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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

Australia Delays Implementation of Industrial Chemical Law

2019-02-15

Australia's newest Industrial Chemical Law was initially scheduled to be implemented on 1 July 2019. However, due to Senate delays, debates have yet to be held regarding the new legislation, which is now expected to come into force 1 July 2020. This new law, which includes six bills would replace the current chemical agency NICNAS with the Australian Industrial Chemicals Introduction Scheme (AICIS). Additionally, the ban on cosmetic testing on animals which is part of the new law has also been postponed. Moreover, once this law has passed, the government intends to implement the following portions of the legislation as soon as possible:

- Remove annual reporting requirements for lower risk chemicals to help reduce regulatory burden
- Reform the definition and regulatory treatment of polymers

Nexreg, 29 January 2019

<http://www.nexreg.com>

You may be an officer and have an important duty under WHS laws

2019-02-15

Safe Work Australia has released guidance material to help small business owners or operators understand their role as officers and their responsibilities under WHS laws. "If you make or influence the significant financial or operational decisions for a business then you may be an 'officer' under WHS laws", said Safe Work Australia's CEO Michelle Baxter.

"As an officer, you have a duty under WHS laws to look for ways to lead on WHS matters." "Our new guidance material includes videos of real officers explaining how they fulfil this important role within their business" said Ms Baxter. Safe Work Australia produced the guidance material after investigations found that small businesses needed more practical guidance about their WHS obligations. The guidance material, including

Australia's newest Industrial Chemical Law was initially scheduled to be implemented on 1 July 2019.

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short videos, is available on a dedicated [web page for officers](#). A broader guide for officers of businesses of all sizes is also available.

Safe Work Australia, 29 January 2019

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

Consultation: Whether the TGA should publish that a prescription medicine is under evaluation

2019-02-15

On 15 February, the Therapeutic Goods Administration (TGA) published a document seeking comments from interested parties on whether or not the TGA should in future disclose earlier that a prescription medicine is under evaluation and what types of prescription medicines should be published. Interested parties should respond by close of business 29 March 2019. Feedback will be released following consideration of submissions.

About the consultation

Are you a patient, consumer group, healthcare provider, industry representative body, company, researcher or other interested party? TGA are seeking your views, including reasons in support or concerns, on four options for the point in time in the evaluation of an application for a registration of a prescription medicine that the TGA should publish the fact that evaluation is taking place and the types of prescription medicine applications that should be published.

Medicines that are considered in scope for this consultation are prescription medicines that are lodged as applications for:

- New medicines (new chemical entities, new biological prescription medicines, new fixed dose combinations).
- New uses for medicines (extension of indications).
- Generic or biosimilar medicines.

This paper reflects an increasing commitment to transparency by government agencies. There has been increased demand from the public for knowledge of a potential marketing approval for medicines. The TGA anticipates that this interest will continue to grow. The TGA currently does not release information about the acceptance of an application for prescription medicine evaluation, nor about the ongoing evaluation of applications unless this information is already publicly available. Information about the status of an application for registration

On 15 February, the Therapeutic Goods Administration (TGA) published a document seeking comments from interested parties on whether or not the TGA should in future disclose earlier that a prescription medicine is under evaluation and what types of prescription medicines should be published.

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of a medicine is of commercial value to sponsors, in particular when a pharmaceutical patent exists. Pharmaceutical patents include patents for claims with active ingredients, new formulations and methods of production or use.

Further information is available at: [Consultation: Whether the TGA should publish that a prescription medicine is under evaluation \(pdf,240kb\)](#)

TGA, 15 February 2019

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

EPA welcomes Consumer guide to domestic chemical disposal

2019-02-15

A new guide to help protect New Zealanders from hazardous domestic chemicals has been released by Consumer New Zealand, with the support of the Environmental Protection Authority (EPA). Chief Executive Dr Allan Freeth says: "Kiwis have been asking us how they should dispose of old and unwanted home and garden chemicals. It's among the most commonly-asked questions from visitors to our Safer Homes regional events. "Almost everyone has unwanted or leftover chemicals in sheds and garages across New Zealand. Left to accumulate they can pose a risk to children, pets and the environment if they're not disposed of safely." The new Consumer guide will help New Zealanders find out how to dispose of this stuff safely, in the approved facility in their area," says Dr Freeth. The guide is based on a survey of Consumer New Zealand members and city and district councils. It includes information on chemical storage, banned pesticides, and a district guide to disposal facilities around New Zealand. Consumer New Zealand's research and production of the guide was funded by the EPA and is freely available to all New Zealanders through [Consumer New Zealand's website](#).

For more tips and information on using and storing chemicals safely around your home, visit our [Safer Homes Facebook page](#) or [EPA website](#).

NZ EPA, 1 February 2019

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

A new guide to help protect New Zealanders from hazardous domestic chemicals has been released by Consumer New Zealand, with the support of the Environmental Protection Authority (EPA).

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Taiwan Consults on Coatings VOC Management

2019-02-15

On 19 January 2019, Taiwan's Environmental Protection Administration Executive Yuan (EPA) released the *Draft Volatile Organic Compound Content Limits for Architectural Coatings and Industrial Maintenance Coatings* for public consultation. The consultation will end on 20 March 2019.

VOC limits for architectural coatings and industrial maintenance coatings manufactured, imported or sold in Taiwan territory are stipulated below:

Category			VOC Content Limit (g/L)	Included Items
A	Coating for interior wall and ceiling (Gloss at 60 angle ≤ 25)	Water-base	100	CNS4940 water-based cement coating (emulsion coating)
		Solvent-base	100	
B	Gloss coating for interior wall and ceiling (Gloss at 60 angle > 25)	Water-base	100	
		Solvent-base	100	
C1	Exterior wall coating	Water-base	100	CNS8144 solvent based cement coating, CNS14463 white cement lime coating, CNS12143 acrylic varnish
C2	Non-transparent exterior wall coating	Solvent-base	400	
C3	Transparent exterior wall coatings	Solvent-base	600	

On 19 January 2019, Taiwan's Environmental Protection Administration Executive Yuan (EPA) released the Draft Volatile Organic Compound Content Limits for Architectural Coatings and Industrial Maintenance Coatings for public consultation.

Manufacturers/importers of designated coating products shall have the following items prominently marked on product SDS, catalogue, packaging or container:

- Manufacturer or importer
- Coating category: All relevant categories shall be marked if the coating meets one or more categories
- Brand and complete product name

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- Volume or weight
- Date of manufacture
- VOC content: g-VOC/L-coating

In the situation of using diluter to adjust the viscosity, it is required to mark the brand of the diluter, complete name, proportion and the dilution rate of the diluter

Upon the official release of this standard:

- 2 years grace period will be given for manufacturing or importing products conforming to standard
- 3 years grace period will be given for existing products

Further information is available at: [Taiwan Executive Yuan Gazette Online](#)

Chemlinked, 14 February 2019

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

AMERICA

House Democrats Back Bill to Significantly Expand OSHA's Coverage

2019-02-15

On 7 February, United States Rep. Joe Courtney, a Connecticut Democrat and a member of the House Education and Labor Committee, reintroduced the Protecting America's Workers Act. Courtney was joined by Rep. Bobby Scott, D-Va., chairman of the committee and Rep. Alma Adams, D-N.C., chairwoman of the Subcommittee on Workforce Protections. The bill would expand OSHA coverage to state and local government employees in 25 states and expand it to include federal employees. "Nine years ago, there was a devastating explosion at the Kleen Energy plant, which was under construction in Middletown, Connecticut," Courtney said. "The explosion took the lives of six workers – including that of my friend, Ronald Crabb of Colchester, Connecticut – and injured dozens more. Today, on the ninth anniversary of the accident, it's appropriate that my colleagues and I reintroduce this legislation to make critical, decades-overdue updates to OSHA. Every day, 14 employees go to work and never come home to their families due to fatal on-the-job injuries. The OSH Act made great strides in protecting American workers, but since it was enacted the American workplace has modernized and

The proposed Protecting America's Workers Act would expand OSHA coverage to state and local government employees in 25 states and expand it to include federal employees.

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diversified. The law should keep up with the realities that workers face on the job today. Our bill is focused on updates and compliance, not on petty, punitive measures against employers and will ensure that today's workforce is empowered and protected by our nation's chief worker safety law." In August 2010, OSHA cited three construction companies and 14 site contractors for 371 alleged workplace safety violations and proposed \$16.6 million in penalties after investigating the natural gas explosion at the Kleen Energy Systems LLC power plant construction site in Middletown. In September 2011, answering a recommendation from the U.S. Chemical Safety Board, the National Fire Protection Association released NFPA 56, Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems, which prohibits using a flammable gas as a cleaning agent to clean out pipes. The explosion had been caused by this type of "gas purging." "The Protecting America's Workers Act makes long overdue improvements to [the] Occupational Safety and Health Act by providing coverage to millions of workers who have been excluded from the law's protections," Scott said. "The legislation bolsters remedies for workers who face retaliation for reporting unsafe work and ensures that there are adequate deterrents for employers who may be tempted to cut corners and put profits ahead of safety. Strengthening our nation's workplace safety laws helps ensure that every worker can return home safe and healthy at the end of every shift." Adams expressed her full support for the bill, saying, "For too long, employers in some of our most dangerous occupations have been able to cut corners and not face true accountability for keeping safe and healthy work spaces. The Protecting America's Workers Act would change this dynamic, improving crucial recordkeeping, increasing monetary penalties for unscrupulous employers, and putting American workers first."

According to the committee's news release, the bill would:

- Require employers to correct hazardous conditions while a citation for a serious, wilful, or repeat violation is being contested;
- Update consensus standards that were incorporated by reference when the OSH Act was passed in 1970;
- Deter high-gravity violations by providing authority for increased civil penalties for wilful and serious violations that cause death or serious bodily injury;
- Require employers to report injury and illness records to OSHA to provide the agency with data to effectively target unsafe workplaces;

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- Authorise felony penalties against employers who knowingly commit OSHA violations that result in death or serious bodily injury and extend such penalties to corporate officers and directors;
- Require OSHA to investigate all cases of death and serious injuries that occur within a place of employment;
- Establish rights for families of workers who are killed on the job by giving families the right to meet with OSHA investigators, receive copies of citations, and to have an opportunity to make a statement before any settlement negotiations;
- Improve protections for workers in state plan states by allowing the secretary of Labor to assert concurrent enforcement authority in those states where the plan fails to meeting minimum requirements needed to protect workers' safety and health, as recommended by a Government Accountability Office report.

Occupational Health & Safety News, 15 February 2019

<http://www.ohsonline.com>

EPA Releases PFAS Action Plan

2019-02-15

The United States Environmental Protection Agency has released its much anticipated PFAS Action Plan, originally slated for release last fall. EPA Acting Administrator Andrew Wheeler held a webcast press conference on 14 February 2019, to announce the elements of EPA's plan. States, individuals and the regulated community have been awaiting this plan and for EPA to formally announce its nationwide action plan to address PFAS. The main elements of EPA's PFAS Action Plan include:

Maximum Contaminant Level (MCL)

EPA is moving forward with the regulatory process for evaluating MCLs under the Safe Drinking Water Act for PFOA and PFOS, two chemicals in the PFAS family for which EPA has already set lifetime health advisory levels. It is also gathering information to determine if additional PFAS compounds should also be regulated.

Unregulated Contaminant Monitoring Rule (UCMR)

EPA will include PFAS in the next UCMR monitoring cycle, slated for pre-proposal input in 2019 and a proposed rule in 2020. While EPA collected data for six PFAS compounds under the UCMR conducted between 2013 and 2015, EPA did not state which or how many PFAS chemicals would be

The United States Environmental Protection Agency has released its much anticipated PFAS Action Plan, originally slated for release last fall.

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included or which analytical method would be used in this next UCMR. EPA uses the UCMR to collect data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act.

Hazardous Substance

EPA is pursuing designating PFOA and PFOS as hazardous substances under CERCLA, which opens up the CERCLA statutory pathway for clean-up cost recovery.

Clean-up Levels

In addition to designation as CERCLA hazardous substances, EPA said it will develop interim groundwater clean-up recommendations for use at sites being addressed under CERCLA and at federal-led RCRA corrective action sites.

Toxic Release Inventory (TRI)

EPA is considering adding PFAS chemicals to the TRI reporting requirements.

Toxic Substances Control Act (TSCA)

EPA will use its authority under TSCA's New Chemicals Program to evaluate new uses of PFAS, including following up on its 2015 Significant New Use Rulemaking for certain long-chain PFAS.

Closing Data Gaps

EPA will also continue research into three main areas, including human health and ecological effects, fate and transport, and remediation technology.

Continued Enforcement

EPA said it will continue to enforce clean-ups using the current health advisory limit of 70 ppt for PFOA plus PFOS and it will continue to support state enforcement actions.

Risk Communication

EPA is developing a "risk communication toolbox" that government partners can use with the public.

EPA's plan also includes a summary of 23 main concerns or challenges it received from stakeholder input and the EPA actions and timeframes to

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address each. Though this summary outlines the steps EPA is taking to get to some sort of regulatory endpoint and address concerns and challenges, it does not provide those regulatory requirements today or even in the next few months. The fractured and uncertain regulatory environment of different standards in different states will continue. While EPA's announcement and release of its PFAS action plan help fill in some of the regulatory landscape regarding PFAS, they also leave states and regulated parties a bit in the dark regarding immediate action plans to address PFAS contamination. Hence, these issues will continue to be addressed on a site-by-site basis and state-by-state basis.

National Law Review, 14 February 2019

<http://www.natlawreview.com>

Thermal Fatigue Probable Cause of Enterprise Products Explosion: CSB

2019-02-15

The United States Chemical Safety Board released its final report on the 27 June 2016, explosion and fire at the Enterprise Products Pascagoula Gas Plant in Pascagoula, Miss., with the board finding the probable cause was thermal fatigue in a brazed aluminium heat exchanger (BAHX). The board issued recommendations to two trade associations and local emergency responders in the report. The explosion occurred when a major loss of containment in a heat exchanger releases methane, ethane, propane, and several other hydrocarbons that ignited, causing a series of fires and explosions. The site was shut down for almost six months afterward, CSB reported. "More than 500 gas processing facilities operate across the country, and the use of similar heat exchangers is common," said CSB Interim Executive Kristen Kulinowski. "Extending the life cycle of equipment at these facilities requires more robust inspection protocols. Operators shouldn't take the risk of waiting to find a leak because, as this case demonstrates, that leak could result in a catastrophic failure." The recommendations to the American Petroleum Institute and the GPA Midstream Association ask both of them to include information on the potential for minor leaks and catastrophic failure of brazed aluminium heat exchangers in a BAHX standard and a technical bulletin, respectively. The board recommended that the GPA Midstream Association develop a database for operators to submit BAHX operational data for collaborative industry learning and analysis. According to the safety board, the Enterprise Plant receives raw natural gas via a pipeline from the Gulf of Mexico and separates the material into two products: natural gas liquids,

The United States Chemical Safety Board released its final report on the 27 June 2016, explosion and fire at the Enterprise Products Pascagoula Gas Plant in Pascagoula, Miss., with the board finding the probable cause was thermal fatigue in a brazed aluminium heat exchanger (BAHX).

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which serve as a feedstock to the chemical industry, and a natural gas fuel stream, primarily composed of methane. A key piece of equipment used in the process is the brazed aluminium heat exchanger, which allows for the transfer of heat between two different process streams while keeping the streams separate. CSB's investigation determined the heat exchanger failed due to thermal fatigue, and its report details how thermal fatigue occurs between aluminium parts of a BAHX. "As the exchanger is heated or cooled, the tightly connected parts expand or contract. If the parts change temperatures at sufficiently different rates, the expansion and contraction can be disproportionate. Over time, this process weakens the metal, and ultimately causes cracks, which can lead to the escape of hydrocarbons. Typically, when a leak is found, it can be repaired with minimal expense or consequence before a major loss of containment occurs. Assuming that leaks will be discovered and can be repaired prior to a catastrophic failure is referred to as a "leak-before failure" assumption. Thermal fatigue is a known factor to BAHXs, and there is industry guidance on recommended limits for maximum cyclic temperature fluctuations during operation and rates of cooling or heating during start-up and shutdown. However, the CSB found this guidance was not robust for the diverse operations and environments where BAHXs operate," according to the board's release about the report. It noted that at the Enterprise plant, process data for the exchangers show its BAHXs were repeatedly subjected to temperature changes that exceeded industry-recommended practices, and over a 17-year period, four different BAHX heat exchangers at the plant were repaired nine times. This incident and four other BAHX failure events at other facilities "illustrate that relying on a leak-before-failure assumption is not adequate," CSB pointed out. "Operators of midstream gas plants need a more robust assessment and risk management plan that considers thermal fatigue to prevent the risk of sudden and catastrophic rupture of BAHX." "A number of midstream gas plant operators have reported that the limits and rates in existing industry guidance may not be realistic. Our report encourages a meaningful dialogue among BAHX manufacturers, gas processors, and repair technicians. The CSB concluded that more realistic and updated guidance is needed to improve the safe use of BAHX," said CSB Investigator William Hougland. The board's recommendation to the Jackson County Local Emergency Planning Committee asked that its members work to explicitly define the methods for communication updates (such as using social media, local news outlets, etc.) to ensure members of the public can get current safety information -- it recommends developing a more robust and engaged community alert network, one that includes social media and the ability to expand opportunities to interact with the community throughout an

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incident. The board also released on Feb. 13 an interactive 3D model of the heat exchanger used at the Enterprise Plant to enhance understanding of how this type of heat exchanger operates and its vulnerability to thermal fatigue.

Occupational Health & Safety News, 13 February 2019

<http://www.ohsonline.com>

EUROPE

Occupational exposure limit web pages published

2019-02-15

The European Chemicals Agency have launched a new web section on the occupational exposure limit (OEL) assessment work carried out by the Agency under the Chemical Agents Directive (CAD) and the Carcinogens and Mutagens Directive (CMD). The web pages provide background information on the relevant legislation, and outline the steps, actors and timelines in the preparation of opinions on OEL values. An activity list will be added later, which will provide an up-to-date overview of planned, ongoing and completed OEL activities, including calls for evidence, public consultations and the adoption of final opinions by the Committee for Risk Assessment. The pages are introduced in the CAD/CMD section under the revamped 'Legislation' tab, which lists all pieces of legislation currently implemented by ECHA. Further information is available at: [OEL web pages](#)

ECHA News, 13 February 2019

<http://echa.europa.eu>

Key Developments in UK and EU Environment, Safety and Health Law, Procedure and Policy

2019-02-15

The Environment Bill is published, setting out post-Brexit environmental governance. The most discussed aspects of the Bill are the environmental principles and the establishment of the Office for Environmental Protection (OEP). The principles will apply in place of the EU treaty principles after Brexit. The Bill requires a policy statement to be prepared explaining how the principles will be interpreted and proportionately applied. The statement "may" also explain how ministers are to take into account other considerations when applying the environmental principles.

The European Chemicals Agency have launched a new web section on the occupational exposure limit (OEL) assessment work carried out by the Agency under the Chemical Agents Directive (CAD) and the Carcinogens and Mutagens Directive (CMD).

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The policy statement will be consulted on, and ministers will be required to have regard to it when making relevant policy decisions (and it seems that a wide range of policy areas, such as tax, spending and allocation resources, will not be relevant types of policy decision). This seems to be a low threshold to meet and these principles will potentially have a much lower impact than the equivalent EU ones which are more overarching and must be met. The OEP will have powers to give an “information notice” to a public authority that it suspects has seriously failed to comply with environmental law and to give a “decision notice” where it is satisfied that there is such a failure, setting out steps to be taken. The OEP can also judicially review the conduct described in the decision notice. There has been widespread criticism of the Bill and many commentators feel the new principles and “watchdog” are not robust and effective enough.

Defra publishes its long-awaited Resources and Waste Strategy for England.

This was announced in the 25-year plan in early 2018. Key areas covered by the strategy are further extending producer responsibility to make producers pay the full costs of disposal and to cover more products; strengthening the circular economy by supporting and removing obstacles from re-manufacturing, re-use, and recycling; and cracking down on waste crime. The strategy also refers to tackling and improving household recycling systems and the introduction of a deposit-return scheme for drinks containers by 2023. Defra also recently published additional statutory guidance on applying the waste hierarchy to food and drink surplus and waste, to help businesses to appropriately deal with this waste stream, and is consulting on extending the plastic bag tax to all retailers and increasing it from 5p to 10p.

Environment Agency (EA) consulting on how it should consult!

The EA is consulting on how it should consult with the public on environmental permitting applications, particularly where the application is sensitive and attracts significant interest. It has issued a draft updated public participation statement explaining when and how the EA consults on permit applications and on changes to standard permit rules. The consultation is open until 1 March 2019.

Defra has issued its Clean Air Strategy

The strategy is intended to lead to a stronger framework of legislation regarding action on air pollution, including new long-term targets on

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reducing exposure to fine particulate matter, and new powers to control air pollution sources.

EA publishes guidance on assessing environmental permitting compliance

EA has responded to last year's consultation changes to permit compliance scoring. The guidance describes how the EA assesses and scores environmental permit compliance and what happens during and after a compliance assessment, and is relevant to companies with waste operation or installation permits, as well as radioactive substance permits. This forms part of the EA's move to more performance-based regulation of sites with environmental permits, replacing the current risk-based operator risk appraisal (Opra) system.

Government consults on modernising water regulation in England

This includes proposals to reform abstraction licensing to make it clearer when the EA can amend licences, giving a statutory footing to water companies' drainage and wastewater plans and changing the process for amending water companies' licence conditions. The consultation is likely to be of particular interest to companies with abstraction licences and is open until 12 March 2019.

Natural Resources Wales (NRW) has prohibited the use of two fuel pipelines

from a refinery after a series of pollution incidents have impacted the Milford Haven estuary in recent months. The enforcement notice requires both pipelines to remain closed until NRW is satisfied that there will be no further discharges.

EA has issued a rare notice of liability under the Environmental Damage (Prevention and Remediation) (England) Regulations 2015

This is only the second one to have been issued under these Regulations, which implement the EU Environmental Liability Directive. It requires Omex Agriculture Limited to provide proposals to repair environmental damage after polluting a river with ammonia. Once proposals are received, the EA will consult and issue a remediation notice setting out work to be done and time periods. In parallel, the EA is investigating the pollution as a potential breach of the Environmental Permitting Regulations.

Case on the meaning of "trade effluent"

Boots has lost an appeal seeking to claim back payments to Severn Trent Water for the disposal of trade effluent, on the basis that it was being

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charged for surface water run-off that had mixed with the trade effluent before being metered. Boots argued that surface water was not trade effluent and it should only be charged for the volume of process effluent. The court held that because the statutory definition of trade effluent refers to liquid that is “wholly or partly produced in the course of any trade or industry”, Boots could be charged for the mixed discharge that arose on its premises. One interesting implication of this judgment is that it potentially allows a business to dilute its process effluent in order to meet sewer discharge consent limits, and water undertakers do not always approve of this.

A number of key Brexit-related regulations have been issued

These include the SI to convert the REACH Regulation into UK law and make transitional arrangements for UK chemical registrations and the SI on waste shipments. The House of Lords has recommended that the waste shipments draft regulation is individually considered by parliament because of concerns about the UK's continued ability to export waste to EU countries after Brexit. The HSE has also issued updated guidance on chemical regulation in the event of a no-deal Brexit.

Plastic converters deem EU goal for recycled plastic material (rPM) unrealistic

The European association of plastic converters (EuPC) announced the results of its second survey on the use of rPM. Its main conclusions include that an uptake of 10 Mt of rPM by 2025, as envisaged by the EU's Plastics Strategy, is practically impossible under current conditions. Of the 10 different plastic materials included in the survey, the majority of respondents only have sufficient supply of two of them. The results come just ahead of the first meeting of the Circular Plastics Alliance, a new EU industry forum launched in December.

EU Council to launch fitness check of endocrine disruptor legislation in the coming months

During a contentious exchange of views with the European Parliament (EP) Committee on Environment, Public Health and Food Safety (ENVI), MEPs criticised the EU Council's (EC) strategy communication “Towards a comprehensive European Union framework on endocrine disruptors”, adopted in November, as insufficient. EC officials said that the EC will launch a cross-cutting evaluation (REFIT) on endocrine disruptors legislation, as there are currently different approaches in different policy areas how to tackle this issue.

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EC shelves non-toxic environment strategy

According to multiple reports, the EC will fail to develop a non-toxic environment strategy (NTE). Whilst the EC would continue work on it, it will be left for the next EC to decide on the form (e.g. communication or staff working document) and timetable for the NTE, as well as any policy options how to address gaps and challenges of the EU legislation. The next EC is not expected to (re-) start working on the NTE before 2020. The 7th Environment Action Programme, adopted in 2013, mandated the EC to develop the strategy by 2018.

EP demands changes to pesticide approval rules

The EP plenary adopted a resolution prepared by the "PEST committee" formed after the approval of Glyphosate. It calls for more transparency and reduced industry influence. It also says the EC's scientific advisers should "initiate a systematic review of all available studies concerning the carcinogenicity of glyphosate and glyphosate-based formulations to assess whether it would be justified to review the approval of glyphosate." A total of 526 MEPs voted in favour of the non-binding resolution, while 66 voted against it.

National Law Review, 13 February 2019

<http://www.natlawreview.com>

Carcinogens or mutagens at work Directive Annex III amended

2019-02-15

Annex III of the Carcinogens or mutagens at work Directive 2004/37/EC has been amended as per Directive (EU) 2019/130 of 16 January 2019. The following substances have been assigned new limit values:

- Trichloroethylene
- 4,4'-Methylenedianiline
- Epichlorohydrine
- Ethylene dibromide
- Ethylene dichloride
- Polycyclic aromatic hydrocarbons mixtures, particularly those containing benzo[a]pyrene, which are carcinogens within the meaning of this Directive

Annex III of the Carcinogens or mutagens at work Directive 2004/37/EC has been amended as per Directive (EU) 2019/130 of 16 January 2019.

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- Mineral oils that have been used before in internal combustion engines to lubricate and cool the moving parts within the engine

Yorda's Hive, 14 February 2019

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

REACH Update

CHEMWATCH

Act now to stay on the EU market after the UK's withdrawal

2019-02-14

All companies placing chemical substances onto the markets of the European Union and European Economic Area need to prepare for the United Kingdom's withdrawal. The European Chemicals Agency (ECHA) recommends companies to prepare for a 'no deal' scenario ahead of the UK's withdrawal on 30 March 2019. With continued political uncertainty regarding the withdrawal agreement, the Agency urges companies to act now to continue complying with their obligations under the REACH; Classification, Labelling and Packaging (CLP); Prior Informed Consent (PIC); and Biocidal Products (BPR) regulations. To keep substances that are registered under REACH legally on the EU-27/EEA market, UK-based manufacturers and formulators can either transfer their business to, or appoint an only representative in, one of the EU-27/EEA countries. Subject to further developments, ECHA will open a 'Brexit window' in REACH-IT from 12 to 29 March, 24:00 hours CET (11 p.m. UK time) to enable UK-based companies to make these changes and transfer their REACH registrations. If an only representative is not appointed, the EU-27/EEA importers will have to submit their own registrations. Step-by-step instructions for using the 'Brexit window' are now available on ECHA's web pages for the UK's withdrawal from the EU. The pages also include a link to the European Chemical Industry Council's (Cefic) recommended standard wording for the suspensive conditional clause to be used in contractual arrangements when appointing only representatives. If a downstream user in one of the EU-27/EEA countries relies on REACH authorisations granted to a UK-based company, they need to make sure that there is another EU-27/EEA supplier with a valid authorisation for their use. EU-27 companies will also need to notify their exports of hazardous substances regulated under the PIC Regulation when exporting to the UK. This will be done using the ePIC tool. The export notification in ePIC needs to be submitted 35 days before the export. ECHA will soon clarify how to deal with exports to the UK during the period right after the UK's effective withdrawal. Companies based in the EU-27/EEA will also need to prepare for placing substances on the UK market after 29 March, which will be governed by UK law. The UK Health and Safety Executive (HSE) has published respective guidance. Further details, including a list of substances registered only by UK companies, are available on ECHA's web pages for the UK's withdrawal from the EU. Further information is available at:

- [The withdrawal of the UK from the EU](#)

All companies placing chemical substances onto the markets of the European Union and European Economic Area need to prepare for the United Kingdom's withdrawal.

REACH Update

CHEMWATCH

- [Questions and answers for companies](#)
- [Advice to companies](#)
- [How to transfer your UK REACH registrations prior to the UK withdrawal from the EU](#)
- [List of substances registered only by UK companies](#)

ECHA, 8 February 2019

<http://echa.europa.eu>

Clearer requirements for applications for authorisation

2019-02-14

Updated formats for applications for authorisation and review reports are now available on the European Chemicals Agency's (ECHA) website. The formats are compatible with the updated opinion format of ECHA's scientific committees, and instruct applicants on how to present their analysis of alternatives and socio-economic analysis when applying for continuing the use of a substance of very high concern. They will become mandatory for applications and review reports from 1 June 2019. Updated formats are available for exposure scenarios of the chemical safety report, analysis of alternatives, socio-economic analysis, and the combined version of analysis of alternatives and socio-economic analysis. During a transitional period lasting until 31 May 2019, applicants should still use the earlier formats for applications and review reports to be submitted within the February and May submission windows. ECHA recommends that applicants familiarise themselves with the new formats as soon as possible and include, if feasible, specific sections (e.g. summary tables) in their applications. Use of the updated formats will be mandatory from 1 June 2019. The latest application date for ethoxylated octyl and nonyphenols is 4 July 2019. To facilitate the use of the new format for applications concerning these two substances, ECHA will exceptionally add an additional submission window running from 20 June to 4 July 2019. The updated formats aim to improve the transparency and efficiency of the application process and to speed up the decision making on applications for authorisation and review reports. Further information is available at:

- [Formats for applications for authorisation](#)
- [Format for RAC and SEAC opinions](#)

ECHA, 13 February 2019

<http://echa.europa.eu>

Updated formats for applications for authorisation and review reports are now available on the European Chemicals Agency's (ECHA) website.

REACH Update

CHEMWATCH

Registries of SVHC and restriction intentions updated to cover entire processes

2019-02-14

The registries now cover the steps in the procedures for SVHC identification and for restriction from intention until outcome, including committee opinions or agreements. The update follows the same approach as the expansion carried out in 2018 for the harmonised classification and labelling (CLH) process. The European Chemicals Agency's (ECHA) registries of intentions until outcome inform interested parties of planned submissions, giving them time to prepare for commenting later in the process. It may also be used to track progress of a dossier through the CLH, SVHC identification and restriction processes. The public activities coordination tool (PACT) has also been updated to include the outcomes of the SHVC identification and restriction processes. Further information is available at:

- [Registry of SVHC intentions until outcome](#)
- [Registry of restriction intentions until outcome](#)
- [PACT](#)

ECHA News, 13 February 2019

<http://echa.europa.eu>

Public consultations launched on applications for authorisation

2019-02-14

The European Chemicals Agency (ECHA) has launched eight public consultations on applications for authorisation for chromium trioxide (EC 215-607-8, CAS 1333-82-0) for the uses of functional chrome plating with decorative character for sanitary applications (including etching and electroplating), as well as for the uses of passivation and electrolytic coating of steel. More information about the uses that authorisation is being applied for, including the description of the function of the substance, exposure scenarios, possible alternatives identified by the applicants, and socio-economic information, is available on ECHA's website. The deadline for comments is 10 April 2019. Further information is available at: [Applications for authorisation - current consultations](#)

ECHA News, 13 February 2019

<http://echa.europa.eu>

The registries now cover the steps in the procedures for SVHC identification and for restriction from intention until outcome, including committee opinions or agreements.

REACH Update

CHEMWATCH

New training videos on degradation kinetics

2019-02-14

The European Chemicals Agency has released new training videos explaining how to use kinetic models to calculate endpoints from biodegradation studies – with a focus on biocides. The videos are useful to both applicants for authorisation and risk assessors. You will learn how to derive the correct half-life data, which can be used as input for exposure models or PBT assessments, and be crucial in deciding on the need for higher-tier studies. Video's are available at:

- [Part 1](#)
- [Part 2](#)
- [Part 3](#)

ECHA News, 13 February 2019

<http://echa.europa.eu>

Authorities and stakeholders discuss ways to improve active substance approvals

2019-02-14

Member State authorities, the European Commission, stakeholders and the European Chemicals Agency (ECHA) have discussed over the last two days ways to improve the biocidal active substance approval process, aiming in particular at speeding up the Review Programme of existing active substances. Themes of the workshop included lessons learnt and evolution of the situation since 2015, optimising the use of available resources, requesting data, assessing endocrine disruptor properties and grouping active substances. The workshop report will be made available on ECHA's website.

ECHA News, 13 February 2019

<http://echa.europa.eu>

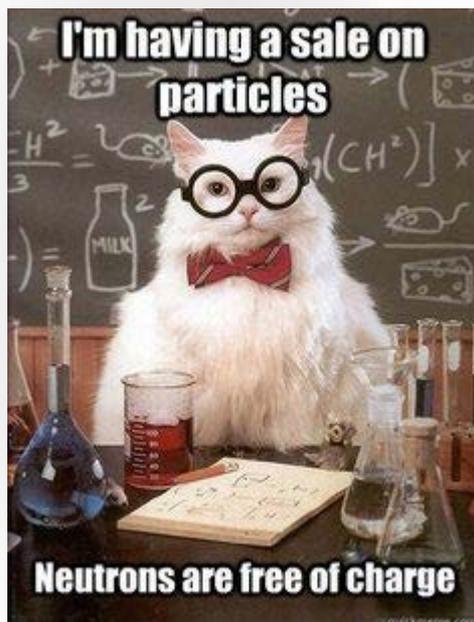
The European Chemicals Agency has released new training videos explaining how to use kinetic models to calculate endpoints from biodegradation studies – with a focus on biocides.

Janet's Corner

CHEMWATCH

Particle Sale

2019-02-04



Hazard Alert

CHEMWATCH

Acrylic Acid

2019-02-04

Acrylic acid (IUPAC: prop-2-enoic acid) is an organic compound with the formula $\text{CH}_2=\text{CHCO}_2\text{H}$. It is the simplest unsaturated carboxylic acid, consisting of a vinyl group connected directly to a carboxylic acid terminus. This colourless liquid has a characteristic acrid or tart smell. [1] It is miscible with water, alcohol, ether, benzene, chloroform, and acetone. It polymerises readily in the presence of oxygen. Exothermic polymerisation at room temperature may cause acrylic acid to become explosive if confined. It is sensitive to heat and sunlight. It is also a fire hazard when exposed to heat or flame. Acrylic acid is incompatible with strong oxidisers, strong bases, strong alkalies and pure nitrogen. It may polymerise (sometimes explosively) on contact with amines, ammonia, oleum and chlorosulfonic acid, iron salts and peroxides. It may corrode iron and steel. [2]

USES [2]

The primary use of acrylic acid is in the production of acrylic esters and resins, which are used primarily in coatings and adhesives. It is also used in oil treatment chemicals, detergent intermediates, water treatment chemicals, and water absorbent polyacrylic acid polymers. Acrylic acid is used widely for polymerisation, including production of polyacrylates. It is a monomer for polyacrylic and polymethacrylic acids and other acrylic polymers. It is used in the manufacture of plastics, as a tackifier, as a flocculant, in the production of water-soluble resins and salts, as a comonomer in acrylic emulsion and solution polymers and in moulding powder for signs, construction units, decorative emblems and insignias. It is used in polymer solutions for coatings applications, in paint formulations, in leather finishings, in paper coatings, in polishes and adhesives and in general finishes and binders.

Acrylic acid (IUPAC: prop-2-enoic acid) is an organic compound with the formula $\text{CH}_2=\text{CHCO}_2\text{H}$.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [2]

- Industry sources: Acrylic acid may be released in wastewater and as emissions during its production and use. Acrylic acid is emitted from the production of acrylic acid and acrylate. The primary stationary sources listed in the US are manufacturers of guided missiles and space vehicles, and electronic components and accessories.

Hazard Alert

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- Diffuse sources: Acrylic acid emissions can occur from polishes, paints, coatings, rug backings, adhesives, plastics, textiles, and paper finishes. Acrylic acid has been used as a pesticide.
- Natural sources: Acrylic acid is also produced naturally by some species of algae and has been found in the rumen fluid of sheep.
- Transport sources: None.
- Consumer products: Products containing acrylic acid include polishes, paints, coatings, rug backings, adhesives, plastics, textiles, and paper.

Routes of Exposure [3]

Exposure can occur through inhalation, ingestion, and contact to the eyes and skin. Studies show that eye or skin irritation from exposure to acrylic acid can range in intensity from mild to severe. People can be exposed to acrylic acid through direct contact with a product containing it or by inhaling it in air contaminated by a nearby plant manufacturing acrylic acid. Exposure to acrylic acid occurs primarily in the workplace via inhalation and dermal contact during its manufacture or use. Consumers may be exposed to acrylic acid in polishes, paints, coatings, rug backings, adhesives, plastics, textiles, and paper finishes. In addition, acrylic acid may be released in wastewater and as emissions during its production and use. Individuals may be exposed by inhaling ambient air or ingesting contaminated water. Acrylic acid is also produced naturally by some species of algae.

HEALTH EFFECTS [4]

Acute Effects

- Acrylic acid is a strong irritant to the skin, eyes, and mucous membranes in humans. The liquid may cause blindness if splashed into the eye.
- Acute (short-term) exposure of rats to acrylic acid by inhalation has been observed to produce nose and eye irritation, lung haemorrhage, and degenerative changes in the liver and kidneys.
- Tests involving acute exposure of rats, mice, and rabbits have demonstrated acrylic acid to have moderate acute toxicity by inhalation or ingestion, and high acute toxicity by dermal exposure.

Chronic Effects

- Information on the chronic (long-term) effects of acrylic acid in humans is not available.

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- In mice and rats chronically exposed to acrylic acid by inhalation, lesions of the nasal mucosa were observed.
- Reduced body weights and altered organ weights were observed in rats orally exposed to acrylic acid.
- The Reference Concentration (RfC) for acrylic acid is 0.001 milligrams per cubic metre (mg/m³) based on degeneration of the nasal olfactory epithelium in mice.
- The Reference Dose (RfD) for acrylic acid is 0.5 milligrams per kilogram body weight per day (mg/kg/d) based on reduced pup weights in rats.

Reproductive/Developmental Effects

- No information is available on the reproductive or developmental effects of acrylic acid in humans.
- Decreased body weight gain and decreased fertility were reported in one study of rats exposed to acrylic acid by ingestion, although the decrease in fertility was not statistically significant compared with the control.
- Embryotoxic and teratogenic effects (birth defects) were observed in rats injected with acrylic acid.

Cancer Risk

- No information is available on the carcinogenic effects of acrylic acid in humans.
- In one study, squamous cell carcinomas of the skin were reported in mice treated topically with acrylic acid. Other animal studies have not reported carcinogenic effects.
- EPA has not classified acrylic acid for carcinogenicity.

SAFETY [5]

Fist Aid Measures

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

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- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- **Serious Inhalation:** Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
- **Ingestion:** Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Handling & Storage

- Keep locked up;
- Keep container dry;
- Keep away from heat;
- Keep away from sources of ignition;
- Ground all equipment containing material;
- Do not ingest or breathe gas/fumes/ vapour/spray;
- Never add water to this product.
- Keep away from incompatibles such as oxidising agents, acids, alkalis, moisture.
- Store in a segregated and approved area;
- Keep container in a cool, well-ventilated area;
- Keep container tightly closed and sealed until ready for use.

Exposure Controls & Personal Protection

Engineering Controls

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.

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- Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling acrylic acid:

- Face shield;
- Full suit;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves;
- Boots

Personal Protection in Case of a Large Spill:

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

REGULATION [3,6]

United States

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for acrylic acid of 2 ppm, 5.9 mg/m³ TWA ; Skin; Appendix A4, Not Classifiable as a Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for acrylic acid of 2 ppm, 6 mg/m³ TWA; Skin

Australia

Safe Work Australia recommends an 8 hour time weighted average (TWA) exposure limit for acrylic acid of 2 ppm (5.9 mg/m³)

Hazard Alert

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REFERENCES

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5. <http://www.sciencelab.com/msds.php?msdsId=9922794>
6. https://www.osha.gov/dts/chemicalsampling/data/CH_217240.html

Gossip

CHEMWATCH

Graphene and related materials safety: Human health and the environment

2019-02-01

As the drive to commercialise graphene continues, it is important that all safety aspects are thoroughly researched and understood. The Graphene Flagship project has a dedicated Work Package studying the impact of graphene and related materials on our health, as well as their environmental impact. This enables safety by design to become a core part of innovation. Researchers and companies are currently using a range of materials such as few layered graphene, graphene oxide and heterostructures. The first step to assess the toxicology is to fully characterise these materials. This work overviews the production and characterisation methods, and considers different materials, which biological effects depend on their inherent properties. "One of the key messages is that this family of materials has varying properties, thus displaying varying biological effects. It is important to emphasise the need not only for a systematic analysis of well-characterised graphene-based materials, but also the importance of using standardised in vitro or in vivo assays for the safety assessment," says Bengt Fadeel, lead author of this paper working at Graphene Flagship partner Karolinska Institutet, Sweden. "This review correlates the physicochemical characteristics of graphene and related materials to the biological effects. A classification based on lateral dimensions, number of layers and carbon-to-oxygen ratio allows us to describe the parameters that can alter graphene's toxicology. This can orient future development and use of these materials," explains Alberto Bianco, from Graphene Flagship partner CNRS, France and deputy leader of the Graphene Flagship Work Package on Health and Environment. The paper gives a comprehensive overview of all aspects of graphene health and environmental impact, focussing on the potential interactions of graphene-based materials with key target organs including immune system, skin, lungs, cardiovascular system, gastrointestinal system, central nervous system, reproductive system, as well as a wide range of other organisms including bacteria, algae, plants, invertebrates, and vertebrates in various ecosystems. "One cannot draw conclusions from previous work on other carbon-based materials such as carbon nanotubes and extrapolate to graphene. Graphene-based materials are less cytotoxic when compared to carbon nanotubes and graphene oxide is readily degradable by cells of the immune system," comments Fadeel. Andrea C. Ferrari, Science and Technology Officer of the Graphene Flagship and Chair of its Management Panel added that "understanding any potential Health and Environmental impacts of graphene and related materials has

Researchers reviewed the current research into the safety of graphene and related materials looking at both human health and environmental impact.

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been at the core of all Graphene Flagship activities since day one. This review provides a solid guide for the safe use of these materials, a key step towards their widespread utilisation as targeted by our innovation and technology roadmap.”

Science Daily, 22 January 2019

<http://www.sciencedaily.com>

The Natural Products that could replace plastic

2019-02-01

Drinking straws and polythene bags may be bearing the brunt of the backlash, but the true scourge of single-use plastics is our sheer overreliance on them. From transport to manufacturing to food services, plastic is everywhere, and combatting this “white pollution” will require a sea change in the material itself. Fortunately, scientists, engineers and designers are shifting their focus to ecologically friendly alternatives that create circular, low-waste ecosystems – liquid wood, algae insulation, and polymer substitutes made from fermented plant starch such as corn or potatoes, for example. These alternatives do more than stem the growing tide of plastics: they also address issues such as safely housing a growing population, offsetting carbon emissions, and returning nutrients to the earth.

Stone wool

To transform one of the world’s most abundant resources into something with utility and sustainability takes a special kind of alchemy. Stone wool comes from natural igneous rock—the kind that forms after lava cools – and a steelmaking by-product called slag; these substances are melted together and spun into fibres, a little like candyfloss. Unlike fibreglass insulation (made with recycled glass), or foamed plastic (the conductive materials often used to block heat transfer in attics, roofs and crawlspaces), stone wool can be engineered to boast unique properties, including fire resilience, acoustic and thermal capabilities, water repellency and durability in extreme weather conditions. Over the past few years, stone wool has gained traction with eco-conscious architects and designers as they search for more sustainable building materials that are still cost-effective and aesthetic. The Rockwool Group is a leading manufacturer of stone wool insulation, running production facilities in Europe, North America and Asia. The company has installed stone wool in commercial and industrial buildings across the globe, including London’s O2 Arena and the Hong Kong Airport. As wildfires and floods increase in frequency

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and severity, Stone Wool may also give homeowners an extra measure of safety in natural disasters.

Mycotecture

Mushrooms aren't just a flavour-packed addition to ravioli or ragu (or a sparkplug to the occasional psychedelic adventure); soon, tree-hugging fungi and forest-floor toadstools may replace materials like polystyrene, protective packaging, insulation, acoustic insulation, furniture, aquatic materials and even leather goods. MycoWorks, a team of creative engineers, designers and scientists, is working to extract the vegetative tissues of mushrooms and solidify them into new structures, curating fungi as one might other organic materials like rubber or cork. Another company, New York-based Evocative Design, uses mycelium as a bonding agent to hold together wood panelling, as well as for flame-retardant packaging. Mushrooms consist of a network of filaments called hyphae. When growth conditions are suitable, fruiting bodies – the structures specialised for the production of spores – make an often-sudden appearance; so-called mycelial products are thus easy to culture and germinate. Mycelium can be grown in almost any kind of agricultural waste (think sawdust or pistachio shells); mushrooms grow together within the material, which can be configured into any shape, forming natural polymers that adhere like the strongest glue. By baking the fungi at precise temperatures, they are rendered inert, thereby ensuring that the mushroom doesn't suddenly sprout again in a rainstorm. While chanterelles, shiitaki and portobello may go better with pizza than mushroomy plaster, one thing is clear: the future is fungi.

Urine bricks

Cement, concrete's primary ingredient, accounts for about 5% of the world's carbon dioxide emissions. Researchers and engineers are working to develop less energy-intensive alternatives, including bricks made with leftover brewery grains, concrete modelled after ancient Roman breakwaters (Romans made concrete by mixing lime and volcanic rock to form mortar, a highly stable material), and bricks made of, well, urine. As part of his thesis project, Edinburgh College of Art student Peter Trimble was working on an exhibit that was supposed to feature a module on sustainability. Almost by accident, he created "Biostone": a mixture of sand (incidentally, one of Earth's most abundant resources), nutrients, and urea – a chemical found in human urine. Pumping bacterial solution into a sand-filled mould, Trimble devised hundreds of experiments over the course of a year until he tweaked the recipe. The microbes eventually

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metabolised the mixture of sand, urea, and calcium chloride, creating a glue that strongly bound the sand molecules together. Trimble's design offers an alternative to the energy-intensive methods with a low energy biological process of microbial manufacturing. Biostone produces no greenhouse gases and uses a widely available raw material. While Trimble's material would require reinforcement to be as strong as concrete, it could become a low-cost way of building temporary structures or street furniture. At the very least, Biostone has spawned a discussion on ways in which industrial manufacturing can be made more sustainable, particularly in Sub-Saharan Africa and other developing countries where sand is readily available. These bio-bricks do have an environmental downside, however: the same bacterial metabolism that solidifies them work also turns the urea into ammonia, which can pollute groundwater if it escapes into the environment.

A greener particleboard

Despite what it sounds like, particleboard – those rigid panels made of compressed and veneered wood chips and resin used in furniture and kitchen cabinetry throughout the world – hasn't actually a place in the green-building pantheon. That's because the glue that binds particleboard's wood fibres traditionally contain formaldehyde, a colourless, flammable, strong-smelling chemical and known respiratory irritant and carcinogen. That means your faux-wood Ikea shelf is quietly "off-gassing" toxins into the air. One company, NU Green, created a material made from 100% pre-consumer recycled or recovered wood fibre called "Uniboard". Uniboard saves trees and avoids landfill, while also generating far fewer greenhouse gases than traditional particleboard, and contains no toxins. That's because Uniboard has pioneered the use of renewable fibres like corn stalks and hops, as well as no added formaldehyde (NAF) resin instead of glue. It's no secret that petroleum extraction, which is required to produce plastic, has devastating environmental consequences. Worse still is disposing of the plastic itself: the toxic chemicals contained in plastic often leach into foods, beverages and groundwater. Shockingly, recycling merely slows down the journey of plastics to landfills or oceans, where the material simply fragments into smaller and smaller bits that never completely biodegrade. Some reports predict that, by 2030, 111 million metric tons of plastic will wind up in landfills and oceans. Recycling is a step in the right direction, but to truly

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reverse course, we need to look toward plastic alternatives and renewable resources for a sustainable future.

BBC Future, 28 January 2019

<http://news.bbc.co.uk>

Your Sweat Will See You Now

2019-02-01

Someday soon, perhaps within a year, you'll be able to slap a soft, stretchy patch on to your arm that tells you if you're dehydrated. Or that your electrolytes are dangerously out of balance. Or even that you have diabetes. Fitness trackers such as Fitbit and Apple Watch already track step counts, heart rate and sleep rhythms. But they tend to be rigid and bulky, and mostly gather mechanical metrics, rather than assess a person's underlying biology. A new generation of devices instead aim to analyse sweat for many chemicals at once, producing a real-time snapshot of the wearer's health or fitness. These devices also fit intimately against the skin, and are comfortable for anyone, from premature babies to the elderly. One version is already being advertised by Gatorade. The latest advance in this technology, described Friday in the journal *Science Advances*, provides real-time information on the wearer's pH, sweat rate, and levels of chloride, glucose and lactate — high levels of which could signal cystic fibrosis, diabetes or a lack of oxygen. "It fits into a broader trend that you're seeing in medicine, which is personalised, tailored approaches to treatment and delivery of care," said John Rogers, a biomedical engineer at Northwestern University in Illinois and the key architect of the device. Technology like this has been anticipated for years, but the field has accelerated rapidly. Some similar devices in development are soft. Some use electric sensors to read chemicals. Others rely on colorimetrics, in which the intensity of the colour in the readout matches the concentration of the chemical being monitored. The new device delivers all of that in a battery-free and wireless form. "This looks like the first version in which they integrated all of it in one device," said Martin Kaltenbrunner, an engineering professor at Joannes Kepler University Linz, in Austria, who was not involved in the research. "The level of technology that is in this paper is very, very advanced." The new device has minuscule holes at its base into which sweat naturally flows. From there, a complex network of valves and microchannels, each roughly the width of a human hair, route the sweat into tiny reservoirs. Each reservoir contains a sensor that reacts with a chemical in the sweat, such as glucose or lactate. "That's basically it," Dr. Rogers said. "There's nothing that penetrates the skin,

A new device — wearable, wireless and battery free — improves the ability to monitor and diagnose health problems by analysing the sweat on your skin.

Gossip

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and there's no power supply that's driving flow." The device relies on the same technology that smartphones use to send wireless payments; the phone can both deliver power through this wireless coupling, and receives data back. Alternatively, the data could be sent to a reader attached to a treadmill or elsewhere in a fitness room — and, perhaps eventually, to a reader much farther away. The system is versatile and could be set up to track the same chemical, or several, over time, such as the level of lactate in a runner as a marathon progresses. Because the device is waterproof and moulded to the body, it also could be used by swimmers to track their performance. Eventually, the device would fill up with sweat — not so hygienic — but the channel system can be easily separated from the electronics and swapped out, giving the device a longer life span. "This approach is especially nice, this modular construction of sensors," said Dr. Kaltenbrunner. To be marketed at large scale, any sweat-based sensor would need to be manufactured at a low cost. Many teams are focused on this goal because of the potential of the devices to transform health care, Dr. Kaltenbrunner said. "If I have to go to the clinic once a day to have my data collected, I wouldn't really do it," Dr. Kaltenbrunner said. "But it just means wearing a patch and being able to self-monitor myself, then eventually this barrier will be reduced." Dr. Rogers's team has begun testing the technology as a way to screen for cystic fibrosis, a rare genetic condition. Doctors already look at chloride concentrations in sweat to identify children with the condition, but they typically use a rigid, uncomfortable device that straps tightly onto the child's arm for a one-time measurement. In 2017, another team described a flexible, wearable sensor that also analyses chloride in sweat to screen for cystic fibrosis. But that sensor is battery-powered, and does not capture separate volumes of sweat as Dr. Rogers's device does. "Really what is needed is big data for human health," said Ali Javey, a member of the team that proposed the earlier sensor and a professor of electrical engineering and computer science at the University of California, Berkeley. The device invented by Dr. Rogers "is really important," Dr. Javey said, because it is "comfortable to wear, has different sensing modalities and is robust." Dr. Rogers' team has been testing their device with children who have cystic fibrosis at Lurie Children's Hospital of Chicago. They are in the late stages of a clinical trial, and plan to apply for approval from the Food and Drug Administration. A much bigger market for sensors lies in helping the approximately 30 million people with diabetes in the United States track their glucose levels. The most advanced diabetes sensor, approved by the F.D.A. in 2017, is a soft skin patch coupled to a small reader, and relies on tiny needles that pierce the skin to monitor blood glucose. The ideal device would not involve needles or draw blood. To use sweat instead,

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however, scientists first need to learn more about it — how sweat rates vary among individuals, how different biochemicals make their way into sweat, and how well those levels reflect blood glucose. “We need to take a step back and be careful to think about how we can make sense of what we’re measuring,” said Carlos Milla, Dr. Javey’s collaborator and a professor of paediatrics at Stanford University. The new study underscores Dr. Milla’s concern. The device measured glucose in sweat, but the results suggested that this was not a good proxy for glucose in the blood. The sweat glucose levels reflect blood glucose from 30 to 60 minutes earlier, too long of a delay to help diabetics. “It’s indicating this might not be as simple as one might have initially hoped,” Dr. Rogers said. He added that sweat glucose might be more helpful as metric in screening for diabetes rather than for real-time monitoring of glucose levels. Dr. Rogers is also working with collaborators to develop sensors for urea and creatinine, which are indicators of how well the kidneys are functioning, and to chart the progress of people undergoing rehabilitation after a stroke. Other labs, such as one led by Wei Gao at Caltech, are trying to develop sensors for mental health conditions, including depression. Progress on many of these fronts is likely to be fast. In November 2016, Dr. Rogers described an earlier vision of his device that used colorimetric analysis of sweat. Within weeks, he was in talks with Gatorade and L’Oreal to adapt the technology. In December, Gatorade debuted a commercial that featured Serena Williams and hinted at an upcoming range of products based on the nature of people’s sweat. And L’Oreal is promoting a small sticker that will track skin hydration. (Dr. Rogers’ device was also featured in an exhibition of the Museum of Modern Art in New York, and has since become part of the permanent collection.) “It shows you how quickly this can happen,” Dr. Rogers said. “Two, three years is a very conservative estimate.”

New York Times, 18 January 2019

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

Stretchy hydrogel heals like muscle

2019-02-01

When we work out, the strain breaks fibres in our muscles. Our body repairs those fibres with a steady supply of amino acids that it knits into proteins, ultimately building us stronger muscles. Scientists have now made a muscle-like hydrogel that works the same way, strengthening itself when mechanically stressed. The work, they say, could lead to longer-lasting tires or soft robots made of flexible plastic that can repair themselves and even grow. The stretchy hydrogel material comes from a

Material made from intertwined polymers gets stronger when stressed

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team led by Hokkaido University's Jian Ping Gong and Tasuku Nakajima and takes advantage of polymer mechanochemistry, in which mechanical force initiates a chemical reaction. The soft yet tough hydrogel is made up of 85% water and two intertwined, cross-linked polymer networks. One of the networks—made of poly(2-acrylamido-2-methylpropanesulfonic acid) sodium salt—is taut. The other network—made of polyacrylamide—is slack. This muscle-inspired hydrogel grows stronger each time it's stretched. When pulled, the slack polymer stretches out, which prevents the hydrogel from ripping, while the taut polymer breaks, forming carbon radicals at the broken ends of the polymer chains. These radicals quickly react with monomer interspersed throughout the material to rebuild the polymer network so that when the hydrogel rebounds to its relaxed state, it's stronger than it was originally. The researchers demonstrate this by showing that the material can lift heavier weights each time it's stretched. (Science 2019, DOI: 10.1126/science.aau9533). Creating a molecular architecture that contains enough radicals to make a macroscopic change in the hydrogel's properties is a technical feat and represents "a significant step forward in the area of smart responsive polymers," says Eindhoven University of Technology's Rint P. Sijbesma, an expert in smart materials. This work, he says, contrasts with earlier efforts in which researchers tried to make similar systems but failed because the polymer architecture they used didn't generate enough radicals to make a noticeable difference in strength. Even so, there's plenty of room for improvement in the system, Nakajima points out. For example, he says, the researchers need to figure out a way to continuously supply the system with monomer. In the current system, the monomer gets depleted after five or six stretches, and the hydrogel becomes stiff and fragile. The system is also sensitive to oxygen, a common problem in radical polymerisations. "Conceptually the advance is inspiring," says Jeffrey S. Moore, a polymer mechanochemistry expert at the University of Illinois at Urbana-Champaign. "While chemists are comfortable performing chemistry in the controlled environment of a flask, this work pushes us to think about the challenges of chemistry in the wild, robust enough to work under demanding conditions."

Chemical & Engineering News, 31 January 2019

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

Companies tout low-cost production technologies and ability to target specific pests

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Biotech firms develop RNAi-based products for pest control

2019-02-01

Biotech firms say RNAi-based pesticides can control crop insect damage better than chemical sprays. Three biotech start-ups have plans to produce and manufacture products based on RNA interference that they say can control crop-munching insects better than chemical sprays. RNAi can interrupt a target organism's ability to produce key proteins. The Donald Danforth Plant Science Centre, a not-for-profit research institute based in St. Louis, has spun out a start-up called RNAissance Ag to commercialise RNAi technology developed at the Centre. TechAccel, a venture development company, provided early-stage financial and technical backing to RNAissance prior to the spin-off. TechAccel is also an investor in GreenLight Biosciences, a Medford, Massachusetts-based biotech firm that raised \$50 million in early January. GreenLight is not new—it was founded in 2008—but TechAccel and other investors say the firm's work on its lower-cost RNAi production platform has opened up pest control markets in addition to the high-value human health care markets it now pursues. TechAccel's CEO Michael Helmstetter says RNAi pesticides can be delivered more effectively than chemical sprays, are less costly, and can reduce health risks to workers and the environment. "An RNAi insect control measure is highly specific to the target insect and is not toxic to other organisms," Helmstetter adds. Meanwhile, Renaissance BioScience, a yeast specialist based in Vancouver, has linked up with the University of British Columbia, the University of Manitoba, and the Canadian research non-profit Mitacs in a three-year, \$730,000 research and development project. The team will test the company's yeast-based RNAi production and delivery platform in insect and animal models.

Chemical & Engineering News, 30 January 2019

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

The International Year of the Periodic Table officially kicks off in Paris

2019-02-01

The periodic table took the stage at Unesco headquarters in Paris. Chemists and physicists from across the world gathered in Paris on 29 January to officially launch the International Year of the Periodic Table (IYPT). The year-long celebration of the periodic table coincides with the 150th anniversary of Dmitri Mendeleev first arranging the known elements

Opening ceremony features periodic tables galore, musical performances, and scientific talks

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into an orderly system based on their properties. Many of the talks at the opening ceremony Tuesday hearkened back to Mendeleev and his table. Mendeleev was, said Nobel Laureate Ben Feringa during his keynote speech, a “real hero of chemistry.” Feringa also touched on a theme shared among many of the talks at the IYPT opening ceremony: the importance of international collaboration. Chemists “have a universal language using the elements and molecules,” he explained. “We have no borders.” In addition to talks, the celebration, held at the United Nations Educational Scientific and Cultural Organisation (UNESCO) headquarters, featured round table discussions and musical performances. Outside the main auditorium, delegates took part in hands-on chemistry demonstrations and admired a display of periodic tables. The collection included several tables made by Japanese schoolteacher Nagayasu Nawa and an 1885 wallchart unearthed by Alan Aitken while he was cleaning a lecture theatre at St. Andrews University in 2014. The chart could be the earliest surviving example of a classroom periodic table in the world. IYPT, with its theme of elements as a common language for science, aims to enhance global awareness of and education in the basic sciences, with a special focus on the countries of the developing world. Speaking at the opening ceremony, American Chemical Society president Bonnie Charpentier said that ACS hopes scientific societies and educational institutions will come together in 2019 to share the importance of chemistry and the periodic table. “I look forward to seeing all the ways you celebrate IYPT and look forward to discussing ways we can work together,” she added, addressing the assembled throng. The opening ceremony was just the beginning for IYPT. Events and competitions are planned throughout the entire year. These include a global breakfast for women chemists, an attempt to create the world’s largest periodic table in Michigan, and a multitude of outreach activities, including global competitions and local demonstrations.

Chemical & Engineering News, 30 January 2019

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

Carbon-capture technology scrubs CO₂ from power plants like scuba-diving gear

2019-02-01

Scientists at the Department of Energy’s Oak Ridge National Laboratory (ORNL) have developed a process that removes CO₂ from coal-burning power plant emissions in a way that is similar to how soda lime works in scuba diving rebreathers. Their research, published January 31 in the journal *Chem*, offers an alternative but simpler strategy for carbon capture

Scientists have developed a process that removes CO₂ from coal-burning power plant emissions in a way that is similar to how soda lime works in scuba diving rebreathers.

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and requires 24% less energy than industrial benchmark solutions. Soda lime is a solid off-white mixture of calcium and sodium hydroxides used in scuba rebreathers, submarines, anaesthesia, and other closed breathing environments to prevent the poisonous accumulation of CO₂ gas. The mixture acts as a sorbent (a substance that collects other molecules), turning into calcium carbonate (limestone) as it amasses CO₂. The ORNL team's CO₂ scrubber works in essentially the same way to treat the CO₂-rich flue gas released by coal-burning power plants -- although advancing carbon-capture technology was not always their objective. "We initially stumbled into this research by accident," says senior author Radu Custelcean, a research scientist at ORNL. Custelcean and his team recently "rediscovered" a class of organic compounds called bis-iminoguanidines (BIGs), which were first reported by German scientists at the turn of the 20th century and recently noted for their ability to selectively bind anions (negatively charged ions). The team members realised that the compounds' ability to bind and separate anions could be applied to bicarbonate anions, leading them to develop a CO₂-separation cycle using an aqueous BIG solution. With their carbon-capture method, flue gas is bubbled through the solution, causing CO₂ molecules to stick to the BIG sorbent and crystallise into a sort of organic limestone. This solid can then be filtered out of the solution and heated at 120 degrees C to release the CO₂ so it can be sent to permanent storage. The solid sorbent can then be dissolved in water and reused in the process indefinitely. State-of-the-art carbon-capture technologies come with major flaws. Many use liquid sorbents, which evaporate or decompose over time and require that more than 60% of regeneration energy be spent on heating the sorbent. Because their approach involves capturing CO₂ as a crystallised bicarbonate salt and releasing it from the solid state instead of heating a liquid sorbent, the ORNL team's technology circumvents these issues. Their twist on carbon capture requires 24% less energy than industrial benchmark sorbents. Plus, the team observed almost no sorbent loss after ten consecutive cycles. "The main advantage of our 'organic soda lime' is that it can be regenerated at much lower temperatures and with significantly less energy consumption compared to inorganic scrubbers," says Custelcean. "The lower energy required for regeneration is expected to significantly reduce the cost of carbon capture, which is critical considering that billions of tons of CO₂ need to be captured every year to make a measurable impact on the climate." Although it is still in the early stages, Custelcean and his team believe the process will eventually be scalable. However, the technique does have a road bump to contend with -- its relatively low CO₂ capacity and absorption rate, which come from the limited solubility of the BIG sorbent in water. "We are currently addressing

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these issues by combining the BIG sorbent with traditional sorbents, such as amino acids, to enhance the capacity and absorption rate," says Custelcean. "We are also adjusting the process so it can be applied to CO₂ separation directly from the atmosphere in an energy-efficient and cost-effective way." This research was supported by the Chemical Sciences, Geosciences, and Biosciences Division of the Basic Energy Sciences program of the US Department of Energy Office of Science.

Science Daily, 31 January 2019

<http://www.sciencedaily.com>

Layered 2D materials: Maximising the potential of MXenes

2019-02-01

Amidst a surge of research over the last two decades focusing on the special properties of structures that are just an atom or two thick, called "two-dimensional" materials, researchers at Drexel University have steadily been uncovering the exceptional properties of one family of these materials, called MXenes. The researchers now know that MXenes are highly conductive and extremely durable, they can block electromagnetic interference, sense chemicals in the air, remove salt from water, and capture hydrogen. They've made a strong case to be involved in the future of energy storage, wireless communication and wearable technology. But before that can happen researchers need to understand why MXenes can do what they do -- and how they can be designed to do it better. As two-dimensional materials, MXenes are largely defined by their surfaces, yet researchers are in the early stages of directly measuring how the surface chemistry of MXenes influences their performance. Researchers in the Dynamic Characterisation Group in Drexel's College of Engineering recently addressed this question in the journal Nature Communications. Their study suggests that engineering the atoms bonded to the surfaces of MXenes and the molecules between their layers could dramatically improve various properties of the materials. In their examination of MXene surface chemistry, the researches relied on a new electron microscopy technique -- developed at Drexel in 2016 -- which allows unprecedented measurement of the property-defining surface chemistry in real time. "While the idea of controlling MXene properties by changing their surface termination and intercalation has always been a key objective in advancing these materials, we are the first to directly achieve this goal and lay the groundwork for engineering these materials to improve conductivity and explore the possibility of developing semiconducting,

New research shows how to customize the properties of materials called MXenes, which have displayed exceptional abilities to conduct electricity and block electromagnetic radiation.

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magnetic and topologically insulating MXenes,” said Mitra Taheri, PhD, Hoeganaes professor and head of the Dynamic Characterisation Group, the lead author of the study. “The holy grail is to have control over what goes on ‘between the sheets,’ so to speak. We are demonstrating a major step toward termination engineering through the use of novel in-situ TEM techniques and our direct detection spectroscopy technology.” MXenes, which were first discovered at Drexel in 2011, are made by chemically etching a layered ceramic material called a MAX phase, to remove a set of chemically-related layers, leaving a stack of two-dimensional flakes. Based on the exact chemical etchant used, the atomic species left bonded with the flake surfaces -- the termination species -- and the molecules which get stuck in between the flakes -- the intercalants -- will vary. Researchers have speculated that the interplay between the MXene, termination species, and intercalation species have something to do with MXenes’ conductivity. Now they’ve confirmed it. Some 30 different types of MXenes have been produced at Drexel, and this study looked at the behaviour of three that are frequently explored for applications. The goal of the researchers was to measure the conductivity of these materials before being tested, and then to monitor it as intercalants were removed and the surface chemistry of the flakes was altered. To do this, the team incrementally heated the materials in a vacuum to temperatures as high as 775 degrees Celsius. During the heating process, the team monitored both the electronic resistance of the material -- a way of determining its conductivity -- as well as observing the chemical dissipation, or de-intercalation, of the intercalant in real time. To make these measurements, the researchers used a technique they’d previously developed -- called direct detection electron energy loss spectroscopy, which is ideal for monitoring chemical changes in 2D materials. The same process was able to monitor and study the release of the termination atoms from the surface of the MXene flakes. In both instances, measures of the electrical resistance of the material, revealed that they became more conductive as intercalants and termination species were eliminated. “In our study, we started with MXenes that had a mix of oxygen, hydroxide, and fluorine termination species, and we showed that as you partially remove these surface termination groups, the conductivity increases significantly. This is also true as water and organic molecules are de-intercalated,” said Jamie Hart, a doctoral researcher in Department of Materials Science and Engineering and an author of the research. “Importantly, by testing these materials in the electron microscope and measuring them with electron energy loss spectroscopy, we were able to establish a causal relationship between intercalation and termination loss and improved conductivity.” Though this confirms a theory that has been speculated upon for some

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time, Hart notes that it has been nearly impossible to accurately induce, track and measure the effects of these chemical changes until now. So, this discovery is significant not only because it shows the source of MXenes' behaviour, but also how the behaviour can be altered. "Most experimental studies looking at MXenes are geared toward a specific application -- for example, using MXene to make a battery and optimising the fabrication and design to maximize battery performance," Hart said. "Our study asks fundamental questions about the properties of MXenes and our findings provide clear guidelines for how to improve conductivity in MXenes, which should directly translate into improved performance for applications such as antennas and electromagnetic interference shielding." The findings are an important step toward optimizing MXenes for various applications -- wearable electronics, energy storage and electromagnetic interference shielding, are among those on the horizon -- as well as understanding how to make them stable in atmospheric conditions for extended periods of time. They also point the way toward creating magnetic MXenes that could be used for data storage devices. "This sort of research is foundational to the development of MXenes and their eventual integration into the devices that improve our day-to-day lives," said Kanit Hantanasirisakul, a doctoral candidate in Drexel's College of Engineering, and co-author of the study. "It will be exciting to follow the progress of MXenes now that we have a better understanding of how to control their properties."

Science Daily, 31 January 2019

<http://www.sciencedaily.com>

Sustainable and recyclable thermoelectric paper

2019-02-01

Thermoelectric materials, capable of transforming heat into electricity, are very promising when converting residual heat into electrical energy, since they allow us to utilize hardly usable or almost lost thermal energy in an efficient way. Researchers at the Institute of Materials Science of Barcelona (ICMAB-CSIC) have created a new concept of thermoelectric material, published in the journal *Energy & Environmental Science*. It is a device composed of cellulose, produced in situ in the laboratory by bacteria, with small amounts of a conductive nanomaterial, carbon nanotubes, using a sustainable and environmentally friendly strategy. "Instead of making a material for energy, we cultivate it" explains Mariano Campoy-Quiles, a researcher of this study. "Bacteria, dispersed in an aqueous culture medium containing sugar and carbon nanotubes, produce the nanocellulose fibres that end up forming the device, in which the carbon nanotubes

Researchers have created a new concept of thermoelectric material. It is a device composed of cellulose, produced in situ in the laboratory by bacteria, with small amounts of a conductive nanomaterial, carbon nanotubes, using a sustainable and environmentally friendly strategy.

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are embedded” continues Campoy-Quiles. “We obtain a mechanically resistant, flexible and deformable material, thanks to the cellulose fibres, and with a high electrical conductivity, thanks to the carbon nanotubes,” explains Anna Laromaine, researcher of this study. “The intention is to approach the concept of circular economy, using sustainable materials that are not toxic for the environment, which are used in small amounts, and which can be recycled and reused,” explains Anna Roig, researcher of this study. “The device is made with sustainable and recyclable materials, and with a high added value,” she adds. Roig claims that, in comparison to other similar materials, “this one has a higher thermal stability compared to other thermoelectric materials based on synthetic polymers, which allows it to reach temperatures of 250 °C. In addition, the device does not use toxic elements, and the cellulose can easily be recycled, since it can be degraded by an enzymatic process converting it into glucose, while recovering the carbon nanotubes, which are the most expensive element of the device.” Moreover, the thickness, colour and transparency of the material can be controlled. Campoy-Quiles explains that carbon nanotubes have been chosen for their dimensions: “Thanks to their nanoscale diameter and their few microns in length, carbon nanotubes allow, with very little quantity (in some cases up to 1%), to obtain electrical percolation, i.e. a continuous path where the electrical charges can travel through the material, allowing cellulose to be conductive.” Additionally, the use of such a small amount of nanotubes (up to a maximum of 10%), while maintaining the overall efficiency of a material containing 100 %, makes the process very economic and energy efficient” adds Campoy-Quiles. “On the other hand, the dimensions of carbon nanotubes are similar to those of cellulose nanofibres, which results in a homogeneous dispersion. In addition, the inclusion of these nanomaterials has a positive impact on the mechanical properties of cellulose, making it even more deformable, extensible and resistant,” adds Roig. These devices could be used to generate electricity from residual heat to feed sensors in the field of the Internet of Things, Agriculture 4.0 or Industry 4.0. “In the near future, they could be used as wearable devices, in medical or sports applications, for example. And if the efficiency of the device was even more optimised, this material could lead to intelligent thermal insulators or to hybrid photovoltaic-thermoelectric power generation systems” explains Campoy-Quiles. In addition, “due to the high flexibility of the cellulose and to the scalability of the process, these devices could be used in applications where the residual heat source has unusual forms or extensive areas, as they could be completely covered with this material” indicates Roig. Because bacterial cellulose can be home made, perhaps we are facing the first step towards a new energy paradigm, where users will

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be able to make their own electric generators. We are still far away, but this study is a beginning. We have to start somewhere. This study is the result of an interdisciplinary project between different groups of the Institute of Materials Science of Barcelona (ICMAB-CSIC) in the framework of the "Frontier Interdisciplinary Projects" call, a strategic action of the Severo Ochoa project of excellence.

Science Daily, 30 January 2019

<http://www.sciencedaily.com>

Cooking chemistry minus heat equals new non-toxic adhesive

2019-02-01

It seems like the cakes designed on competitive cooking shows get larger and more intricate every year. From re-creating full play stages to life-size sculptures, bakers often need to have serious architectural skills. They also need to make all of the pieces stick together. A new soy-based adhesive created in Jonathan Wilker's lab at Purdue University could solve such problems—although he's going to leave it up to someone else to figure out how it tastes, he said. Wilker studies how marine animals, such as oysters and mussels, create natural adhesives. Unlike most glues you'd find in a hardware store, these adhesives are non-toxic, and many hold up underwater. While trying to re-create a new glue in his lab one day, Wilker noticed something strange. "Things were sticking when they shouldn't have been," he said. "We found that the components being used, proteins and sugar, were reacting and turning into an adhesive." This is the essence of Maillard chemistry, or "cooking chemistry," for those of us who aren't chemists. It happens when you grill a steak or bake bread in the oven; after a while, the edges start to brown and a savory smell fills the air. Chemically, sugars and proteins are combining to create aromatic compounds. Usually, it takes heat to kick off this process, but Maillard chemistry is a whole class of messy reactions, and it can happen a few different ways. Products of each reaction get involved in their own reactions and can release chemicals that we experience as flavours. Describing the Maillard reaction in detail would take up an entire book alone, according to PBS. "When foods brown, certain molecules are linking together. Proteins can connect to one another by reacting with sugars," Wilker said. "When sea creatures make their adhesives, they are also cross-linking proteins together. They use totally different chemistry, but the idea is somewhat similar; cross-linking proteins can create an adhesive." This new soy-based adhesive doesn't hold up well under water, so it

The natural adhesive created by mussels to stick to each other and underwater surfaces has inspired a new non-toxic glue

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probably isn't a perfect replacement for the toxic glues used in plywood and chipboard (the fumes from which, when used to build houses, can be breathed in by homeowners for many years). However, it may find use in packaging of organic-certified food products. "Food packaging usually relies on typical petroleum-based adhesives, which can leach out toxins," Wilker said. Not only is this new adhesive made from food components, but it's even stronger than Gorilla Glue on wood. On aluminium, it's about the same. The findings were published recently in the *Journal of the American Chemical Society*. To test the strength of the adhesive, Wilker's team glued two pieces of wood or aluminium together. The far ends have a hole for a pin, and a machine pulls them in opposite directions to test their strength. The new adhesive was so strong on wood that the pin ripped through the hole. Although the soy-based adhesive was pretty strong, the team achieved even better results with a different protein, bovine serum albumin (BSA). BSA is a generic protein often used in labs for experiments. It's cheap for researchers, but not cheap enough to make a BSA-based adhesive affordable on a large commercial scale. "If you want to break into the adhesive market, your product needs to be cheap, high-performance, and the material also has to be available on large scales," Wilker said. "This new soy-based adhesive may be able to hit these requirements while also being grown renewably."

Phys.org, 31 January 2019

<http://phys.org>

Catching atoms in action: watching next-gen materials crystallise

2019-02-01

One of the many possible routes to next-gen materials— ones that enable new advances in data storage, electronic devices, and lighter and stronger structural building materials— is through supercooling of metals into a category of alloys called 'metallic glass,' with no regular or crystalline pattern of atomic structure (scientists call it "amorphous"). Unlike common or window glass, however, these metallic glasses are excellent electrical conductors, making them promising for all sorts of tech applications. When metallic glass is heated at much lower temperature than its melting point, unpredictable new states of matter pop up. Some of these unusual materials structures contain small islands or fragments of crystallised solids, ones that could have potentially useful properties. "The challenge is understanding how these alloys form, and how we can control their formation under these conditions; no existing models can predict their

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existence due to the great variations of atomic mobility at different temperatures," said Lin Zhou, a scientist at the U.S. Department of Energy's Ames Laboratory. "Experimental measurements of the transition pathway are critical to establish reliable models to overcome this challenge. That will be the key to making these materials in a controlled way, with exactly the properties we want to have." Experts in capturing atomic-level details of complex materials transformations, Zhou and other scientists in Ames Laboratory's Division of Materials Sciences and Engineering melted, super-cooled and then reheated a model alloy of aluminium and samarium, and monitored the reheating process in real time with a combination of high-energy X-ray diffraction and transmission electron microscopy. The videos captured slow-growing, irregularly-placed crescent nanocrystals of aluminium, which are engulfed in the faster-forming complex intermetallic from the glassy metal, a process called devitrification. These abnormal results were surprising, but helped to explain some confusing results from previous experiments. "Previously, we would draw conclusions by comparing still images before and after transformation with theoretical models," said Zhou. "With these techniques we have much more precise information to explain these transformations." The research is further discussed in the paper, "An abnormal meta-stable nanoscale eutectic reaction revealed by in-situ observations," authored by Lin Zhou, Fanqiang Meng, Shihuai Zhou, Kewei Sun, TaeHoon Kim, Ryan Ott, Ralph Napolitano, and Matthew J. Kramer; and published in *Acta Materialia*.

Phys.org, 31 January 2019

<http://phys.org>

Harnessing light for a solar-powered chemical industry

2019-02-01

RMIT University researchers have developed a nano-enhanced material that can capture an incredible 99% of light and convert it to power chemical reactions. As well as reducing the environmental impact of chemical manufacturing, the innovation could one day be used to deliver technologies like better infrared cameras and solar-powered water desalination. Published in *ACS Applied Energy Materials*, the research addresses the challenge of finding alternative energy sources for chemical manufacturing, which accounts for about 10% of global energy consumption and 7% of industrial greenhouse gas emissions. In the US, chemical manufacturing uses more energy than any other industry, accounting for 28% of industrial energy consumption in 2017. While photo catalysis—the use of light to drive chemical reactions—is growing

New technology that harnesses sunlight to drive chemical reactions is paving the way for a more sustainable chemical manufacturing industry, one of the globe's biggest energy users.

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in the industry, efficiency and cost remain significant obstacles to wider take-up. Lead investigator Associate Professor Daniel Gomez said the new technology maximised light absorption to efficiently convert light energy into chemical energy. "Chemical manufacturing is a power-hungry industry because traditional catalytic processes require intensive heating and pressure to drive reactions," Gomez, an ARC Future Fellow in RMIT's School of Science, said. "But one of the big challenges in moving to a more sustainable future is that many of the materials that are best for sparking chemical reactions are not responsive enough to light." "The photo catalyst we've developed can catch 99% of light across the spectrum, and 100% of specific colours. "It's scaleable and efficient technology that opens new opportunities for the use of solar power—moving from electricity generation to directly converting solar energy into valuable chemicals."

Nano-tech for solar power

The research focused on palladium, an element that's excellent at producing chemical reactions but usually not very light responsive. By manipulating the optical properties of palladium nanoparticles, the researchers were able to make the material more sensitive to light. While palladium is rare and expensive, the technique requires just a minuscule amount—4 nanometres of nano-enhanced palladium is enough to absorb 99% of light and achieve a chemical reaction. An average human hair, for comparison, is 100,000 nanometres thick. Beyond chemical manufacturing, the innovation could be further developed for a range of other potential applications including better night vision technology by producing more light-sensitive and clearer images. Another potential use is for desalination. The nano-enhanced material could be put in salty water then exposed to sunlight, producing enough energy to boil and evaporate the water, separating it from the salt. Gomez, who leads the Polaritonics Lab at RMIT, said the new technology could significantly increase the yield in the emerging photo-catalysis sector, with leading firms currently producing about 30kg of product each day using light as the driving force. "We all rely on products of the chemical manufacturing industry—from plastics and medicines, to fertilisers and the materials that produce the colours on digital screens," he said. "But much like the rest of our economy, it's an industry currently fuelled by carbon. "Our ultimate goal is to use this technology to harness sunlight efficiently and convert solar energy into

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chemicals, with the aim of transforming this vital industry into one that's renewable and sustainable."

Phys.org, 30 January 2019

<http://phys.org>

Dynamic aspirin -- molecular vibrations drive electrons over large distances

2019-02-01

Aspirin is not only an important drug but also an interesting physics model system in which molecular vibrations and electrons are coupled in a particular way. For the first time, x-ray experiments in the ultrashort time domain make electron motions visible in real time. They demonstrate that very small atomic displacements shift electrons over much larger distances within the aspirin molecules. The molecules couple to each other via comparably weak interactions and generate electric fields which exert a force on the electrons of every molecule. Upon excitation of molecular vibrations, the distribution of electrons in space and, thus, the chemical properties should change. While this scenario has been a subject of theoretical work, there has been no experimental demonstration and understanding of the molecular dynamics so far. Scientists of the Max Born Institute in Berlin, Germany, have now gained the first and direct insight in electrons motions during a coupled vibration of the aspirin molecules. In a recent issue of the journal *Structural Dynamics* [6,014503 (2019)], they report results of an x-ray experiment in the ultrashort time domain. An ultrashort optical pump pulse induces vibrations of the aspirin molecules with a vibrational period of approximately 1 picosecond (ps, a millionth of a millionth of a second). An ultrashort hard x-ray pulse, which is delayed relative to the pump pulse, is diffracted from the excited powder of crystallites to map the momentary spatial arrangement of electrons via an x-ray diffraction pattern. The animation in Figure 1c shows the rotational motion of the methyl (CH₃) group of an aspirin molecule which arises upon vibrational excitation. In the animation, the atomic displacements are artificially enlarged to make them visible. The methyl rotation is connected with a spatial shift of electrons over the entire aspirin molecule (yellow clouds, so-called isosurface of constant electron density). The periodic electron motions occur in time with the vibrational motions of the atoms and the distances travelled by the electrons are typically 10000 times larger than the atom displacements in the methyl rotation. This behaviour demonstrates the hybrid character of the methyl rotation which is comprised of both atomic and electron motions on totally

Aspirin is not only an important drug but also an interesting physics model system in which molecular vibrations and electrons are coupled in a particular way.

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different length scales. The hybrid character originates from the electric interaction between the aspirin molecules and the dynamic minimisation of electrostatic energy in the crystallite. These new results underline the central role of hybrid modes for the stabilisation of the crystal structure, in agreement with theoretical calculations. In the case of aspirin, this property favours the so-called form 1 of the crystal structure compared to other molecular arrangements. The strong modulation of the electron distribution by vibrations is relevant for numerous crystal structures in which electric interactions prevail. Vibrational excitations of ferroelectric materials should allow for an ultrafast switching of the macroscopic electric polarization and, thus, lead to new electronic devices for extremely high frequencies.

EurekAlert, 31 January 2019

<http://www.eurekalert.org>

New 3D printer shapes objects with rays of light

2019-02-01

A new 3D printer uses light to transform gooey liquids into complex solid objects in only a matter of minutes. Nicknamed the "replicator" by the inventors -- after the Star Trek device that can materialise any object on demand -- the 3D-printer can create objects that are smoother, more flexible and more complex than what is possible with traditional 3D-printers. It can also encase an already existing object with new materials -- for instance, adding a handle to a metal screwdriver shaft -- which current printers struggle to do. The technology has the potential to transform how products from prosthetics to eyeglass lenses are designed and manufactured, the researchers say. "I think this is a route to being able to mass-customize objects even more, whether they are prosthetics or running shoes," said Hayden Taylor, assistant professor of mechanical engineering at the University of California, Berkeley, and senior author of a paper describing the printer, which appears online 31 January in the journal Science. "The fact that you could take a metallic component or something from another manufacturing process and add on customizable geometry, I think that may change the way products are designed," Taylor said. Most 3D printers, including other light-based techniques, build up 3D objects layer by layer. This leads to a "stair-step" effect along the edges. They also have difficulties creating flexible objects because bendable materials could deform during the printing process, and supports are required to print objects of certain shapes, like arches. The new printer relies on a viscous liquid that reacts to form a solid when exposed to a

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certain threshold of light. Projecting carefully crafted patterns of light -- essentially "movies" -- onto a rotating cylinder of liquid solidifies the desired shape "all at once." "Basically, you've got an off-the-shelf video projector, which I literally brought in from home, and then you plug it into a laptop and use it to project a series of computed images, while a motor turns a cylinder that has a 3D-printing resin in it," Taylor said. "Obviously there are a lot of subtleties to it -- how you formulate the resin, and, above all, how you compute the images that are going to be projected, but the barrier to creating a very simple version of this tool is not that high." Taylor and the team used the printer to create a series of objects, from a tiny model of Rodin's "The Thinker" statue to a customized jawbone model. Currently, they can make objects up to four inches in diameter. "This is the first case where we don't need to build up custom 3D parts layer by layer," said Brett Kelly, co-first author on the paper who completed the work while a graduate student working jointly at UC Berkeley and Lawrence Livermore National Laboratory. "It makes 3D printing truly three-dimensional."

A CT scan -- in reverse

The new printer was inspired by the computed tomography (CT) scans that can help doctors locate tumours and fractures within the body. CT scans project X-rays or other types of electromagnetic radiation into the body from all different angles. Analysing the patterns of transmitted energy reveals the geometry of the object. "Essentially we reversed that principle," Taylor said. "We are trying to create an object rather than measure an object, but actually a lot of the underlying theory that enables us to do this can be translated from the theory that underlies computed tomography." Besides patterning the light, which requires complex calculations to get the exact shapes and intensities right, the other major challenge faced by the researchers was how to formulate a material that stays liquid when exposed to a little bit of light, but reacts to form a solid when exposed to a lot of light. "The liquid that you don't want to cure is certainly having rays of light pass through it, so there needs to be a threshold of light exposure for this transition from liquid to solid," Taylor said. The 3D-printing resin is composed of liquid polymers mixed with photosensitive molecules and dissolved oxygen. Light activates the photosensitive compound which depletes the oxygen. Only in those 3D regions where all the oxygen has been used up do the polymers form the "cross-links" that transform the resin from a liquid to a solid. Unused resin can be recycled by heating it up in an oxygen atmosphere, Taylor said. "Our technique generates almost no material waste and the uncured material

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is 100 percent reusable," said Hossein Heidari, a graduate student in Taylor's lab at UC Berkeley and co-first author of the work. "This is another advantage that comes with support-free 3D printing." The objects also don't have to be transparent. The researchers printed objects that appear to be opaque using a dye that transmits light at the curing wavelength but absorbs most other wavelengths. "This is particularly satisfying for me, because it creates a new framework of volumetric or 'all-at-once' 3D printing that we have begun to establish over the recent years," said Maxim Shusteff, a staff engineer at the Livermore lab. "We hope this will open the way for many other researchers to explore this exciting technology area."

EurekaAlert, 31 January 2019

<http://www.eurekaalert.org>

Silicones obtained at low temperatures with the help of air

2019-02-01

Russian scientists have developed a new method for synthesising para-carboxyphenylsiloxanes, a unique class of organosilicon compounds. The resulting compounds are promising for creating self-healing, electrically conductive, heat- and frost-resistant silicones. Organosilicon compounds, especially materials based on silicones, are among the most in-demand products. The ability to withstand incredible thermal and mechanical stress makes it possible to use silicones for sealing and protecting many items in aircraft and rocket construction. The strength and durability of silicones lends them to applications in medicine, food industry, and in many other fields of human life. Though many silicone materials have already been created and their fields of application have been found, scientists believe that their usability potential has not been fully realised. This is due to one of the central problems in the modern chemistry of silicones, namely, the synthesis of organosilicon products with a "polar" (-C(O)OH, -OH, -NH₂, etc.) functional group in an organic substituent. Such a moiety allows the easy introduction of other substituents, and the ability to tune the compound to repel water or to form stable aqueous emulsions, and to impart other "super-capabilities" to a material. This opens quite unique prospects for subsequent modification of these compounds in order to synthesize new copolymers, self-healing and conductive materials, and compounds for the storage and delivery of drugs and fuels. Just a small modification of a compound would also allow one to solve the problem of low mechanical strength and incompatibility of silicones with polymers, such as polyesters and others. With rare exceptions, the classical

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methods for synthesising silicones (first monomers, then polymers) cannot realise functional organosilicon substrates. As a rule, these methods are either applicable to a narrow range of substrates or are time-consuming, expensive and involve multiple stages. In recent years, there have been an increasing number of publications on the oxidation and functionalisation of organic compounds involving molecular oxygen, i.e., a “green,” simple and available oxidant. A number of industrially important processes already rely on this approach. However, despite all the advantages, these processes generally feature low selectivity and require drastic conditions (elevated temperature, high pressure, etc.). A team of scientists from A.N. Nesmeyanov Institute of Organoelement Compounds of the Russian Academy of Sciences (INEOS RAS), in collaboration with colleagues from the Russian Federation, used a combination of metallic and organic catalysts to solve these problems. The reaction conditions were softened and high process selectivity was achieved. The reaction occurred with involvement of molecular oxygen in liquid phase and at temperatures slightly above the room temperature, whereas many industrial processes are performed in gas phase under drastic conditions. The method can be scaled to gram amounts in order to produce a required compound. “Thus, we suggested a highly efficient method based on aerobic metal- and organo-catalysed oxidation of starting para-tolylsiloxanes to para-carboxyphenylsiloxanes. This approach is based on ‘green,’ commercially available, simple and inexpensive reagents, and employs mild reaction conditions,” says Dr. Ashot Arzumanyan, the leader and one of the contributors of this study, senior scientist of the K.A. Andrianov Laboratory. Furthermore, it has been shown that the suggested method is applicable to the oxidation of organic derivatives (alkylarenes) to the corresponding acids and ketones, as well as hydridosilanes to silanols (and/or siloxanols). The scientists also studied whether materials can be obtained on the basis of para-carboxyphenylsiloxanes, including an analogue of PET, which is used in beverage bottles, fibres for clothes and for technical applications. “The compounds that we obtained open prospects for the creation of self-healing, electrically conductive, heat- and frost-resistant and mechanically strong silicones. They can also serve as a basis for developing new hybrid materials that may find use in catalysis, drug delivery, fuel storage, and in other fields of science, technology and medicine,” Ashot notes.

Phys.org, 25 January 2019

<http://phys.org>

Platinum, a noble metal, is oxidised more quickly than expected under conditions that are technologically relevant.

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Platinum forms nano-bubbles

2019-02-01

Platinum, a noble metal, is oxidised more quickly than expected under conditions that are technologically relevant. This has emerged from a study jointly conducted by the DESY NanoLab and the University of Vienna. Devices that contain platinum, such as the catalytic converters used to reduce exhaust emissions in cars, can suffer a loss in efficacy as a result of this reaction. A team led by principal author Thomas Keller, from DESY and the University of Hamburg, has published a recent study of this phenomenon in *Solid State Ionics*. "Platinum is an extremely important material in technological terms," says Keller. "The conditions under which platinum undergoes oxidation have not yet been fully established. Examining those conditions is important for a large number of applications." The scientists studied a thin layer of platinum that had been applied to an yttria-stabilised zirconia crystal (YSZ crystal), the same combination that is used in the lambda sensor of automotive exhaust emission systems. The YSZ crystal is a so-called ion conductor, meaning that it conducts electrically charged atoms (ions), in this case oxygen ions. The vapour-deposited layer of platinum serves as an electrode. The lambda sensor measures the oxygen content of the exhaust fumes in the car and converts this into an electrical signal which in turn controls the combustion process electronically to minimise toxic exhausts. At DESY NanoLab, the scientists applied a potential difference of about 0.1 volts to the platinum-coated YSZ crystal and heated it to around 450 degrees Celsius—conditions similar to those found in many technical devices. As a result, oxygen collected beneath the impermeable platinum film reaching pressures of up to 10 bars, corresponding to that in the tyres of a lorry. The pressure exerted by the oxygen, along with the raised temperature, caused small bubbles to form inside the platinum film, typically having a diameter of about 1000 nanometres (0.001 millimetres). "Platinum blistering is a widespread phenomenon, and we would like to develop a better understanding of it," explains Keller. "Our investigation can also be considered representative of this type of electrochemical phenomenon at a range of other boundary layers." The scientists used a focused ion beam (FIB) as a sort of ultrasharp scalpel in order to slice open the platinum bubbles and examine their inside more closely. They found that the inner surface of the bubbles was lined with a layer of platinum oxide which could be up to 85 nanometres thick, much thicker than expected. "This massive oxidation took place in conditions under which it is not normally observed," reports co-author Sergey Volkov, who has written his doctoral thesis at the University of Hamburg on the topic. "As a rule, platinum

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is a highly stable material, which is precisely why it is chosen for many applications, such as catalytic converters in cars, because it is not easily altered. Our observations are therefore important for such applications." The scientists suspect that the high pressure of the oxygen within the bubble speeds up the oxidation of the metal. This needs to be taken into account in the operation of electrochemical sensors.

Phys.org, 28 January 2019

<http://phys.org>

Better batteries: The energy implications of organic radical polymers

2019-02-01

Texas A&M University professor Dr. Jodie L. Lutkenhaus is one step closer to realising her goal of creating a battery made entirely of polymers, which has the potential to charge and discharge much faster than traditional batteries. Lutkenhaus, an associate professor in the Artie McFerrin Department of Chemical Engineering, has detailed her most recent findings on these polymers in a paper in Nature Materials. A major hurdle to creating a metal-free, 100-percent polymer battery is finding a polymer that is electrochemically active -- meaning it has to be able to store and exchange electrons. Lutkenhaus, along with a team of researchers including doctoral candidate Shaoyang Wang, think that the organic radical polymers will do the trick. Owing to their chemical structure, organic radical polymers are very stable and reactive. They have a single electron on the radical group, and this unpaired electron allows rapid charge transfer in these polymers during redox reactions. According to Lutkenhaus, the main appeal of this class of polymer lies in the speed of the reaction. "These polymers are very promising for batteries because they can charge and discharge way faster than any common battery in a phone or similar device. This rapid charging could dramatically change the way electric vehicles are used today." The redox-active properties of organic radical polymers have been known for some time. However, prior to this research the exact mechanism by which electrons and ions are transported through the polymer had not been described. In part, the scale and speed at which these reactions take place make it difficult to capture reliable data. However, Lutkenhaus and her team were able to capture incredibly detailed measurements using a specialized device, an electrochemical quartz crystal microbalance with dissipation monitoring (EQCM-D). The use of an EQCM-D is actually quite simple, but it operates on tremendously small scales. Lutkenhaus explained the experimental

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setup: "As we charge and discharge the polymer, we are actually weighing it, so we know exactly how much it weighs even down to nanogram accuracy. The device is so sensitive that we can measure ions going in and out of the organic radical polymer." The results of the EQCM-D analysis led to somewhat unexpected results. Before this research the consensus was that only anions were transported in this process. However, the results show that lithium ions are transported as well. Further, the behaviour and transport of the ions seems to be more dependent on the electrolyte than the polymer itself. With this deeper understanding of the underlying processes, Lutkenhaus plans to take a closer look at the electrolyte polymer interactions.

Science Alert, 28 January 2019

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

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Insomnia Isn't Just One Disorder, Says New Study

2019-01-31

Researchers have come up with five different types of insomnia – types that might help doctors personalise specific treatments in the future, making them more effective and better tailored towards each individual with sleep problems. Contrary to what you might expect, these groupings aren't actually based on your typical sleep symptoms, such as trouble waking up or difficulty staying asleep. Instead, these new types are linked to other factors - stress, emotions, personality traits, mood, and previous life events. Applying labels Type 1 to Type 5, scientists showed how different people with insomnia had different cognitive characteristics, including levels of anxiety and emotional sensitivity. The study also showed participants tended to stay in the same type over time. "While we have always considered insomnia to be one disorder, it actually represents five different disorders," says one of the researchers, Tessa Blanken from the Netherlands Institute for Neuroscience. "Underlying brain mechanisms may be very different." "For comparison: progress in our understanding of dementia was propelled once we realised that there are different kinds, such as Alzheimer, vascular, and frontal-temporal dementia." Data was gathered from around 2,224 individuals showing self-reported symptoms of insomnia. They were asked to fill in questionnaires about personality traits that we already know are linked to brain structure and function, and compared with a control group. Type 1 individuals scored highly on distressing traits like neuroticism and feeling low, while those in the Type 2 and Type 3 groups both scored lower for distressing traits – though Type 2 respondents were generally more positive and content than Type 3. Type 4 and Type 5 individuals reported lower levels of distress, but Type 4 folk tended to experience long-lasting insomnia after stressful life events, whereas this wasn't noticeable in Type 5 people. In follow-up surveys taken five years later, the study participants were usually still in the same type group – an 87 percent probability, on average.

Knowing some of the traits behind a person's insomnia could help doctors come up with treatment that gets better results, the researchers say – Type 2 and Type 4 people had the most improvement in their sleep after taking benzodiazepine, for example. The people in the Type 2 bracket also responded well to cognitive behavioural therapy, whereas the people in Type 4 didn't. According to the team behind the work, people across all the different types had the same sort of insomnia symptoms, and it's here that previous attempts to split insomnia into different categories might have fallen down. Looking at the bigger picture could be a better way

"While we have always considered insomnia to be one disorder, it actually represents five different disorders," says one of the researchers

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to split people up. There are some limitations to talk about: firstly, these were individuals who reported insomnia symptoms, rather than people diagnosed with insomnia. Second, participation was voluntary, so it may not represent the population as a whole (just those who are happy filling out health questionnaires). Nevertheless, it's an interesting peek into how insomnia treatments might be improved in the future. Previous work has looked at some of the genetic risk factors for insomnia, another avenue for exploring more personalised treatments. Around one in ten people are thought to suffer from chronic insomnia, and it's known for significantly increasing the risk of depression and other mental illnesses too. Any help we can get in fighting it is going to be welcome. "Insomnia subtyping paves the way for studies that aim to prevent depression, resolve inconsistencies in and reduce heterogeneity of insomnia, and reveal differential causes of and develop better tailored personalised treatment for insomnia disorder," conclude the researchers. The research has been published in *The Lancet Psychiatry*.

Science Alert, 22 January 2019

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

The Sugar Pills in Your Birth Control Pack Were Put There to Placate The Pope

2019-01-31

For nearly 60 years, women have been taking the birth control pill in a less than ideal way, and weirdly enough, the reason is not scientific - instead, some of the thinking can be traced back to the Catholic Church. The seven inactive pills, included in most oral birth control packets, are not there for a medical reason. Each time a woman pops out a sugar pill, it is a reminder of a futile attempt to placate the Pope. When the first birth control pill hit the market in the 1960s, it had a profound impact on society, but just like any great medical breakthrough, its creation was shaped by more than just medicine. One of the gynaecologists working on the pill, John Rock, was Catholic. He knew that in order for the Pill to be accepted by the Catholic Church and its followers, it would have to be sold as a "natural" form of contraception based on hormones already present in the female body. While the Church had condemned unnatural contraception like condoms, the rhythm method - which is when couples time sexual intercourse with certain phases of the menstrual cycle - was deemed perfectly normal and acceptable. According to American journalist Jonathan Eig, the symptoms induced by the hormonal contraceptives made women think they were pregnant, so Rock and

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his collaborators advised women to skip the pills for five days before starting the next pack, which would trigger a false period and assure them a pregnancy had not taken place. In addition, this usage would make the pill feel more 'natural', and Rock thought this might appease the Catholic Church, too. Of course, it was difficult to correctly count days and remember when to start the next pill pack, so soon enough brands entered the market that marked the off days with sugar pills. In terms of religious acceptance, all those efforts were made in vain, though. In 1968, years after FDA approval, Pope Paul VI declared all forms of "artificial" contraception to be against church doctrine. He even tried to pass it off as a favour to women, arguing that "a man who grows accustomed to the use of contraceptive methods may forget the reverence due to a woman, and, disregarding her physical and emotional equilibrium, reduce her to being a mere instrument for the satisfaction of his own desires." But even though Rock's olive branch failed, by then it was too late. After eight years of being on the market, 'off days', often marked with sugar pills, had become a standard of hormonal contraception, and the withdrawal bleeds they induce were often thought of as necessary, real periods, even though they aren't technically the same. While there hasn't been a long-term study on the continuous use of oral contraceptives, today most gynaecologists agree that bleeding each month is medically unnecessary and that skipping a period is perfectly safe. In fact, not only is there no apparent harm that accompanies continuous usage, recent research suggests that missing out on a menstrual cycle may actually be beneficial to women in several ways. A study from 2014, for instance, found that women who continuously took the pill "fared better in terms of headaches, genital irritation, tiredness, bloating, and menstrual pain." What's more, some research has found that continuous use of oral contraceptives can help patients manage their endometriosis better, reducing pelvic pain, boosting sexual activity, and generally improving the quality of life for this debilitating condition. It's taken decades, but medical guidelines are finally catching up to the facts. The United Kingdom's National Health Service (NHS) is the latest government body to shake itself free of this common misconception. Adhering to the best available evidence and expert consensus, the institute's Faculty of Sexual and Reproductive Healthcare (FSRH) has now admitted that there is no health benefit to a seven-day break from the birth control pill, and, as such, this form of birth control can be taken every day of the month. The new guidelines argue that the consistent use of oral contraceptives "is associated with a reduced risk of endometrial, ovarian and colorectal cancer", not to mention the benefits of "predictable bleeding patterns, reduction in menstrual bleeding and pain, and management of symptoms of polycystic ovary syndrome (PCOS),

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endometriosis and premenstrual syndrome."There's even a theory that continuous use of the Pill can reduce the risk of unwanted pregnancies caused by 'escape ovulation', although conclusive evidence supporting this idea is still missing. "The guideline suggests that by taking fewer hormone-free intervals – or shortening them to four days – it is possible that women could reduce the risk of getting pregnant on combined hormonal contraception," Diana Mansour, vice president for clinical quality at FSRH, told The Independent. Obviously, not every woman will want to skip their sugar pills. Some might still find it comforting to have their period each month, a reassurance that childbirth is not a reality of the near future. But we need to equip women with the proper facts. To this day, many women are still unaware that skipping their period is even an option, and many continue to believe that if they do so, they might be putting their health at risk. Governments should follow the UK's example so that women around the world can make their own decisions about how they want to live their lives. After decades of misinformation and misunderstandings, it's the least we can do.

Science Alert, 21 January 2019

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

More blood pressure drugs may have shortages after recalls: FDA

2019-01-31

Additional shortages of blood pressure drugs in the United States are possible following recent recalls related to traces of a probable carcinogen found in some versions a particular class of hypertension medicines, the U.S. Food and Drug Administration said recently. The drugs, including valsartan, belong to a class of widely-used medicines for treating high blood pressure called angiotensin II receptor blockers, or ARBs. Valsartan is the generic of Novartis' Diovan. The FDA also said it may have identified the root cause of the potentially cancer-causing impurities but that it is still investigating. The recalls began last summer after the FDA was informed that ingredients used by Chinese manufacturer Zhejiang Huahai Pharmaceuticals Co (Huahai) to produce valsartan contained the impurities. The FDA later halted all imports from one of Huahai's factories. Other manufacturers have also had to recall valsartan after the impurities were found in their versions of the drug as well. It is currently listed as in shortage by the FDA. Some generic versions of other ARBS, such as losartan and irbesartan, have also been recalled. The agency said that it determined that the impurities "may be generated when specific

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chemicals and reaction conditions are present in the manufacturing process” and “may also result from the reuse of materials, such as solvents.” The reuse of solvents is an accepted practice in the industry, but manufacturers are generally expected to ensure that reused materials meet certain safety standards.

Reuters Health, 26 January 2018

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

Childhood lead exposure tied to adult mental health issues

2019-01-31

Beyond the well-known effects of childhood lead exposure on IQ, a new study suggests lasting effects on the brain may extend to personality traits in adulthood. Among more than 500 New Zealanders whose blood lead levels were tested when they were children, those with higher levels as kids were more likely to have personality traits that have been linked to a number of poor life outcomes, including greater psychopathology, worse physical health, less job satisfaction and troubled interpersonal relationships. “We were following up in folks who were born decades ago when lead was still very much present in our atmosphere,” said Aaron Reuben, a doctoral candidate in clinical psychology at Duke University in Durham, North Carolina. “We asked the question: if a person was exposed to lead in childhood, would it affect them in adulthood in terms of their mental health and personality?” Although the effects Reuben’s team found were “modest,” they were comparable to results in past studies in these same New Zealanders, including a small drop in IQ and a slightly greater risk for criminal behaviour, he said. Moreover, the impact of lead turned out to be comparable to that of other modifiable risk factors, such as abuse during childhood. Peak levels of lead in the air coincided with its use in gasoline between the 1940s and the early 1990s, Reuben’s team writes in *JAMA Psychiatry*. From 1976 to 1980, they note, the average child in the U.S. had blood lead levels three times higher than the current standard for clinical attention. The researchers analysed data from a large multigenerational health study, focusing on 579 people born in 1972 and 1973 in Dunedin, New Zealand. Participants had their blood tested for lead at age 11 and were interviewed every two to six years in adulthood to check for indicators of mental disorders. They were also asked to nominate people who knew them well to describe them using a 25-item questionnaire that measured five personality traits: neuroticism, extraversion, openness to experience, agreeableness and

Beyond the well-known effects of childhood lead exposure on IQ, a new study suggests lasting effects on the brain may extend to personality traits in adulthood.

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conscientiousness. The results showed that people with higher lead levels as kids “were a little more neurotic, a little less agreeable, a little less conscientious,” Reuben said. “And those factors influence how well you do in your job and interpersonal relationships.” Each 5-microgram per decilitre increase in blood lead levels at age 11 was associated with a 34 percent increase in adulthood in the odds of general psychopathological symptoms like disordered thinking, and with small increases in levels of neuroticism as well as decreases in agreeableness and conscientiousness, the study found. These associations cannot prove cause and effect, but the researchers were able to account for a variety of factors that might influence the results. For example, they show that childhood socioeconomic status was not linked to the adult psychiatric traits. While other studies have looked at the effects of lead exposure on the risk of future antisocial behaviour, ADHD and IQ, “these researchers looked at personality traits,” said Joel Nigg, a professor of psychiatry, paediatrics and behavioural neuroscience at the Oregon Health and Science University in Portland. “That’s a nice extension.” It’s important to note “that those were pretty high blood levels of lead compared to what you see today,” said Nigg, who was not involved in the new study. “They are about 10 times as high as you see in American kids today.” Still, Nigg said, “there’s a lot of work showing that much lower levels of lead are related to mental health problems in children. Though we don’t have longitudinal data, the short-range data show the same kinds of effects (as reported in the new study) at low lead levels.” Nigg’s own research has shown that genetics can play a role in the impact of lead exposure. “The effect of lead on development can be very different depending on one’s genetic makeup,” he said. That means that the effects measured in a study like Reuben’s might be bigger for some kids and smaller for others than the average that is reported, Nigg said. “Our study showed that some kids were very susceptible in terms of ADHD.”

Reuters Health. 24 January 2019

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

Common pain reliever can improve survival in head and neck cancer

2019-01-31

Regular use of a common type of medication, such as aspirin and ibuprofen, significantly improves survival for a third or more patients with head and neck cancer, a new study led by UC San Francisco has found. Non-steroidal anti-inflammatory drugs, or NSAIDs, improved the

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overall five-year survival rate from 25 percent to 78 percent for patients whose cancer contained a specific altered gene, known as PIK3CA, the researchers reported. The survival for patients whose gene was not altered in their tumour, was unaffected by NSAID use. This is the first study to show a strong clinical advantage of regular NSAID use for head and neck cancer patients with mutations in the PIK3CA gene and may indicate a clear, biological reason to implement NSAID therapy in certain cases of the disease, said the authors. The paper is published 25 January 2019 in the *Journal of Experimental Medicine*. "Our results suggest that the use of NSAIDs could significantly improve outcomes for not only head and neck cancer patients, but also patients with other cancers that contained the PIK3CA mutation," said Jennifer R. Grandis, MD, a UCSF professor of otolaryngology, head and neck surgery, and senior author of the paper. "The magnitude of the apparent advantage is strong, and could potentially have a positive impact on human health," Grandis said. Within head and neck squamous cell carcinoma, PIK3CA is the most commonly altered oncogene, with 34 percent of all tumours carrying mutations that activate the PIK3CA gene. In head and neck cancer associated with the human papillomavirus (HPV), PIK3CA is mutated in more than half of tumours. Head and neck squamous cell carcinoma is a complex malignancy that carries a poor prognosis: the five-year survival rate is about 45 percent. According to the American Cancer Society, head and neck cancer accounts for approximately 4 percent of all cancers in the United States, with an estimated 65,000 people developing it annually. While the disease can occur in the young, most patients are above age 50 when diagnosed. Primary risk factors include smoking, alcohol use, and HPV infection. NSAIDs, which include over-the-counter drugs such as ibuprofen and aspirin, are known to relieve pain and reduce inflammation, fever and blood clots. They are the most frequently-prescribed medication for conditions such as arthritis. In the new research, 266 patients from the University of Pittsburgh Medical Centre whose tumours were surgically removed were investigated by the study authors. The majority (84 percent) smoked and 67 percent received post-surgery chemotherapy and/or radiotherapy. Median overall survival was 66 months. Altogether, 75 tumours (28 percent) in the study had an activating alteration of the PIK3CA gene. Among the patients who regularly used NSAIDs, 93 percent used aspirin as a component of the NSAID regiment, and 73 percent took aspirin exclusively. Most of the regular users started on the aspirin therapy following their head and neck cancer diagnosis. The investigators learned that regular use of NSAIDs for at least six months provided "markedly prolonged" improved survival compared to non-use for patients whose PIK3CA gene was mutated or amplified—in these patients, NSAIDs raised

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overall five-year survival from 25 to 78 percent. However, patients without alterations in their PIK3CA gene were no better off by taking NSAIDs. Through analysis of both cell line and mouse studies, the researchers speculated that NSAIDs likely blocked tumour growth by reducing the production of an inflammatory molecule called prostaglandin E2. The researchers pointed out that their results need to be corroborated in a prospective trial. Additionally, they noted limitations, including the small size of the study group, as well as the type, timing, and dosages of NSAIDs taken by patients. "NSAID use likely confers a statistically and clinically significant advantage in overall survival in PIK3CA-altered head and neck cancer through direct interaction between the PI3K and COX pathways," said Grandis, a member of the UCSF Helen Diller Family Comprehensive Cancer Centre. "Given the marked mortality of this disease," she said, "the researchers have designed a prospective, randomized clinical trial to address the initial study's limitations and assess the clinical significance of this therapeutic use."

Medical Xpress, 25 January 2019

<http://medicalxpress.com>

Neurotoxic cyanotoxins prevalent in eastern Australian freshwater systems

2019-01-31

Scientists have confirmed the presence of an amino acid, BMAA, thought to be associated with a higher incidence of neurodegenerative disease, in eastern Australian freshwater systems, and have identified some of the cyanobacterial species responsible for its production. Detectable levels of BMAA were found in 89% of samples examined, with some samples containing the highest levels ever recorded. BMAA (β -methylamino-L-alanine) is a toxin produced by cyanobacteria, more commonly known as blue-green algae, which, under the right conditions, grow excessively to form blooms. Such blooms are a regular feature of Australian inland waterways and are increasing due to nutrient run-off, reduced river flows and climate change. The toxin was first linked to neurodegenerative disease in the 1940s and more recent global studies have implicated BMAA in an increased incidence of amyotrophic lateral sclerosis (ALS)/motor neuron disease (MND) worldwide. Eleven freshwater sites from across NSW, including lakes streams creeks and dams, were sampled by researchers from The University of Technology (UTS) to see if it was possible to isolate the cyanobacterial species and create single species cultures that could be tested for these toxins. Associate Professors Ken

The presence of an amino acid, BMAA, produced by blue-green algae (cyanobacteria) and thought to be associated with a higher incidence of neurodegenerative disease, has been confirmed in eastern Australian freshwater systems.

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Rodgers and Simon Mitrovic, who led the study, said that all the sites were associated with regular blooms and many were from areas that have been tentatively linked to increased incidence of neurodegenerative diseases including Griffith in NSW. Earlier studies from this research team showed that BMAA, and one of its toxic isomers 2,4-DAB, were present in scum samples from Australian freshwater sites but this is the first time the cyanobacterial species responsible for toxin production have been identified. From the samples in this study, the primary researcher, Jake Violi, was able to establish 19 single-species cyanobacterial cultures and extract the amino acids for analyses. The research team from UTS which also included Dr Anne Colville used a highly sensitive analytical method known as liquid-chromatography-tandem mass spectrometry to analyse the samples for the toxins. Of the 19 cyanobacterial isolates 89% had detectable levels of BMAA and the toxin was detected in at least one culture isolated from each location. Some sites sampled included Anzac Creek in Sydney, Lake Wyangan near Griffith and Lostock Dam in the Hunter Region. "This shows the prevalence of BMAA in Australian freshwater environments and reflects/accords with results from overseas studies," Jake Violi said. The research, published in *Ecotoxicology and Environmental Safety* found the highest concentration of BMAA in cyanobacterial isolates reported in the published literature. The researchers conclude that the prevalence, abundance and high concentrations of the cyanotoxins found in Eastern Australian freshwater environments necessitates ongoing monitoring and analysis so that safe levels can be determined and guidelines established.

Science Daily, 24 January 2019

<http://www.sciencedaily.com>

Zinc deficiency may play a role in high blood pressure

2019-01-31

Lower-than-normal zinc levels may contribute to high blood pressure (hypertension) by altering the way the kidneys handle sodium. The study is published ahead of print in the *American Journal of Physiology -- Renal Physiology*. Zinc deficiency is common in people with chronic illnesses such as type 2 diabetes and chronic kidney disease. People with low zinc levels are also at a higher risk for hypertension. The way in which the kidneys either excrete sodium into the urine or reabsorb it into the body -- specifically through a pathway called the sodium chloride cotransporter (NCC) -- also plays a role in blood pressure control. Less sodium in the urine typically corresponds with higher blood pressure. Recent research

Link found between zinc, blood pressure and kidney sodium transporter in mouse study

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has suggested that zinc may help regulate proteins that in turn regulate the NCC, but a direct link between zinc-deficiency-induced hypertension has not been examined. Researchers compared male mice with zinc deficiency to healthy controls with normal zinc levels. The zinc-deficient mice developed high blood pressure and a corresponding decrease in urinary sodium excretion. The control group did not experience the same changes. A small group of the zinc-deficient mice were fed a zinc-rich diet partway through the study. Once the animals' zinc reached adequate levels, blood pressure began to drop and urinary sodium levels increased. "These significant findings demonstrate that enhanced renal [sodium] reabsorption plays a critical role in [zinc-deficiency]-induced hypertension," the research team wrote. "Understanding the specific mechanisms by which [zinc deficiency] contributes to [blood pressure] dysregulation may have an important effect on the treatment of hypertension in chronic disease settings," the researchers added.

Science Daily, 24 January 2019

<http://www.sciencedaily.com>

You've Been Wearing That Cast On Your Ankle Twice As Long As Necessary

2019-01-31

If you've ever damaged your ankle and spent weeks hobbling around in a cast while it healed, we have some deeply annoying news. You could probably have been out of the cast in half the time and healed as well or better. The new finding raises questions as to how many other body parts are also being immobilised for longer than is necessary, the cumulative inconvenience of which adds up to a significant chunk of people's lives. Not all medical treatment's protocols are based on solid research. There have been plenty of studies comparing the benefits of wearing a cast for bone fractures compared to other options, but how long the cast is needed hasn't had the same attention. Dr Tero Kortekangas of Finland's Oulu University Hospital noted casts come with a cost. The longer a limb is immobilised the greater the chance of skin damage, deep vein thrombosis, and stiffness after release. Then there is the physical inconvenience of someone trying to get on with life. Kortekangas enrolled a group of patients who had suffered the most common sort of ankle fracture, but didn't require surgery. A third of patients were assigned to wear a cast for three weeks, a third made do with an ankle brace, while the rest wore the cast for the traditional six weeks. A year after the injury, those who had worn the cast for six weeks actually had the worst outcomes, with an

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average score of 87.6 on a healing measure, compared to 91.7 for those whose cast came off after three weeks. Those wearing a brace fell in between, but the differences were not statistically significant. On measures of pain, and quality of life all three groups were equal by this point, while those given the brace had somewhat greater ankle movement. Unless you're Chris Pratt's character in Parks and Recreation, you're probably keen to get the cast off as soon as possible. These results, published in the British Medical Journal suggest people are being partially incapacitated for at least three unnecessary weeks to end up with similar, or even slightly worse, outcomes at the end. Three weeks is not so much to lose, and ankle fractures are not particularly common. Kortekangas and co-authors note the 247 participants account for a large proportion of Finns over the age of 16 injured in this way during the trial period, although those with a history of previous fractures or ligament injuries to their ankle were excluded. However, the implications may be much more widespread. People with a variety of bone injuries may be spending more time than needed lugging around large lumps of plaster, simply because no one checked.

IFL Science, 25 January 2019

<http://www.iflscience.com>

There's A Surprising Link Between Your Risk Of Alzheimer's And Your Dental Health

2019-01-31

You've probably heard that a healthy dose of crossword puzzles and light exercise can help stave off dementia, but it seems something even simpler might protect your brain – keeping your teeth clean. According to new research published in the journal Science Advances, there is a significant link between the bacterium *Porphyromonas gingivalis* – the main cause of chronic gum disease – and Alzheimer's. A team of scientists from the University of Louisville found *P. gingivalis* in the brains of deceased people who suffered from Alzheimer's. They also discovered the bacterium's DNA in their spinal fluid and toxic enzymes called gingipains, which are produced by the microbe, in their brains. The same brains also contained higher levels of tau protein and ubiquitin, which are both linked to Alzheimer's disease. Interestingly, the brains of 50 control bodies, who were elderly but did not suffer from Alzheimer's, contained low levels of gingipains. This is important because previous studies have found a link between *P. gingivalis* and Alzheimer's before, but it's been unclear whether poor oral care is just a side effect of dementia. These findings suggest that it's the other way around, and that the control patients might have

You've probably heard that a healthy dose of crossword puzzles and light exercise can help stave off dementia, but it seems something even simpler might protect your brain – keeping your teeth clean.

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gone on to develop the disease if they had lived longer and the gingipains had built up more. The team then turned to mice to see whether *P. gingivalis* enters the brain following a mouth infection. Over six weeks, they established infections in the mouths of otherwise healthy mice and indeed discovered the presence of the bacterium in their brains. They also found dying nerve cells and high levels of beta-amyloid protein, a hallmark of Alzheimer's disease. While the new results are certainly exciting, and the study is the largest ever to investigate the link between Alzheimer's and *P. gingivalis*, it's important to note that it doesn't prove the bacterium causes Alzheimer's, just that it is likely a contributing factor. "We now have strong evidence connecting *P. gingivalis* and Alzheimer's pathogenesis, but more research needs to be done before *P. gingivalis* is explicitly implicated in the causation or morbidity of Alzheimer's disease," said study co-author Jan Potempa. "We know diseases like Alzheimer's are complex and have several different causes, but strong genetic evidence indicates that factors other than bacterial infections are central to the development of Alzheimer's, so these new findings need to be taken in the context of this existing research," added David Reynolds, Chief Scientific Officer at Alzheimer's Research UK. The team even managed to find a way to kill *P. gingivalis* in the brains of mice. They used a compound that targeted the gingipains, which likely supply nutrients to the bacteria, to successfully kill off the bacteria, reducing neurodegeneration and the formation of beta-amyloid protein. Biotech start-up Cortexyme, Inc., who sponsored the new research, has previously shown a similar drug to be safe and tolerable in both healthy old people and those with Alzheimer's in a Phase 1 clinical trial. They hope to conduct a Phase 2 trial to further test out their drug soon.

IFL Science, 24 January 2019

<http://www.iflscience.com>

A High-carb diets may explain why Okinawans live so long.

2019-01-31

The search for the "elixir of youth" has spanned centuries and continents – but recently, the hunt has centred on the Okinawa Islands, which stretch across the East China Sea. Not only do the older inhabitants enjoy the longest life expectancy of anyone on Earth, but the vast majority of those years are lived in remarkably good health too. Of particular note is the number of people who reach 100 years of life. For every 100,000 inhabitants, Okinawa has 68 centenarians – more than three times the

Scientists have found a peculiarly high ratio of carbohydrates to protein in the Okinawan diet.

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numbers found in US populations of the same size. Even by the standards of Japan, Okinawans are remarkable, with a 40% greater chance of living to 100 than other Japanese people. Little wonder scientists have spent decades trying to uncover the secrets of the Okinawans' longevity – in both their genes and their lifestyle. And one of the most exciting factors to have recently caught the scientists' attention is the peculiarly high ratio of carbohydrates to protein in the Okinawan diet – with a particular abundance of sweet potato as the source of most of their calories. "It is quite the opposite of current popular diets that advocate a high protein, low carb diet," says Samantha Solon-Biet, who researches nutrition and ageing at the University of Sydney. Despite the popularity of the Atkins and Paleo diets, however, there is minimal evidence that high-protein diets really do bring about long-term benefits. So, could the "Okinawan Ratio" – 10:1 carbohydrate to protein – instead be the secret to a long and healthy life? Although it would still be far too early to suggest any lifestyle changes based on these observations, the very latest evidence – from human longitudinal studies and animal trials – suggest the hypothesis is worth serious attention. According to these findings, a low protein, high carbohydrate diet sets off various physiological responses that protect us from various age-related illnesses – including cancer, cardiovascular disease and Alzheimer's disease. And the Okinawan Ratio may achieve the optimal dietary balance to achieve those effects. Much of this research comes from the Okinawa Centenarian Study (OCS), which has been investigating the health of the ageing population since 1975. The OCS examines inhabitants from across the Okinawa prefecture, which includes more than 150 islands. By 2016, the OCS had examined 1,000 centenarians from the region. Rather than suffering a prolonged demise, the Okinawan centenarians appeared to have delayed many of the usual effects of ageing, with almost two thirds living independently until the age of 97. This remarkable "healthspan" was evident across many age-related diseases. The typical Okinawan centenarian appeared to be free of the typical signs of cardiovascular disease, without the build-up of the hard "calcified" plaques around the arteries that can lead to heart failure. Okinawa's oldest residents also have far lower rates of cancer, diabetes and dementia than other ageing populations.

Genetic jackpot

Given these results, there is little doubt that Okinawa has an exceptional population. But what can explain that extraordinary longevity? Genetic good fortune could be one important factor. Thanks to the geography of the islands, Okinawa's populations have spent large chunks of their

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history in relative isolation, which may have given them a unique genetic profile. Preliminary studies suggest this may include a reduced prevalence of a gene variant – APOE4 – that appears to increase the risk of heart disease and Alzheimer's. They may also be more likely to carry a protective variant of the FOXO3 gene involved in regulating metabolism and cell growth. This results in a shorter stature but also appears to reduce the risk of various age-related diseases, including cancer. Even so, it seems unlikely that good genes would fully explain the Okinawans' longevity, and lifestyle factors will also be important. The OCS has found that Okinawans are less likely to smoke than most populations, and since they worked predominantly in agriculture and fishing, they were also physically active. Their tight-knit communities also help the residents to maintain an active social life into old age. Social connection has also been shown to improve health and longevity by reducing the body's stress responses to challenging events. (Loneliness, in contrast, has been shown to be as harmful as smoking 15 cigarettes a day.) It is the Okinawans' diet, however, that may have the most potential to change our views on healthy ageing. Unlike the rest of Asia, the Okinawan staple is not rice, but the sweet potato, first introduced in the early 17th Century through trade with the Netherlands. Okinawans also eat an abundance of green and yellow vegetables – such as the bitter melon – and various soy products. Although they do eat pork, fish and other meats, these are typically a small component of their overall consumption, which is mostly plant-based foods. The traditional Okinawan diet is therefore dense in the essential vitamins and minerals - including anti-oxidants - but also low in calories. Particularly in the past, before fast food entered the islands, the average Okinawan ate around 11% fewer calories than the normal recommended consumption for a healthy adult. For this reason, some scientists believe that Okinawans offer more evidence for the life-enhancing virtues of a "calorie restricted" diet. Since the 1930s, some doctors and scientists have argued that continuously limiting the amount of energy you consume could have many benefits above and beyond weight loss – including a deceleration of the ageing process. In one of the most compelling experiments, a group of rhesus macaques eating 30% fewer calories than the average monkey showed a remarkable 63% reduction in deaths from age-related diseases over a 20-year period. They also looked younger – they had fewer wrinkles and their fur retained its youthful lustre rather than turning grey. Due to practical difficulties, long-term clinical trials in humans have yet to be completed to test the effects on longevity, but a recent two-year experiment, funded by the US National Institute on Aging, was highly suggestive: participants on a calorie restricted diet showed better cardiovascular health – including lower blood pressure

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and cholesterol. It's still not clear why a calorie restricted diet would be so beneficial, but there are many potential mechanisms. One possibility is that calorie restriction alters the cell's energy signalling, so that the body devotes more resources to preservation and maintenance – such as DNA repair – rather than growth and reproduction, while limiting 'oxidative stress' caused by the toxic by-products of metabolism that can cause cellular damage.

The benefits of the Okinawan Diet may not end with its calorie restriction

Solon-Biet has conducted a series of studies examining the influence of dietary composition (rather than sheer quantity) on ageing in animals, and her team has consistently found that a high-carb, low-protein diet extends the lifespan of various species, with her most recent study showing that it reduces some of the signs of ageing in the brain. Amazingly, they have found that the optimum ratio is 10 parts carb to one-part protein – the same as the so-called Okinawan Ratio. Although there aren't yet any controlled clinical trials in humans, Solon-Biet cites epidemiological work across the world that all point to similar conclusions. "Other long-lived populations have also been shown to have dietary patterns that include relatively low amounts of protein," she says. "These include the Kitavans, [who live on] a small island in Papua New Guinea, the South American Tsimane people and populations that consume the Mediterranean diet." Once again, the exact mechanisms are murky. Like calorie restriction, the low protein diets seem to promote the cell repair and maintenance. Karen Ryan, a nutritional biologist at the University of California, Davis, points out that the scarcity of amino acids can encourage cells to recycle old material (rather than synthesising new proteins). "Together, these changes may prevent the ageing-associated accumulation of damaged proteins within cells," she says. This build-up of damaged proteins may usually be responsible for many diseases, she says – but the regular clean up when we eat a low-protein diet could prevent it. So, should we all start adopting the Okinawan Diet? Not quite. Ryan points to some evidence that low protein intake may limit bodily damage up to the age of 65, but you may then benefit from increasing your protein intake after that point. "Optimal nutrition is expected to vary across the life history," she says. And it's also worth noting one study, which found that the relative merits of protein and carbohydrates may depend on the protein's source: a diet higher in plant-based protein appears to be better than a diet rich in meat or dairy, for instance. So, the Okinawans may be living longer due to the fact that they are eating (mostly) fruit and vegetables, rather than its high carb, low protein content. Ultimately, the Okinawans' health is probably due to

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a lucky confluence of many factors, Ryan says. "And specific interactions among these factors will also be important." And we may need many more years of research to understand the importance of each of those ingredients before we finally come up with a true recipe for the "elixir of youth".

BBC Future Now, 18 January 2019

<http://news.bbc.co.uk>

The coldest jobs in the world

2019-01-31

The polar oceanographer

Madi Rosevear, 27, PhD student, works in Antarctica and lives in Hobart, Tasmania. I'm about to go on my third research trip to Antarctica. For my first, we flew in from New Zealand to our base. From the air it's just blue and white: icebergs and sea ice, and valleys full of high-glaciated mountains. You don't see any wildlife and even seeing exposed rock is a rarity. It's stunning. The runway at the research base is ice, no tarmac. Stepping off the plane, the air is so cold and dry (it's often around -25C) that it instantly sucks the moisture out of everything. It can be hard to breathe. I'm doing a PhD looking at how the oceans are melting Antarctic ice shelves. An ice shelf is like a cork in a bottle – if you pull out the cork, grounded ice starts to flow more rapidly into the ocean. The work I'm doing is measuring the Totten Glacier, which is in quite a vulnerable region. We go in the summer months – December and January. There's daylight 24 hours a day. For maybe an hour the sun dips below the horizon and it gets a little dusky. The research base is a small, closed community of scientists and base staff. I struggle with the danger of the cold and that it keeps you confined to the base a lot of the time. If you want to get out and have time on your own, you have to jump through a lot of hoops. With the remote location, I find the loss of personal freedom hard. I miss feeling in control of my own life. I work in a team of four and our trips are 10 weeks long. We are flown to the glacier. The first time we got dropped off, and the helicopter flew away, I was overwhelmed to be in such an isolated place. I felt like a tiny person in a huge expanse and it was quiet, quiet, quiet like you couldn't believe. It was emotionally intense. Our priority is to find six equipment towers in the snow that were placed on the glacier the previous year. They're light aluminium frames that house our monitoring equipment. Year to year the towers move up to 1km due to the flow of the glacier. We only have the last known GPS positions to try to locate

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them. The biggest challenge is keeping my hands warm, because I need good dexterity. I work with them bare and then ball them up quickly in big mittens. I don't use gloves, because as soon as my fingers are separate, they're gone. I'm also never without my Thermos. I quite happily immerse myself in my new little community and don't miss my friends and family too much. But when I return to Hobart, I'm happy to no longer have to always tell someone where I'm going, or have to take someone else along with me.

The cold storage manager

Matt Bennett, 26, industrial freezer team leader, Chiltern Cold Storage, Peterborough. There are three doors to get into the freezer. They're sealed and air-locked to keep the cold in. When you enter, you get a big waft of cold air in your face. The temperature's between -18C and -25C. But if you're working at the back when the fans kick in, it feels like -30C. Sometimes you find snowflakes hanging about. If I'm doing a morning shift, I get up at 4am, but I have to be quiet as I have a missus and three children. I'll put on my thermal socks, thermal vest, T-shirt, sweatshirt and jacket. And then a woolly jacket. When I get to work, I put on a pair of overalls, a freezer jacket, freezer boots and woolly hat. Over that I wear a hard hat that has a neck wrap and ear muffs. The warehouse is quite dark, like a cave. It's filled with long aisles and pallets stacked high. We mainly store meat: there's beef, lamb, chicken and turkeys for Christmas. It comes from all over: Spain, Italy, Brazil. Tesco stores salmon here, also Greggs, Wetherspoon's. We have other bits and bobs, too. Last year we had big ice sculptures and ice glasses for an ice bar in London, and we've had ice samples from the Antarctic for scientists. After about half an hour my goatee starts to frost up. After two hours I look like Santa Claus. My beard goes hard and when I breathe, I feel it melt and run, and then it'll refreeze. Sometimes my lips get stuck together. The summer months are the weirdest, because first you come out of the warehouse and get blinded by the sun and then after a few minutes of warming up you start sweating, so you take all your gear off. When I leave, I stay away from heat to let my fingers defrost by themselves, otherwise you get a horrible burning feeling. I've done this job for five years and I enjoy it. The day goes fast, as there's so much to do. I started as a warehouse operative and worked my way up. I now introduce new staff to the freezer. After 20 minutes some will say: "Nah, not for me, far too cold." The more you think about it, the more you get cold. If you just focus on the job, you crack on and get it done.

The avalanche forecaster

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Jimmy Tart, 41, ski patroller and avalanche educator, Utah. I experienced hypothermia while working once. In 2005 I was in Vail, Colorado, and was standing on a ridgeline for more than an hour in 60mph winds that created a -40C wind-chill zone. It was the day after a big storm and the visibility was low. It's an understatement to say I felt cold. It was awful. It became difficult to move. When your body temperature drops below a certain point, blood stops being sent to your appendages in an effort to keep your brain warm. I stopped shivering. My hands and feet felt like ice blocks. I've been working in snow safety for 16 years. I'm trained to forecast, avoid and mitigate avalanches and to educate the public on them. On a morning with new snow, I go with a team up to ski areas and we plan out and cause controlled avalanches while the area is closed. We use our knowledge of the terrain and watch weather patterns, because that drives everything. For example, winds can transport snow to a sheltered slope and force the top layer of snow grains together, creating a hard slab to form over soft, older snow. The effect is like putting a textbook on top of potato chips; it becomes vulnerable to collapse. To make areas like that safe, we throw 2lb hand explosives into the snow to create pressure that can trigger an avalanche. Our work makes the danger of avalanches to the public minimal. But to us it can still be very real. On that morning in 2005 it was all well planned, as it always is – multiple teams working their way down the ridgeline, coordinating on radio so we don't get underneath somebody who's about to create an avalanche. But small delays here and there, and the next thing we knew, my route partner and I were standing out for longer than we should have been. Our supervisor, Colin, had skied down to a safe spot about 500ft below us to assess the conditions in the bowl. We told him we had one explosive left, and, to avoid the hazard of taking it back to our cache, he told us to throw it. We threw it into the bowl where we'd already put multiple charges, but it created an unexpected mid-size avalanche above where Colin was standing. The avalanche was large enough to bury people and trees. It must have taken between 10 to 15 seconds for the avalanche to run its path and the powder cloud to settle. I was looking down and knew something wasn't right, but my brain was working so slowly I couldn't tell what it was. We tried to call Colin, but he didn't respond. I wasn't panicking, because I couldn't think properly. The powder cloud following the avalanche had knocked Colin off his feet and he had nearly been buried. Luckily the debris flow missed him and he was OK. Not being able to think during something so dangerous was a strange sensation. The job involves a lot of standing around in snow. We also forecast for avalanches by digging deep pits that we climb into and analyse the stratigraphy, which are the layers of snow caused by different weather. The avalanche

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danger can be determined by studying the layers and how they relate to each other. I've found it's always better to carry more layers than you think you're going to need – the extra weight is worth it. And I always tell people to wear warmer gloves than they think they need, too. When I really feel it, push-ups are my go-to to get the blood flowing. I grew up in Texas, where everything is unbearably hot. I remember being eight and riding to a friend's house on summer break and thinking my brain was melting. Maybe, subconsciously, that's why I ended up doing this work.

The horse breeder

Mikhail Etigelow, 56, Oymyakon, Russia. After the fall of the Soviet Union there was no work for me. I had to think of a way to provide for my family, so I decided to create my own smallholding. I have 100 horses and work with my son and brother-in-law. Our horses are bred to grow extra fur in time for winter and to get a layer of fat for warmth. It enables them to live outside when it's incredibly cold. Here it ranges from -20C to -50C in the winter. It's important for us to dress warmly because you don't want to lose an ear or a finger. It's not uncommon for that to happen to people; the trauma centre in Yakutsk, the nearest city, conducts dozens of amputations every year of fingers and toes due to frostbite. I've experienced -67C, but I have to work outside every day. I don't mind. We're in the mountains and being in nature is the best way to spend time. Oymyakon is 1,000km from Yakutsk. It takes 30 hours to get here by car when the roads are frozen. About 1,000 people live here. Homes are wooden and heated with wood or coal fire. Our toilets have to be outside because it's too cold for plumbing. We don't use our fridges in winter – we just keep things outside. There are only four hours of daylight then, so in the evenings the streets are empty. Most people stay inside and watch TV. I like the news and talk shows, and I also like to read, especially historical fiction. This weather is normal to us. Nothing really stops here, we drive (if our cars don't freeze) or walk to work. The school only closes when it goes below -52C outside. When it's very cold the little children are often taken on a sleigh. No one really complains about the cold; for us, this is natural. We live 3,000m above sea level and it's beautiful and wild. We're so used to it that it's actually difficult for us to travel anywhere south and acclimatise. It's so cold here that there are few diseases and we can easily get sick when we go somewhere warmer.

Subsistence gatherer and trapper

Renae Zackar, 40, Iguigig, Alaska. I've always liked the cold. It means we can travel and hunt – and the things that I make sell better. We live at the

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mouth of a river on Lake Iliamna in Alaska. There are about 60 people in our village. When the lake freezes from December to around May, we use the ice as a highway to get from village to village. A week at -35C is enough to freeze it solid. This year it was late to freeze. Subsistence has been part of my life since I was young. At least half of our family's diet comes from indigenous fish, plants and animals that we hunt, gather and preserve ourselves. I work really hard. The older of my five children help whenever they can, and my husband works, too. We hunt caribou and moose in the winter, and also trap fur animals such as wolverines, wolves, beavers, otters and lynxes. We use the fur for our warm winter gear. We travel out and bury the traps in the snow. Most of the time the men skin the animals, but my husband cut himself deeply once while skinning a wolverine and, as I didn't want the coat to go bad, I took over and finished it off. Now I always do it because I'm better and more careful. It's coldest in March. The lowest temperature I've known is -45C. As long as you have the right gear to deal with it, the cold is good. I wear fur hats made from seal and sea otter and gauntlet-style mittens over gloves – my daughter and I make them for the whole family. We also make gumukluks, which is the local dialect for shoes made out of skins. But most of us wear bunny boots now: they're military shoes made from rubber with air pockets in them that trap heat. They're awesome and last forever. We also ice-fish in the winter. We make a hole with an ice pick and use a pole made from a skinny tree branch with a small amount of fishing line, and salmon eggs as bait. We mainly catch trout. Ice fishing only gives us enough for one night's meal though. The summer months are when we catch most fish. For my size of family, I have to catch and smoke about 700 salmon to last a year. We used to store them outdoors in caches, which are tiny houses on high stilts, but now that we have freezers. I put them in there. In winter, we have about five hours of daylight. Things slow down, it's not quite hibernating, but almost. Electricity changed how we live. With TV and artificial light, we stay up longer and I sew. But we don't use too much electricity, because it's expensive. They have to fly diesel into our village for the generator. It used to come by barge, but the water level dropped and they can't get up the river now. In the past 16 years the lake hasn't frozen for two or three winters, which scares me. We can't hunt, trap, ice-fish or travel to see people. It's harder to live. We don't get berries in the spring. It makes me worry the permafrost will melt under our house and it will slide into the river; some of the banks are already eroding around us. I put a lot of my life savings into building this house. I think it will be OK here for about 20

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years, but over time it will turn into a desert, as we don't get much rain and now we're getting less snow.

The Guardian, 27 January 2019

<http://www.guardian.com>

Why creating the perfect cup of coffee really is rocket science

2019-01-31

As a rival to the Millennium Falcon or the Starship Enterprise, a proposed spacecraft from entrepreneurs Anders Cavallini and Hatem Alkhafaji is low on sophistication and rocket thrust. In fact, it would be built to carry out only one task: to produce perfectly roasted coffee beans – in outer space. Hence the craft's name: the Coffee Roasting Capsule. The capsule – which could be launched next year – would use the heat of re-entry to roast coffee beans as they float inside it in a pressurised tank. The effect would be to roast the beans all over and produce perfect coffee, Cavallini and Alkhafaji claim in a recent issue of the space journal *Room*. They say that on Earth, beans tumble around, break apart and are scorched by contact with the hot surfaces of the roaster. "But if gravity is removed, the beans float around in a heated oven, giving them 360 degrees of evenly distributed heat and roasting to near perfection." The capsule – which would initially carry around 300kg of coffee beans – would be fired on a rocket to a height of around 200km, taking the task of making the ideal cup of coffee to new heights. The beans would then be roasted in the heat generated by the craft's 20-minute re-entry into Earth's atmosphere, with temperatures in the pressurised tank being kept to around 200C. In the interview, the two entrepreneurs claimed they were already in discussion with private rocket companies such as Rocket Lab and Blue Origins in a bid to find a suitable launcher. Once back on Earth, the planet's first space-roasted beans would be used to make coffee that would be sold for the first time in Dubai, where the pair's company is based. It is not clear how much they would charge for a cup. Cavallini and Alkhafaji said they hoped to blast their first coffee beans into space next year. However, calls and emails from the Observer to the Space Roasters office received no response last week. Surprisingly, the Space Roaster concept – should it go ahead – will not be the first attempt to take coffee into space. In 2015, Italian aerospace company Argotec and Italian coffee company Lavazza collaborated on the construction of the ISSpresso, the first espresso coffee machine designed for use in space. It was installed in the International Space Station (ISS) as part of a public-private partnership with the Italian

Dubai pair plan to blast beans into space in their quest for a flawless roast

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Space Agency. The first espresso it produced was drunk on 3 May 2015 in a special zero-gravity cup by Italian astronaut Samantha Cristoforetti. "Coffee: the finest organic suspension ever devised," she tweeted.

The Guardian, 26 January 2019

<http://www.guardian.com>

Fried Foods Tied to Heart Disease in Women

2019-01-31

Researchers used health and dietary data on 106,966 postmenopausal women enrolled in a large health study between 1993 and 1998, and followed their health through the beginning of 2017. They found that compared with women who ate none, those who ate fried chicken once a week or more had 12 percent increased risk of premature death from any cause and an 11 percent increased risk of death from cardiovascular disease. Women who ate fried fish that often had a 7 percent increased risk of mortality and a 12 percent increased risk of cardiovascular death compared with those who ate none. The study, in *BMJ*, controlled for age, race, education and many diet, health and behavioural characteristics. "These are modest associations," said the senior author, Dr. Wei Bao, an assistant professor of epidemiology at the University of Iowa. "And fried food is just one component of an overall diet. But it is probably a good idea at least to reduce portion size and frequency of consumption of fried food." The public health implications could be significant. According to the Centres for Disease Control and Prevention, on any given day, more than a third of American adults patronize fast-food restaurants, where fried chicken and fish are staples.

New York Times, 23 January 2019

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

11 Surprising Uses For Pee and Poop

2019-01-31

When most animal bodies process nutrients, they expel waste in the form of liquids and solids — generally referred to as urine and faeces. Waste is usually smelly and unappetising (for people, at least) but it can also be surprisingly beneficial. Pee and poo have a wide range of applications; providing nutrients for diverse ecosystems, serving as a foundation for expensive perfumes, or even fuelling robots. Here are just a few of their unexpected uses.

Women who ate fried fish or fried chicken once a week or more had an increased risk of death from cardiovascular disease.

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From poop to perfume

A yellowish-grey “rock” found on a beach in the UK was greasy and smelled terrible — and no wonder, as it originated in the guts of a sperm whale. The slick, malodorous lump was a sizable chunk of ambergris, a fatty substance thought to form in whales’ digestive tracts around sharp objects such as squids’ beaks. Whales then poop out the ambergris, which is highly prized by humans as an ingredient in pricey fragrances. The lump found on the beach was estimated to be worth at least \$68,000, and possibly as much as \$180,000.

To dye for

A 1,500-year-old Byzantine copy of the New Testament known as the Codex Purpureus Rossanensis is printed on purple pages, and researchers recently uncovered the long-held secret behind the parchment’s vivid colour — urine. Analysis of the tome revealed that the pages derived their purple hue from orcein — a dye extracted from the fungus *Rocella tinctoria*, and then processed with fermented urine. The manuscript, which is about half-complete, is written in gold and silver ink on 188 pages, and likely originated in Syria between the 5th and 6th centuries A.D.

Tastes like...

Researchers in Japan recently brought a stomach-turning offering to the table, by transforming human faeces into steak. At the request of Tokyo Sewage, scientists investigated practical uses for excess sewage, and discovered that they could isolate proteins from the bacteria in human waste; combined with carbohydrates and fats, the result could be served as a meat-like substance. Experts told Live Science that while it should be possible to make something edible — and safe to eat — using this method, cooking the “steak” before consuming it is still strongly recommended.

Drink up

Don’t want to eat steak made from poop? How about drinking a nice glass of water...that used to be poop? An innovative processing system called the Omniprocessor heats sewage sludge, separating the liquid as water vapor that is then treated to make it suitable for drinking. With human populations on the rise in many countries, access to clean water and sanitation is a growing challenge worldwide. Processing systems such as this could provide an efficient solution to both problems, according to Bill Gates, whose foundation is funding development of the technology.

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Building blocks

Bricks made from urine could one day serve as cheap, sustainable building materials for homes and other structures. But how do you turn pee into a brick? Scientists mixed fresh urine with lime — calcium hydroxide powder — strained the liquid, and then combined it with sand and bacteria, which turn the material into a cementlike substance. The bricks are sturdy; about as hard as limestone. They set at room temperature, so their production doesn't require a coal- or wood-burning oven. As the bricks are setting, they do exude an unpleasant urine aroma, though the smell subsides in about 48 hours.

Poop-eroni

Poop sausage may not sound like a tasty treat, but scientists have figured out how to use bacteria from baby poop to make sausages that are both delicious and healthy. Microbes are already harnessed to produce delicacies like cheese, wine and beer — and fermented sausages. And baby poop is chock-full of microbes; particularly *Lactobacillus* and *Bifidobacterium*, which are used in probiotics. Using bacteria cultured from poop in babies' diapers, researchers made a type of Spanish fermented pork sausage called "fuet," and they claimed that it tasted "very good."

Urine therapy

In India, cow urine has been used for therapeutic purposes for at least 5,000 years, and a Hindu group that promotes drinking cow urine for its health benefits recently claimed that the liquid "offers a cure for around 70 to 80 incurable diseases like diabetes," according to Om Prakash, of the Cow Protection Department for the Hindu sect Rashtriya Swayamsevak Sangh (RSS). However, health experts have questioned the effectiveness of remedies containing cow urine, particularly when it is purported to treat or prevent cancer.

Robot fuel

The pumping action of an artificial heart sends urine coursing over a microbial fuel cell, in a device that could power pollution-monitoring robots. Dubbed EcoBots, these pee-powered bots represent technology that recycles waste into electricity. Their fuel cells harness living microbes such as those that colonise the human gut — and sewage treatment plants. When the microorganisms digest urine they produce electrons, which can then be harvested to generate an electrical current. And urine

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isn't the nastiest fuel source these robots have used — previous versions ran on energy extracted from sludge, wastewater, dead flies, and rotting produce.

Worm 'towers'

Giant soil mounds in the grasslands of Colombia and Venezuela alternate with deep pits in the ground, and the mounds were formerly thought to be the result of erosion or termite activity. But scientists recently discovered that they were made of piles and piles of worm poop, collecting in locations that the worms would visit for generations. Worms measuring up to 3 feet (1 meter) in length eat and digest dirt, excreting pellets known as casts. Over time, the mounds can grow wider than 16 feet (5 metres) in diameter, and groups of them form an impressive landscape features called a *surale*, which is also found in Uganda, New Guinea and South Africa.

Poop-biotics

Could a path toward better health begin with a baby's diaper? Baby poop — specifically, the microbes inhabiting babies' guts — could one day produce potent probiotics to address digestion disorders. What's so special about baby poo-microbes? Some types of microorganisms in baby poop promote the production of molecules called short-chain fatty acids, which are associated with a healthy gut. Faecal transplants with these microbes could help to correct imbalances in the gut, promoting the growth of beneficial bacteria and protecting against disease.

Ocean fertiliser

Whales are among the largest living creatures on Earth — as such, they generate enormous quantities of pee and poop. And that's a good thing, as their waste provides critical nutrients for a variety of marine creatures. Whales typically relieve themselves at the sea surface before they dive, leaving behind a "fluffy" effluvia plume. This faecal feast releases nutrients that originated in ocean depths and nourish phytoplankton — tiny marine plants — which live close to the surface, and play an important part in ocean food webs.

Live Science, 22 January 2019

<http://www.livescience.com>

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Here's How 'Flesh-Eating' Bacteria Feast on Your Flesh

2019-01-31

"Flesh-eating" bacteria can cause serious infections that can result in loss of limbs and even death. Now, a new study reveals just how the bacteria thrive deep in muscle tissue and cause such severe disease. The study focused on bacteria called group A Streptococcus, the most common cause of "flesh-eating" disease. The researchers found that the bacteria's survival is aided, in large part, by special proteins called transporters, which help feed the microbes in muscle tissue. The findings might one day lead to better ways to treat and prevent the often-deadly disease, the researchers said. "We now have a blueprint for what the organism uses to cause this devastating disease," said study senior author Dr. James Musser, chairman of the Department of Pathology & Genomic Medicine at Houston Methodist Hospital. The work is "the first step in a long journey that can lead to new treatments that may help us defeat this organism," he said. The study was published online Jan. 22 in the Journal of Clinical Investigation.

Devastating disease

Infections with flesh-eating bacteria, known medically as necrotising fasciitis or necrotising myositis, can spread quickly in the body and destroy skin, muscle and connective tissue. (Necrotising fasciitis refers to infections in the fascia, a type of connective tissue, and necrotising myositis refers to infections in the muscles.) Flesh-eating infections with group A Streptococcus are rare but deadly, causing death in up to one-third of patients who develop the disease, according to the Centres for Disease Control and Prevention. But exactly how group A Streptococcus causes flesh-eating disease on a molecular level isn't very well understood. So, in the new study, the researchers set out to determine which genes in the bacteria's genome contribute most to the disease. The researchers used a technique that allowed them to deactivate the bacteria's genes one by one. They found that, out of the bacteria's 1,800 genes, 72 genes were key to its survival in necrotising myositis. Of these, more than 25 percent were genes for transporter proteins, which help bring molecules into and out of the cell, Musser told Live Science. For example, transporters help the bacteria take in nutrients and spit out toxins. The findings so far suggest that, depending on where the bacteria is living in the body, "it uses a very different set of genes and proteins to survive and thrive in particular niches in the human," Musser told Live Science. It may be, for example, that the genes the bacteria use to survive in people with strep throat are very different from those that are used for infections in muscles. It's possible

A new study reveals just how the flesh-eating bacteria thrive deep in muscle tissue and cause such severe disease

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that developing drugs that inhibit these transporters could lead to better treatments for flesh-eating disease caused by group A strep, although much more research is needed to explore this idea, Musser said. It's also important to note that, for most of the study, the researchers used a model of necrotizing myositis infection in monkeys. But when the researchers tested human tissue from a patient with a flesh-eating infection, they found that at least six of the "key" genes identified in the monkey model were also activated in human disease. This suggests that the findings have implications for people too.

Live Science, 23 January 2019

<http://www.livescience.com>

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