who worked on increasing their endurance with aerobic exercise, according to a report published in *JAMA Cardiology*. Both forms of exercise resulted in the reduction of a second type of heart fat, epicardial adipose tissue, which has also been linked with heart disease. “We were surprised by this finding,” said the study’s lead author, Dr. Regitse Hojgaard Christensen, a researcher at the Centre of Inflammation and Metabolism and the Centre for Physical Activity Research at the Copenhagen University Hospital. While the study doesn’t explain why weight training would have a different effect from endurance training, “we know from other studies that resistance training is a stronger stimulus for increased muscle mass and increased basal metabolism compared to endurance training and

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we therefore speculate that participants doing resistance training burn more calories during the day - also in inactive periods-compared to those engaged in endurance training," Christensen said in an email. To explore the impact of different types of exercise on heart fat, Christensen and her colleagues recruited 32 adults who were obese and sedentary but did not yet have heart disease, diabetes, or atrial fibrillation. The participants were randomly assigned to a three-month program of aerobic exercise, weight training or no change in activity (the control group). Each person had an MRI scan of the heart done at the beginning of the study and at the end. Both types of exercise training reduced epicardial adipose tissue mass compared to no exercise: endurance training, by 32% and weight training, by 24%. However, only weight training had an impact on pericardial adipose tissue, which was reduced by 31% compared to no exercise. "The resistance exercise training in this study was designed as a 45-minute interval type, medium load, high-repetition, time-based training," Christensen said. "Participants performed three to five sets of 10 exercises and the sessions were supervised. This specific exercise intervention alone was effective in reducing both fat depots of the heart. We did not combine resistance and endurance training, which would have been interesting to reveal their potential additive effects." While there are plenty of studies looking at the impact of reducing abdominal obesity, the new study is interesting because it looks specifically at the relation between exercise and fat (around the heart)," said Dr. Chadi Alraeis, a staff interventional cardiologist and director of Interventional Cardiology at Detroit Medical Centre's Heart Hospital. Alraeis suspects, based on the new study, that the best way to combat heart fat is to do both endurance and weight training. "Along with the time you spend on the treadmill, you might want to add some work with dumbbells, or some lunges, sit-ups or push-ups," Alraeis said. "It might even be enough to bring some weights to the office so you can use them there." While the findings are interesting, "we don't know what the implication of this is 10 years later," Alraeis said. "We don't know if outcomes are really being changed. We need some long-term studies to look at that."

Reuters Health, 6 July 2019

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

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Sydney's city council reviews use of Bayer's Roundup weed killer amid cancer fears

2019-07-11

Recently, Sydney's city council said it was reviewing its weed management, which included the use of Bayer AG's Roundup, after other councils in Australia began cutting ties with the product amid concerns about possible links to cancer. The council, which covers the city's business centre, was "reviewing (its) weed management methods and investigating other technologies", a spokeswoman told Reuters in an email, a day after a strike by workers at a nearby council pressured it into trialling an alternative weedkiller. The City of Sydney council currently used Roundup "as a last resort ... when non-pesticide methods such as hand-weeding and mulching have been ineffective", and began testing alternative products in late 2018, the spokeswoman added. Bayer says Roundup is safe and backed by several regulatory bodies, despite research that found its main ingredient glyphosate was probably carcinogenic. The German company has been hit by massive compensation payouts in the United States this year, over claims its product caused cancer, which have seen its share price to plummet. The prospect of Sydney council rethinking its ties to Roundup, a flagship product of U.S. agribusiness giant Monsanto Co until a buyout from Bayer last year, shows the pressure that grassroots campaigns and lawsuits are putting on governments about the product even as regulators declare it safe. "Because there's a lot of emotion around it, local agencies may be moved to make a decision that's made based on placating the general public rather than the available science," said Ian Musgrave, a molecular pharmacologist and toxicologist at University of Adelaide. "We should be making decisions on safety based on actual science, not based on our fear or dismay of megacorporations." Earlier this week, Blacktown City Council in Sydney's west agreed to trial an alternative to Roundup after a worker strike over the product left 40,000 garbage bins unemptied. Another four councils around Sydney previously quit using Roundup over possible links to cancer. Last month, an Australian gardener filed the country's first lawsuit against Bayer, accusing Monsanto of causing him harm from exposure to glyphosate via decades of using Roundup. A Bayer spokesman said the company "encourages constructive dialogue with our stakeholders to build a broader trust in science". The company had published "extensive research which supports our products' safety" and

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was “committed to ensuring our customers continue to have access to these critical products as part of their sustainable agricultural activities”.

Reuters Health, 5 July 2019

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

‘Hunger hormone’ enhances memory

2019-07-11

A team of neuroscience researchers at the University of Southern California have identified a surprising new role for the “hunger hormone” ghrelin. Ghrelin has previously been recognized for its unique role in sending hunger signals from the gut to the brain, but, as presented this week at the annual meeting of the Society for the Study of Ingestive Behavior, these new findings suggest that it may also be important for memory control. Ghrelin is produced in the stomach and secreted in anticipation of eating, and is known for its role to increase hunger. “For example, ghrelin levels would be high if you were at a restaurant, looking forward to a delicious dinner that was going to be served shortly,” said Dr. Elizabeth Davis, lead author on the study. Once it is secreted, ghrelin binds to specialized receptors on the vagus nerve -- a nerve that communicates a variety of signals from the gut to the brain. “We recently discovered that in addition to influencing the amount of food consumed during a meal, the vagus nerve also influences memory function,” said Dr. Scott Kanoski, senior author of the study. The team hypothesized that ghrelin is a key molecule that helps the vagus nerve promote memory. Using an approach called RNA interference to reduce the amount of ghrelin receptor, the researchers blocked ghrelin signalling in the vagus nerve of laboratory rats. When given a series of memory tasks, animals with reduced vagal ghrelin signalling were impaired in a test of episodic memory, a type of memory that involves remembering what, when, and where something occurred, such as recalling your first day of school. For the rats, this required remembering a specific object in a specific location. The team also investigated whether vagal ghrelin signalling influences feeding behaviour. They found that when the vagus nerve could not receive the ghrelin signal, the animals ate more frequently, yet consumed smaller amounts at each meal. Dr. Davis thinks these results may be related to the episodic memory problems. “Deciding to eat or not to eat is influenced by the memory of the previous meal,” says Davis. “Ghrelin signalling to the vagus nerve may be a shared molecular link between remembering a past meal and the hunger signals that are generated in anticipation of the next meal.” These novel findings add to our understanding of how episodic

Neuroscience researchers have identified a surprising new role for the ‘hunger hormone’ ghrelin.

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memories are generated, as well as the relationship between memory and eating behaviour. In the future, researchers may be able to develop strategies for improving memory capacity in humans by manipulating ghrelin signalling from the gut to the brain.

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<http://www.sciencedaily.com>

New antibacterial fillings may combat recurring tooth decay

2019-07-11

Tooth decay is among the costliest and most widespread bacterial diseases. Virulent bacteria cause the acidification of tooth enamel and dentin, which, in turn, causes secondary tooth decay. A new study by Tel Aviv University researchers finds potent antibacterial capabilities in novel dental restoratives, or filling materials. According to the research, the resin-based composites, with the addition of antibacterial nano-assemblies, can hinder bacterial growth and viability on dental restorations, the main cause of recurrent cavities, which can eventually lead to root canal treatment and tooth extractions. Research for the study was led by Dr. Lihi Adler-Abramovich and TAU doctoral student Lee Schnaider in collaboration with Prof. Ehud Gazit, Prof. Rafi Pilo, Prof. Tamar Brosh, Dr. Rachel Sarig and colleagues from TAU's Maurice and Gabriela Goldschleger School of Dental Medicine and George S. Wise Faculty of Life Sciences. It was published in ACS Applied Materials & Interfaces on May 28. "Antibiotic resistance is now one of the most pressing healthcare problems facing society, and the development of novel antimicrobial therapeutics and biomedical materials represents an urgent unmet need," says Dr. Adler-Abramovich. "When bacteria accumulate on the tooth surface, they ultimately dissolve the hard tissues of the teeth. Recurrent cavities -- also known as secondary tooth decay -- at the margins of dental restorations results from acid production by cavity-causing bacteria that reside in the restoration-tooth interface." This disease is a major causative factor for dental restorative material failure and affects an estimated 100 million patients a year, at an estimated cost of over \$30 billion. Historically, amalgam fillings composed of metal alloys were used for dental restorations and had some antibacterial effect. But due to the alloys' bold colour, the potential toxicity of mercury and the lack of adhesion to the tooth, new restorative materials based on composite resins became the preferable choice of treatment. Unfortunately, the lack of an antimicrobial property remained a major drawback to their use. "We've developed an

Novel material may prevent one of the costliest and most prevalent bacterial diseases in the world

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enhanced material that is not only aesthetically pleasing and mechanically rigid but is also intrinsically antibacterial due to the incorporation of antibacterial nano-assemblies," Schnaider says. "Resin composite fillings that display bacterial inhibitory activity have the potential to substantially hinder the development of this widespread oral disease." The scientists are the first to discover the potent antibacterial activity of the self-assembling building block Fmoc-pentafluoro-L-phenylalanine, which comprises both functional and structural subparts. Once the researchers established the antibacterial capabilities of this building block, they developed methods for incorporating the nano-assemblies within dental composite restoratives. Finally, they evaluated the antibacterial capabilities of composite restoratives incorporated with nanostructures as well as their biocompatibility, mechanical strength and optical properties. "This work is a good example of the ways in which biophysical nanoscale characteristics affect the development of an enhanced biomedical material on a much larger scale," Schnaider says. "The minimal nature of the antibacterial building block, along with its high purity, low cost, ease of embedment within resin-based materials and biocompatibility, allows for the easy scale-up of this approach toward the development of clinically available enhanced antibacterial resin composite restoratives," Dr. Adler-Abramovich says. The researchers are now evaluating the antibacterial capabilities of additional minimal self-assembling building blocks and developing methods for their incorporation into various biomedical materials, such as wound dressings and tissue scaffolds.

Science Daily, 9 July 2019

<http://www.sciencedaily.com>

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Central hemodynamics in relation to blood lead in young men prior to chronic occupational exposure

PUBLIC HEALTH RESEARCH

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