Nov/Dec 2016 • No. 239

ESA Newsletter

Electrostatics Society of America - The Friendly Society

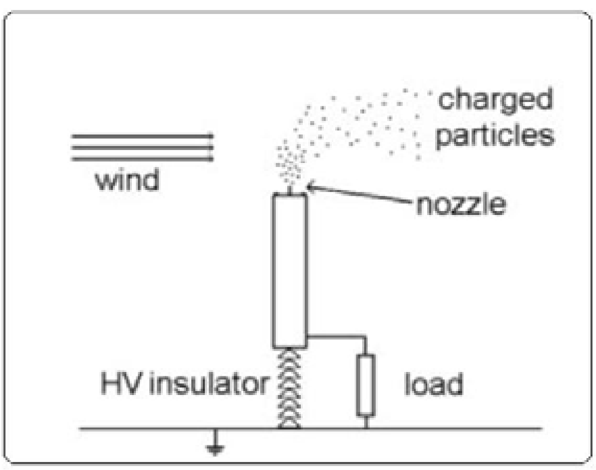
President's Message

January means it is the start of the New Year, and of course the winter season. I would like to begin by wishing you all a very happy 2017. Here in North America the season also reminds us about the power of static electricity!

Static charge is not just a nuisance, as we all know it has many applications based on charge generation and collection. In fact, this week in my undergraduate class on high voltage engineering we talked about generating tens of millions of volts using a Van de Graaff generator as well as many of the applications where high voltage DC is used. What inspired me to write about static electricity generation in this newsletter is the idea of using electrostatics in converting wind energy into electricity.

Humankind has exploited wind energy for thousands of years; however, we have been harvesting wind energy in a massive way to meet the energy requirements of the growing world's population and demand for energy only as recently as the late 90s. Today, one of the major sources for the generation of electricity using a renewable energy source is wind energy via the use of turbines. Although there are many advantages to using wind turbines and wind energy plants, harmful effects such as noise, vibration, visual pollution from shadow flicker, and bird fatalities from moving blades are some of the serious concerns that we are facing.

Currently, researchers at Delft University of Technology (Netherlands) are trying to find a solution to minimize the harmful effects of turbines. The concept is to generate electricity using electrostatic principles without any moving parts other than the moving charged droplets and wind. Avoiding mechanical systems may not only decrease the cost of energy production but also help eliminate many of the concerns mentioned above. In the Electrostatic WInd energy CONverter, named as EWICON by the researchers at Delft, energy conversion occurs through the displacement of charged particles by the wind in the opposite direction of an electrical field. The idea of extracting energy from wind using charged aerosol electrostatic generators was in fact patented by Alvin Marks [1]; but the efficiency of the transduction process was too low to be applied in practically accepted solutions.



Earth acts as the collector in the EWICON system. The system itself is insulated from earth and the dispersal of charged particles will increase the potential of the system. From *http://www.windpowerengineering.com/design/dutch-wind-wheel-generates-electricity-without-moving-parts/*

The first generation of EWICON uses charged droplets created at a charging system, usually consisting of a liquid supply, a number of electrodes, and a set of spray-nozzles. The wind moves the charged particles towards an electrically isolated collector. As droplets collide with the collector its electric potential increases. The maximum potential that the collector attains depends on the wind speed. There is a need for aligning the charging system and the collector; however, in situations with varying wind directions rapid alignment of the electrode system would be a problem. Furthermore, considering the dispersion of the charged droplet cloud, the collector dimensions need to be relatively large with respect to the charging system in order to collect the charge effectively. To overcome these limitations, a modified ver-

(cont'd. p. 2)

President's Message (cont'd.)

sion of the EWICON system produces charged droplets using an electrically isolated charging system. As the droplets move away by the wind, the electrical potential of the EWICON system will rise with a polarity opposite to that of the droplets. With earth acting as a collector, the requirement for wind alignment and use of an external collector are not necessary. Both lab scale experimental studies and simulation demonstrate the proof of principle. However, many practical problems still need to be solved before implementing EWICON for the mass power generation that the researchers are hoping to achieve in the future. As most of the issues are electrostatics related such as optimizing the droplet charging, minimizing the charge loss from back flow and/or corona, improving the charge collection, and the like, I would welcome ESA members to comment on the feasibility of this technology as a viable option. A complete description on EWICON system, including the theory, analysis, and practical problems that need further research, can be found in work from Delft University researchers [2, 3].

1. A. M. Marks, "Charged aerosol power conversion device and method", US Patent No. 3,518,461, 1970.

2. D. Djairam, P. H. F. Morshuis, and J. J. Smit, "A Novel Method of Wind Energy Generation: The Electrostatic Wind Energy Converter", IEEE Electrical Insulation Magazine, July/August 2014, Vol. 30, No. 4, pp. 8-20.

3. H. Nowakowska, M. Lackowski, T. Ochrymiuk and R. Szwaba, Novel Electrostatic Wind Energy Converter, An Overview, TASK QUARTERLY vol. 19, No 2, 2015, pp. 207–218.

Here in Canada, we are celebrating the Nation's 150th birthday and the city of Ottawa has planned year-round events. As our Annual meeting is very close to July 1st, I would like to encourage everyone to plan early to attend the meeting. Both occasions provide opportunities for newcomers and friends to come together and enjoy the technical program as well as multicultural presentations. Our conference chair Poupak Mehrani has arranged accommodations on the University of Ottawa campus, located right in the middle of the city. The due date to submit your abstract is fast approaching - 1st March 2017. Please visit the conference website for details.

For the Friendly Society
Shesha Jayaram, *shesha.jayaram@uwaterloo.ca*
President, Electrostatics Society of America

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Calendar

- Electrostatics 2017, April 10-13, 2017, Frankfurt/Main, Germany, *http://www.dechema.de/en/electrostatics2017.html* Contact: Nadja Strein, *strein@dechema.de*
- ESA 2017 Annual Meeting, June 13-15, 2017, University of Ottawa, Ottawa, Ontario, Canada *http://www.electrostatics.org* Contact: Poupak Mehrani, *poupak.mehrani@uottawa.ca*

Current Events

Scientists Create 'Floating Pixels' Using Soundwaves and Force Fields

James Hakner

A mid-air display of 'floating pixels' has been created by scientists. Researchers at the Universities of Sussex and Bristol have used soundwaves to lift many tiny objects at once before spinning and flipping them using electric force fields. The technology – called JOLED - effectively turns tiny, multi-coloured spheres into real-life pixels, which can form into floating displays or bring computer game characters to life as physical objects.

Professor Sriram Subramanian, in the University of Sussex's School of Engineering and Informatics, is the head of lab behind the research. He says: "We've created displays in mid-air that are free-floating, where each pixel in the display can be rotated on the spot to show different colours and images. "This opens up a whole new design space, where computer and mobile displays extend into the 3D space above the screen."

The pixels are levitated using a series of miniature ultrasound speakers that create high-pitched and high-intensity soundwaves that are inaudible but forceful enough to hold the spheres in place. A thin coating of titanium dioxide gives the pixels an electrostatic charge, enabling them to be manipulated in mid-air by changes to an electric force field, created by tiny electrodes.

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2017 Annual Meeting of the Electrostatics Society of America
University of Ottawa, Ontario, Canada
June 13-15, 2017

The Electrostatic Society of America (ESA) invites papers in all scientific and technical areas involving electrostatics for the 2017 Annual Meeting of the ESA. Contributions range from fundamental physics and new developments in electrostatics to applications in industry, atmospheric and space sciences, medicine, energy, and other fields.

Anticipated Technical Session Topics
- Breakdown phenomena and discharges
- Electrically-induced flows and electrokinetics
- Contact charging and triboelectric effects
- Gas discharges and microplasmas
- Atmospheric and space applications
- Biological and medical applications
- Materials synthesis, processing, and behavior
- Measurements and instrumentation
- Safety and hazards

Keynote Speakers
We are excited to have confirmed an excellent slate of keynote speakers:
- **Dr. Elyse Rosenbaum,** *Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, USA*
- **Dr. Charles Fan,** *Global Research & Development, General Motors Company, USA*
- **Dr. Karen Aplin,** *Department of Physics, Oxford University, UK*
- **Dr. Philip Kwok,** *Department of Pharmacology and Pharmacy, University of Hong Kong, Hong Kong*

Conference information, including, registration and lodging, will be updated and available at *http://www.electrostatics.org*

Student Presentation Competition
Presentations by undergraduate and graduate students are eligible for the Student Presentation Competition. Please indicate student presenter when submitting abstract.

Important Dates
January 1, 2017	*Abstract submission open*
March 1, 2017	*Abstract submission deadline*
March 17, 2017	*Notification of abstract acceptance*
May 1, 2017	*Early registration deadline*
May 15, 2014	*Final manuscript deadline*

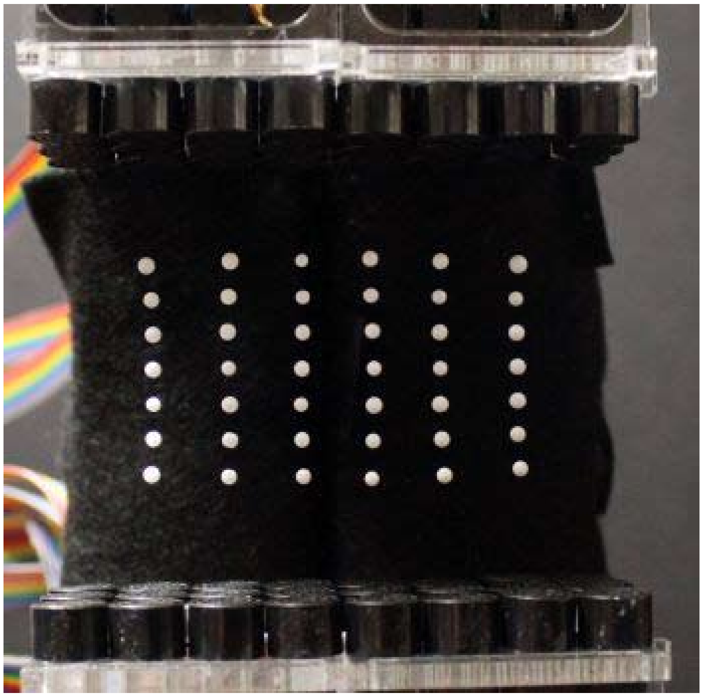
Abstract Submission
Online submission at *http://www.electrostatics.org*

Preliminary Agenda
Monday	*June 12th*	*6:00pm – 8:00pm*	Informal Welcome Gathering & Registration
Tuesday	*June 13th*	*8:00am – 5:00pm*	Registration & Technical Sessions
Wednesday	*June 14th*	*8:00am – 5:00pm* *6:30pm – 9:00pm*	Technical Sessions Conference Banquet
Thursday	*June 15th*	*8:00am – 1:00pm*	Technical sessions & Conference Concludes
Friday	*June 16th*	*9:00am – 1:00pm*	Ottawa City Tour

Contact Information
General Chair: Prof. Poupak Mehrani, University of Ottawa, Canada (poupak.mehrani@uottawa.ca)

Technical Chair: Prof. Shubho Banerjee, Rhodes College, USA (banerjees@rhodes.edu)

About University of Ottawa
Located in Ottawa, Canada's capital city, within walking distance of Canada's Parliament Hill, uOttawa is the largest bilingual (English-French) university in the world. uOttawa has a student population of over 42,000 and has more than 450 programs in 10 faculties.



The pixels are levitated using a series of miniature ultrasound speakers that create high-pitched and high-intensity soundwaves that are inaudible but forceful enough to hold the spheres in place. They can be spun and flipped using electric force fields.

Dr Deepak Sahoo, Research Associate in Human-Computer Interaction at the University of Sussex, said: "The most exciting part of our project is that we can now demonstrate that it is possible to have a fully functioning display which is made of a large collection of small objects that are levitating in mid-air. "JOLED could be like having a floating e-ink display that can also change its shape."

The paper is the first to demonstrate such a fine level of control over these levitating pixels, moving the technology closer to something that might soon be part of theme parks or galleries. Asier Marzo, research associate in the Department of Mechanical Engineering at the University of Bristol, explained: "Traditionally, we think of pixels as tiny colour-changing squares that are embedded into our screens. JOLED breaks that preconception by showing physical pixels that float in mid-air. "In the future we would like to see complex three-dimensional shapes made of touchable pixels that levitate in front of you."

Professor Subramanian added: "In the future we plan to explore ways in which we can make the display multi-coloured and with high colour depth, so we can show more vivid colours.

(excerpted from *http://www.sussex.ac.uk/newsandevents/?page=2&id=37420*)

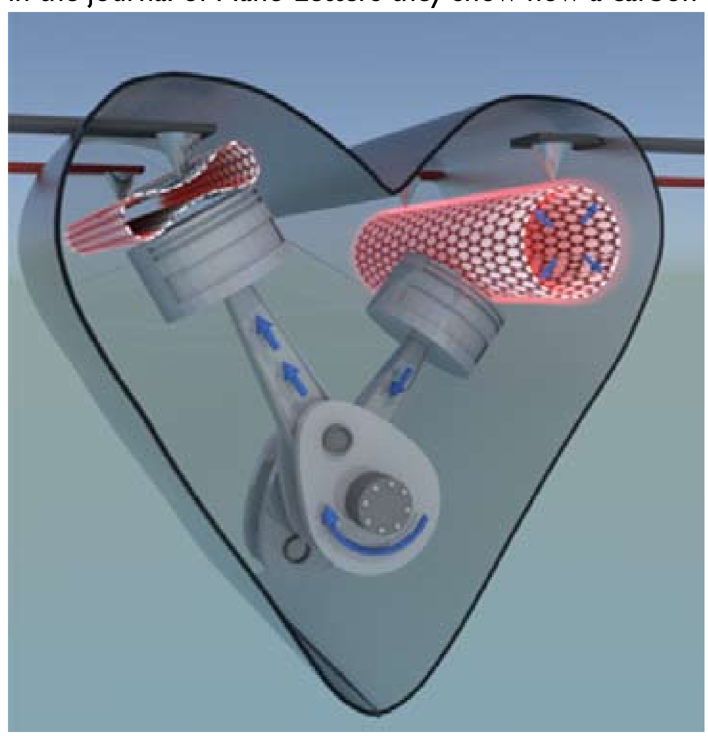
Static electricity can control nanoballoon

Robert Emmerich

Inflatable balloon actuators are commonly used for macroscopic applications to lift buildings, as impact protection in cars or to widen narrowed or obstructed arteries or veins. At the micro scale they are used as micro pumps and in nature jumping spiders create microformat fluid-filled cushions to power their legs in explosive jumps.

Interestingly, at the nanoscale, balloon actuators are virtually unknown. However, a few years ago researchers at the Penn State University theoretically proposed a charge controlled nanoballoon actuator based on the collapsing and reinflation of a carbon nanotube.

Now, this has been realized experimentally by Hamid Reza Barzegar and his colleagues. In a study published in the journal of Nano Letters they show how a carbon



Schematic drawing of two carbon nanotubes, one in inflated state (cylindrical tube to the right) and one in collapsed state (flattened tube to the left). The transition between the two states can be controlled by applying a small voltage which charges the tube electrostatically and thereby changes the state from a collapsed state to an inflated. The applied voltage is visualized by two tip contacts touching each tube. In the image the tubes are connected to two pistons to envision that the phase change of the tubes could set an imaginary nanomachine in motion.

nanotube, which can be visualized as a cylindrical tube of carbon atoms, can be controlled to transform from a collapsed to an inflated state and vice versa by applying a small voltage. The defect-free nature of carbon nanotubes imply that such an actuator would be able to work without wear or fatigue. This is also shown by the researchers who run the actuator over several cycles with no signs of loss in performance.

"The work is conceptually interesting and gives insight into the complexity of how to control motion at the nanoscale by external stimuli" says Hamid Reza Barzegar, doctor of Physics at Umeå University, now working at UC Berkeley in professor Alex Zettl's research group. "It also gives insight into fundamental physics such as how the capacitance effect and in general the electrostatic forces can be used to control the dynamics of molecular structures."

"In a longer perspective one can also envision how our findings could be used for pneumatic control on molecular level or for designing molecular containers that can open or close by controlling the surface charges of the molecules, by for example tuning the pH of the solution in which the molecules are dispersed. This could for example be of use for medical applications such as for delivering medicine to internal organs or tumors" says Thomas Wågberg, associate professor of Physics at Umeå University.

(excerpted from *http://www.teknat.umu.se/english/about-the-faculty/news/newsdetailpage/static-electricity-can-control-nanoballoon.cid274687*)

New kind of supercapacitor made without carbon

David L. Chandler

Energy storage devices called supercapacitors have become a hot area of research, in part because they can be charged rapidly and deliver intense bursts of power. However, all supercapacitors currently use components made of carbon, which require high temperatures and harsh chemicals to produce.Now researchers at MIT and elsewhere have for the first time developed a supercapacitor that uses no conductive carbon at all, and that could potentially produce more power than existing versions of this technology.

The team's findings are being reported in the journal Nature Materials, in a paper by Mircea Dinca, an MIT associate professor of chemistry; Yang Shao-Horn, the W.M. Keck Professor of Energy; and four others.

Dinca and his team have been exploring for years a class of materials called metal-organic frameworks, or MOFs, which are extremely porous, sponge-like structures. These materials have an extraordinarily large surface area for their size, much greater than the carbon materials do. That is an essential characteristic for supercapacitors, whose performance depends on their surface area. But MOFs have a major drawback for such applications: They are not very electrically conductive, which is also an essential property for a material used in a capacitor. But the material did exhibit another needed characteristic for such electrodes, which is that it conducts ions (atoms or molecules that carry a net electric charge) very well.

"All double-layer supercapacitors today are made from carbon," Dinca says. "They use carbon nanotubes, graphene, activated carbon, all shapes and forms, but nothing else besides carbon. So this is the first noncarbon, electrical double-layer supercapacitor." One advantage of the material used in these experiments, technically known as Ni3(hexaiminotriphenylene)2, is that it can be made under much less harsh conditions than those needed for the carbon-based materials, which require very high temperatures above 800 degrees Celsius and strong reagent chemicals for pretreatment.

The new devices produced by the team, even without any optimization of their characteristics, already match or exceed the performance of existing carbon-based versions in key parameters, such as their ability to withstand large numbers of charge/discharge cycles. Tests showed they lost less than 10 percent of their performance after 10,000 cycles, which is comparable to existing commercial supercapacitors.

But that's likely just the beginning, Dinca says. MOFs are a large class of materials whose characteristics can be tuned to a great extent by varying their chemical structure. Work on optimizing their molecular configurations to provide the most desirable attributes for this specific application is likely to lead to variations that could outperform any existing materials. "We have a new material to work with, and we haven't optimized it at all," he says. "It's completely tunable, and that's what's exciting."

While the MOF material has advantages in the simplicity and potentially low cost of manufacturing, the materials used to make it are more expensive than conventional carbon-based materials, Dinca says. "Carbon is dirt cheap. It's hard to find anything cheaper." But even if the material ends up being more expensive, if its performance is significantly better than that of carbon-based materials, it could find useful applications, he says.

(excerpted from *http://news.mit.edu/2016/supercapacitor-made-without-carbon-1010*)

Electric Fields Fight Deadly Brain Tumors

Eliza Strickland

Jessica Morris was on a hiking trail in upstate New York last January when she suddenly uttered a line of gibberish and fell to the ground, her body shaking in a full seizure. A few hours later in a hospital she learned that she had glioblastoma, an aggressive brain tumor, and several days after that she was on the operating table having brain surgery. Since then, she's been fighting for her life.

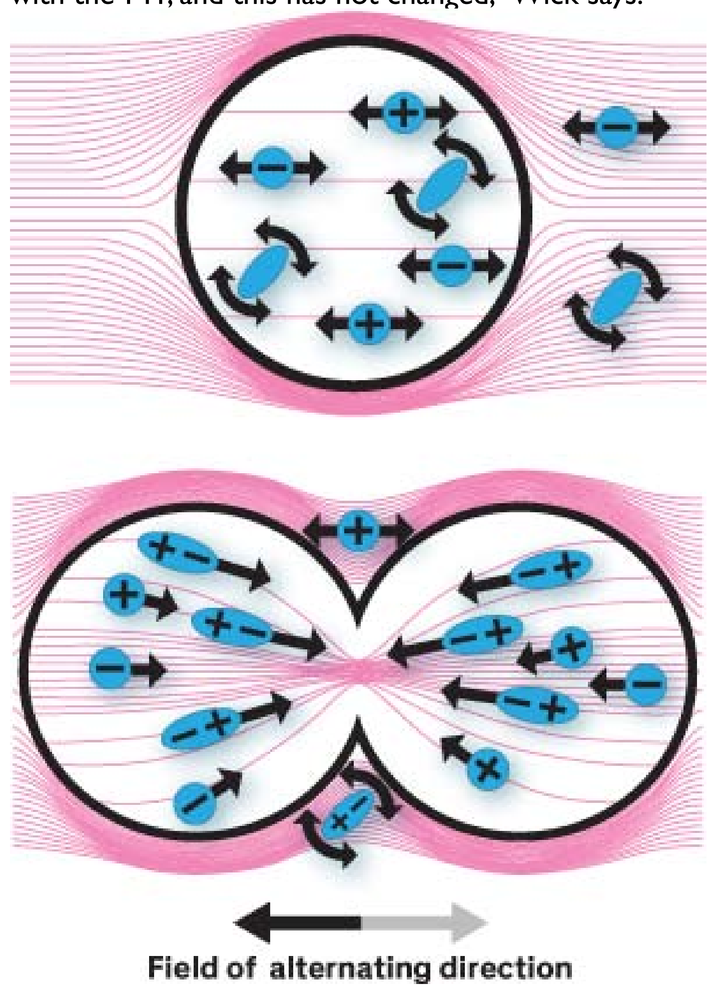
She's grateful to have a radical new weapon in her arsenal, one that only became available to patients like her in 2015. She wears electrodes on her head all day and night to send an AC electric field through her brain, trying to prevent any leftover tumor cells from multiplying. She's been wearing this gear for about six months so far. "I think it's brilliant," Morris says. "I'm proud to wear it."

The Optune device from Novocure, an international company with R&D operations in Haifa, Israel, can't exactly be called convenient or unobtrusive. Morris goes about her business with a shaved head plastered with electrodes, which are connected by wires to a bulky generator she carries in a shoulder bag. Every few days her husband helps her switch out the adhesive electrode patches, which requires reshaving her head, making sure the skin of her scalp is healthy, and applying the new patches. Morris isn't complaining about the effort. "If you have a condition which has no cure, it's a great motivator," she says dryly.

Doctors typically combat glioblastoma with the triad of surgery, radiation, and chemotherapy. Optune's tumor-treating fields (TTFs) offer an entirely new type of treatment. Unlike chemo, this electrical treatment doesn't cause collateral damage in other parts of the body. Yet the technology has been slow to catch on. "The adoption rate has not been stellar to date," admits Eilon Kirson, Novocure's chief science officer.

He's hoping the most recent results of Optune's biggest clinical trial yet will make the difference: Two years after beginning treatment, 43 percent of 695 patients with glioblastoma who used Optune were still alive, compared to 30 percent of patients on the standard treatment regimen. Four years out, the survival rates are 17 percent for Optune patients and 10 percent for the others. "To patients, that's a big difference," Kirson says. "That's worth fighting for."

Many oncologists, however, still hesitate to prescribe Optune. Wolfgang Wick, a professor of neuro-oncology at the University of Heidelberg, in Germany, has written skeptically about TTFs and says the long-term results don't change his outlook. He draws a contrast with the chemotherapy drug temozolomide, which provides a clear benefit to a subset of patients who have a particular biomarker. Doctors don't know which patients will respond best to the electric fields, he says, and that makes Optune a less appealing treatment option. "If I listen to my patients, this is one thing missing with the TTF, and this has not changed," Wick says.



Ilustration: Erik Vrielink

How It Works: Inside a normal cell [top], oscillating electric forces result only in the vibration of charged molecules. In a dividing cell [bottom], the forcespush molecules toward the pinch point, disrupting the delicate process of cell division.

Novocure's system uses electrodes stuck to the scalp to create a low-intensity oscillating electric field in the brain, which interferes with cancer cells as they try to divide and multiply. At one moment in the cell division process, the cell distorts into an hourglass shape. That's when the tumor-treating field has its impact because the cell's geometry concentrates the TTF at the center of the hourglass. The TTF works on molecules inside the cell that are polarized and respond to electric fields. By pulling those polarized molecules out of their proper positions, the field interferes with the precise procedures of cell division. Or, as Doyle puts it, "all hell breaks loose inside the cell." The cells don't divide and may even go into a state of programmed cell death.

So why do the TTFs damage tumor cells while leaving normal cells unharmed? Doyle says the secret lies in the frequency of the electric field. Each different cell type has a membrane with specific filtering properties, allowing only certain frequencies to penetrate it. (You can think of the cellular membrane as a capacitor, Doyle says; at the right frequency, the field can go through it with very little impedance.) Optune uses a frequency of 200 kilohertz to get inside glioblastoma cells, but the frequency doesn't penetrate neurons and other normal brain cells.

It doesn't hurt that there's very little cell division going on in the brain. That's not an advantage Novocure will have as it looks to push Optune into treating cancer in other parts of the body, such as the pancreas, ovaries, and lungs, where normal healthy cells also divide frequently.

Jessica Morris hopes many other brain cancer patients will try the Optune, despite the uncertainties that come with a new medical technology. Her doctor originally recommended a nine-month treatment plan but recently revised that estimate, saying she might want to keep the gear on for two years. That change reflects her promising medical outlook: Her MRI scans haven't shown any new brain tumor growth, and Morris wants to keep it that way. "If I'm still doing well, why would I take it off?" she says.

(excerpted from *http://spectrum.ieee.org/biomedical/devices/electric-fields-fight-deadly-brain-tumors?bt_alias=eyJ1c2VySWQiOiAiNmI0MzgxODQtYTMzMC00MTU2LWFjMGUtYTRhY2E5ZTc0NDgyIn0%3D&utm_source=Tech+Alert&utm_campaign=TechAlert_01-12-17&utm_medium=Email*)

Researchers make breakthrough in dewetting surfaces

How would you like a kitchen surface that cleans itself? Technological advances such as this could be one step closer after a breakthrough by Northumbria University and Nottingham Trent University.

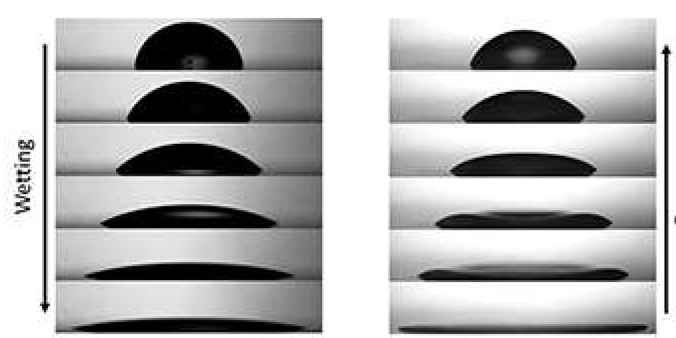
Using experimental techniques, researchers have made the first ever direct observation of the elusive dewetting process, which takes place when a liquid film retracts to form a bead-shaped drop. The achievement could now spark a new line of research and lead to breakthroughs involving the use of liquids, such as better coatings and more effective self-cleaning surfaces.

Dewetting is the opposite of 'spreading', a familiar process which can be observed day to day, such as when a drop of oil is placed on the surface of a pan. The liquid initially has a bead-like shape, and it slowly spreads to form a thin film. The opposite process, called dewetting, occurs when a liquid film retracts from a solid to form a bead-shaped drop, which can be observed when a wet window is left to dry up.

The details of dewetting are extremely important to any situation involving the removal or drying of a liquid. Despite its apparent simplicity, the direct observation of the full dewetting of a droplet into a single drop had remained elusive and difficult to achieve until Northumbria and Nottingham Trent's recent experiment.

In a recent paper in the journal Science Advances, the research team came up with an ingenious solution to this problem. Using a novel method known as dielectrowetting, they exploited the electric properties of liquids to force a liquid to coat a solid surface using an applied voltage.

By embedding very thin patterned electrodes in the solid and carefully arranging them into a circular pattern, the team achieved the formation of a thin circular liquid film. By switching off the voltage, they revealed,



Credit: Northumbria University

for the first time, the full dewetting process of the liquid film back to a bead-like drop shape.

"At first sight, one might have expected that dewetting is just the time-reversal of spreading. Surprisingly, we found that dewetting not spreading in reverse" said Prof Carl Brown from Nottingham Trent University's School of Science and Technology. "Instead of a smooth sequence of drop-like shapes, the dewetting film forms a rim at its own edge which retracts at constant speed for most of the dewetting process."

To understand this behaviour, the team used a combination of theory and numerical simulations to rationalise the experiments. Dr Rodrigo Ledesma-Aguilar, from Northumbria, said: "Both the simulations and the theory support that the liquid tends to adopt the closest local equilibrium shape it can during dewetting. This explains the smooth rim shape which survives for most of the process."

(excerpted from *https://phys.org/news/2016-09-break-through-dewetting-surfaces.html*)

You're more likely to get struck by lightning here than anywhere else on Earth

Sid Perkins

If you don't want to get struck by lightning, avoid open areas and tall objects, as the experts suggest. But if you want to be extra safe, stay the heck away from the middle of Venezuela's Lake Maracaibo. Satellite data suggest that one particular square kilometer there—on the northern tip of South America—gets zapped more than 200 times per year.

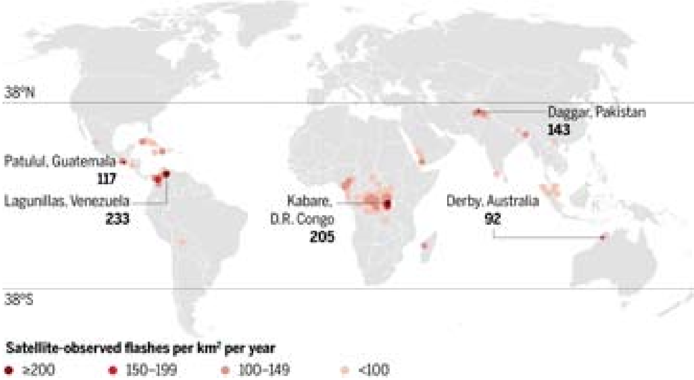
The find comes from instruments on a satellite called the Tropical Rainfall Measuring Mission, which operated from 1997 to 2015. Circling the planet on a path that covered every spot between 38°N (about the latitude of Athens) and 38°S (just south of Melbourne, Australia), it could view a square about 600 kilometers on a side (an area almost the size of Montana) at once, says Rachel Albrecht, a meteorologist at the University of São Paulo in São Paulo, Brazil. The craft passed over each spot in that broad swath between three and six times per day, viewing it for about 90 seconds each time, she notes.

Albrecht and her colleagues divvied up all lightning flashes spotted between January 1998 and December 2013 into areas roughly 10 kilometers on a side or smaller. Then, they tallied the planet's top 500 hot spots for lightning, based on flashes observed per square kilometer per year. (Because the satellite could observe each spot only 10 minutes or so each day, the hottest of the hot zones are likely struck by lightning tens of thousands of times each year, data suggest.) The hard data gathered by this space-based survey confirm many of the general trends that meteorologists have long noted, the researchers say.

In general, lightning occurs more frequently over land than over the oceans, in summer more than in winter, and most often between noon and 6 p.m. local time. Each of these factors tends to increase the temperature difference between the air at ground level and layers at higher altitude, which in turn increases the amount of humid air rising to fuel thunderstorms. Yet exceptions to these general rules abound, and the Lake Maracaibo hot spot bucks all three trends: Most of its lightning occurs over the lake, between the hours of midnight and 5 a.m., and in late spring and autumn. All told, the satellite spotted about 233 flashes of lightning per square kilometer per year over one portion of the nearly Connecticut-sized lake, the researchers report this month in the Bulletin of the American Meteorology Society.

Many of the world's lightning hot spots are associated with steep terrain, which helps set up the clash between warm and cool air masses that can drive thunderstorm development, Albrecht says. The top hot spots on each continent, with one exception, are near steep mountains, the researchers note. That's certainly true of Lake Maracaibo, which is rimmed by lofty peaks; the clash between the cool winds flowing off those mountains at night and the lake's warm tropical waters creates thunderstorms over the lake about 297 nights each year. Indeed, the researchers note, lightning over the lake at night is so reliably persistent that early explorers sailing the Caribbean used its flickering as a navigational aid.

Venezuela's Lake Maracaibo is the world's hot spot for lightning. NASA/Flickr



The world's top 100 hot spots for lightning (including the top one on each continent, labeled) at latitudes below 38°N, as measured by satellite between January 1998 and December 2013.

CREDITS: (GRAPHIC) J. You/Science; (DATA) Albrecht et al., Bulletin of the American Meteorology Society (2016)

At least 14 other large lakes worldwide, including lakes Victoria and Tanganyika in Africa, are also lightning hot spots, says Steven J. Goodman, an atmospheric physicist at the National Oceanic and Atmospheric Administration in Greenbelt, Maryland, and co-author of the new study. Though Lake Maracaibo is the hottest spot of all, central Africa is still home to the broadest area afflicted by lightning, with 283 of the world's top 500 locales. Although many sites with latitudes above 38°N experience thunderstorms, they do so far less often than low-latitude regions and typically only during half the year, unlike tropical areas where they can strike year-round, Goodman says. So, it's not likely that the team's new study missed any of the world's top lightning hot spots.

(excerpted from *http://www.sciencemag.org/news/2016/12/you-re-more-likely-get-struck-lightning-here-anywhere-else-earth*)

Electric Field Quantitative Measurement System and Method

NASA Langley Research Center's Electric Field Imaging (EFI) system is the only noncontact method capable of quantitatively measuring the magnitude and direction of electrostatic fields in near- and far-field applications. Based on low-cost, commercially available components, the EFI system uses measurement of very-low-current, human-safe electric fields to construct a three-dimensional image of objects and people based on their dielectric properties. This platform technology, originally developed for measurement of the efficacy of electrical shielding around cables, could be optimized for a variety of applications, including medical imaging, security and detection, weather and natural disaster prediction, and nondestructive evaluation of composites and insulators. The EFI system has the potential to offer a lower-cost, portable, and safer alternative to the imaging systems currently used in these applications.

The EFI imaging platform consists of a sensor array, processing equipment, and an output device. By registering voltage differences at multiple points within the sensor array, the EFI system can calculate the electrical potential at points removed from the sensor. Using techniques similar to computed tomography, the electrical potential data can be assembled into a three-dimensional map of the magnitude and direction of electric fields. Objects interact with electric fields differently based on their shape and dielectric properties, so this electric field data can then be used to understand shape, internal structure, and dielectric properties (e.g., impedance, resistance) of objects in three dimensions.

The EFI sensor can be used on its own to see electric fields or image electric field-emitting objects near the sensor (e.g., to evaluate leakage from poorly shielded wires or casings). For evaluation of objects that do not produce an electric field, NASA has developed a generator that emits a low-current, human-safe electrostatic field for snapshot evaluation of objects. Additionally, an alternative EFI system optimized to evaluate electric fields at significant distances (greater than 1 mile) is being developed for weather-related applications.

(excerpted from *http://www.techbriefs.com/component/content/article/1264-ntb/tech-briefs/electronics-and-computers/26139-lar-tops-116?Itemid=12*)

A photograph of a damaged hybrid composite (left), and the electric potential image of the hybrid composite (right).

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