Jul/Oct 2018 • No. 247

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Scientific and engineering professional organizations provide important support to students, researchers and practicing engineers/scientists. As such an organization, the ESA has been working to: 1) provide professional development opportunities, 2) publish the latest innovations, and 3) connect professionals to the community in the area of electrostatics. Much of our society's activities spring from the annual meetings and publications. Having our conference proceedings freely accessible to everyone who can access the internet is an added advantage. A membership to the ESA is not even required to access our conference proceedings and Newsletters. Moreover, our annual meetings are highly successful. We have just experienced such a moment at the June 2018 meeting in Boston; with excellent technical sessions and mind-triggering electrostatics demos during the conference and at the Banquet. Please read the details elsewhere about the 2018 Electrostatics Joint Conference (ESJC) in this newsletter.

At one time we were focused on how to improve our annual meeting participation; and our hard work has really paid off. Adding invited talks, hosting the electrostatics demonstrations, and working with multiple societies to hold joint meetings; all have strengthened our society in specific, and our electrostatics community in general. Now our focus must be to sustain and continue to serve the community with high value meetings and publications on the topics of electrostatics and its applications.

Generally our joint meetings are well attended, and participation since the first joint meeting (held in 2003 in Little Rock, AR) is around 100 or more, as can been seen from the ESA Annual Meeting Participation chart that Kelly Robinson has prepared and maintained (Figure 1). Furthermore, attendance at our regular annual meetings have reached 80 or more on average, in the past few years.

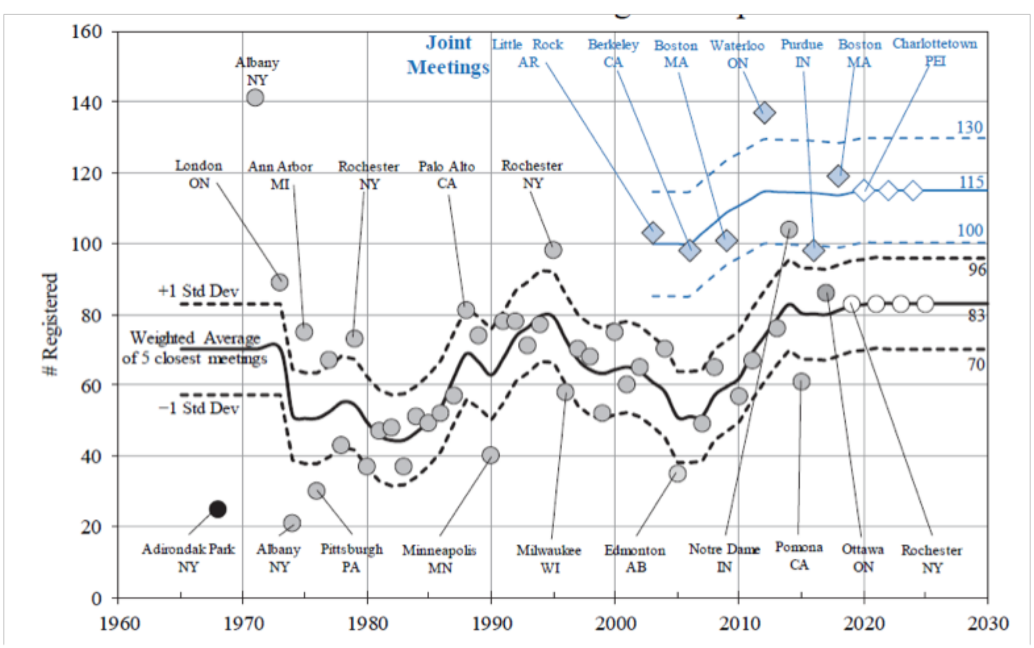


Figure 1: Historic ESA Conference Participation

As there are modulations in every aspect, we should also expect changes with our society's strength. During the 2018 ESA council meeting in Boston, executives of other societies; Institute of Electrostatic Japan (IEJ), La Societé Francaise d'Electrostatique (SFE) and Electrohydrodynamic (EHD) organization expressed some concerns. Holding a joint

(Cont'd. on p. 4)

Calendar

- 2019 ESA Annual Meeting, June 10-12, 2019, Rochester Riverside Hotel, Rochester, NY, USA, Contact: Kelly Robinson, *kelly.robinson@electrostaticanswers.com*, http: *http://www.electrostatics.org/annualmeeting.html*
- EIC 2019, Elec Insul Conf, June 16-19, 2019, Hyatt Regency Calgary, Calgary, Alberta, Canada, Further info: *http: http://ieee-eic.org*
- ICDL 2019, IEEE Int'l. Conf. on Dielectric Liquids, June 23-27, 2019, Univ. of Roma, Rome, Italy, Contact: Massimo Pompili or Luigi Calcara, *icdl2019@uniroma1.it*, *https://www.icdl2019.org*

ESA Officers

President:
Shesha Jayaram, Univ. of Waterloo

Vice President and Awards Chair:
Maciej Noras, Univ. of North Carolina

Executive Council:
David Go, Univ. of Notre Dame
Poupak Mehrani, Univ. of Ottawa
Rajeswari Sundararajan, Purdue Univ.

ESA Awards - Call for Nominations

Dear Friends,

The ESA is accepting nominations for the following awards:

The ESA Distinguished Service Award recognizes outstanding service to the ESA over an extended period of time, with a demonstrated long-term commitment to the growth and continued well-being of the Society (requirement: 10 years as ESA member).

The ESA Lifetime Achievement Award recognizes outstanding contributions to the field of Electrostatics, as shown by the pervasiveness of the contributions in understanding certain problems or important practical benefits resulting from the work (requirement: 10 years working in field of Electrostatics).

The ESA Honorary Life Member Award recognizes exceptional contributions to both the ESA and to the field of Electrostatics, sustained over much of a career (requirements: 10 years as ESA member, 20 years working in field of Electrostatics).

The ESA Rising Star Award recognizes significant contributions at an early stage of a career to the field of Electrostatics, Requirements: age of 40 or younger, but cannot be a student).

The ESA Entrepreneur Award recognizes companies and/or individuals that implement electrostatics- related technologies and are recognized as having a meaningful impact in the industry and/or academia.

The Teacher of the Year Award recognizes outstanding teachers who use Electrostatics to stimulate learning, inspire students, or otherwise encourage and energize the learning process in a formal educational setting in grades K-12 (requirement: 3 years teaching Electrostatics).

The Student of the Year Award recognizes middle or high school students who demonstrate outstanding achievement in Electrostatics, as showcased in laboratory projects, papers or presentations.

The ESA is also accepting nominations for induction to the Electrostatic Hall of Fame. This honor recognizes and records for posterity those individuals who have made extraordinary contributions to the field of Electrostatics. Nominees do not need to be still living. The Hall of Fame has three categories: (1) advancement of the fundamental knowledge of Electrostatics; (2) promotion of interest in the field of Electrostatics; (3) innovations using Electrostatics technology in industry.

The list of the award recipients is available at *http://electrostatics.org/esaawardwinners.html.* Nominations should be submitted electronically to the ESA Award Chair, Prof. Maciej Noras at *mnoras@uncc.edu*, by April 30, 2019. The nomination should be in the form of a letter from an ESA member that includes a description of how the accomplishments of the nominee satisfy the award requirements (including citations of publications or patents when relevant), the contact information of the nominator and nominee, and the names and contact information of 3 other ESA members who endorse the nomination. For the Teacher and Student awards, endorsements from two faculty members of the nominee's institution should substitute for the ESA member endorsements.

Thank you in advance for all the submissions,

Sincerely,
Maciej Noras

2019 Annual Meeting of the Electrostatics Society of America

Rochester Riverside Hotel, Rochester, NY

June 10-12, 2019

The Electrostatics Society of America (ESA) invites papers in all scientific and technical areas involving electrostatics for the 2019 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
- Charge motion and static dissipation
- Gas discharges and microplasmas
- Atmospheric and space applications
- Biological and medical applications
- Materials synthesis and processing
- Material delectric properties
- Measurements and instrumenation
- Safety and hazards

Conference Information: Registration Fee and Housing options will be announced ~ 1/1/2019 and available at: http://www.electrostatics.org.

Student Presentation Competition: Presentations by undergraduate & graduate students are eligible for the *Student Presentation Competition*. Please identify the student presenter when submitting the abstract.

Important Dates

January 1, 2019	*Abstract submission open*
March 1, 2019	*Abstract submission deadline*
March 15, 2019	*Notification of abstract acceptance*
May 3, 2019	*Early registration deadline*
May 17, 2019	*Final manuscript deadline*

Abstract Submission

Online submission at http://www.electrostatics.org

Contact Information

Organizing Committee

Kelly	Robinson	Electrostatic Answers	kelly.robinson@electrostaticanswers.com
Bill	Vosteen	Monroe Electronics	billv@monroe-electronics.com
Mark	Zaretsky	Eastman Kodak	mark.c.zaretsky@gmail.com

Technical Chair

Prof. N. K. Kishore, PhD, Indian Institute of Technology, Kharagpur, India, kishor@ee.iitkgp.ac.in

About Rochester NY: On the southern shore of Lake Ontario in Western New York, Rochester (metro area population of just over 1 million) is New York's third most populous city. The University of Rochester and Rochester Institute of Technology have renowned research programs. Many important inventions and innovations originated in the Rochester area, and is the birthplace of Kodak, Xerox, Bausch & Lomb, Gleason, and Western Union.

conference once every two years is inconvenient and difficult for the members of these above organizations to travel to North America, due to their own meetings held in Europe and Asia. Suggestions have been made to hold a joint conference once every three or four years; while still hosting the 2020 meeting as a Joint Conference in Prince Edward Island, Canada.

Some thoughts that come to my mind are: continue to support and encourage student participation, provide support for authors when possible, and host special sessions to expand the field of electrostatics applications. We certainly need your input and support to keep up with the growth ESA has been seeing in this century. As has been decided at the 2018 ESA Council meeting, we will be holding our first virtual ESA Council Meeting in late November, 2018. Please e-mail me your comments and suggestions by mid-November 2018.

Working together with other societies, IEJ, SFE, EHD, and IEEE – Industry Applications Society, Electrostatics Processes Committee (IAS-EPC), we surely can help each other to keep electrostatics as an active area for innovations and industrial developments.

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

Current Events

T Cell Engineering Breakthrough Sidesteps Need for Viruses in CRISPR Gene-Editing

Pete Farley

In an achievement that has significant implications for research, medicine, and industry, UC San Francisco scientists have genetically reprogrammed the human immune cells known as T cells without using viruses to insert DNA. The researchers said they expect their technique – a rapid, versatile, and economical approach employing CRISPR gene-editing technology – to be widely adopted in the burgeoning field of cell therapy, accelerating the development of new and safer treatments for cancer, autoimmunity, and other diseases, including rare inherited disorders.

The new method, described in the July 11, 2018, issue of Nature, offers a robust molecular "cut and paste" system to rewrite genome sequences in human T cells. It relies on electroporation, a process in which an electrical field is applied to cells to make their membranes temporarily more permeable. After experimenting with thousands of variables over the course of a year, the UCSF researchers found that when certain quantities of T cells, DNA, and the CRISPR "scissors" are mixed together and then exposed to an appropriate electrical field, the T cells will take in these elements and integrate specified genetic sequences precisely at the site of a CRISPR-programmed cut in the genome.

"This is a rapid, flexible method that can be used to alter, enhance, and reprogram T cells so we can give them the specificity we want to destroy cancer, recognize infections, or tamp down the excessive immune response seen in autoimmune disease," said UCSF's Alex Marson, MD, PhD, associate professor of microbiology and immunology, a member of the UCSF Helen Diller Family Comprehensive Cancer Center, and senior author of the new study. "Now we're off the races on all these fronts."

But just as important as the new technique's speed and ease of use, said Marson, also scientific director of biomedicine at the Innovative Genomics Institute, is that the approach makes it possible to insert substantial stretches of DNA into T cells, which can endow the cells with powerful new properties. Members of Marson's lab have had some success using electroporation and CRISPR to insert bits of genetic material into T cells, but until now, numerous attempts by many researchers to place long sequences of DNA into T cells had caused the cells to die, leading most to believe that large DNA sequences are excessively toxic to T cells.

To demonstrate the new method's versatility and power, the researchers used it to repair a disease-causing genetic mutation in T cells from children with a rare genetic form of autoimmunity, and also created customized T cells to seek and kill human melanoma cells.

Marson attributes the new method's success with Roth's "absolute perseverance" in the face of the widespread beliefs that viral vectors were necessary and that only small pieces of DNA could be tolerated by T cells. "Theo was convinced that if we could figure out the right conditions we could overcome these perceived limitations, and he put in a Herculean effort to test thousands of different conditions: the ratio of the CRISPR to the DNA; different ways of culturing the cells; different electrical currents. By optimizing each of these parameters and putting the best conditions together he was able to see this astounding result."

(excerpted from *https://www.ucsf.edu/*

news/2018/07/411071/t-cell-engineering-breakthrough-side-steps-need-viruses-gene-editing)

Plasma Scientists Created Invisible, Whooping 'Whistlers' in a Lab

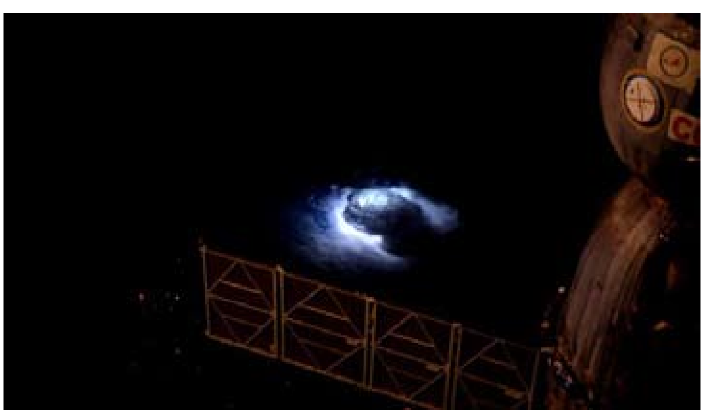
Rafi Letzter

There's a sort of radio wave that bangs its way around Earth, knocking around electrons in the plasma fields of loose ions surrounding our planet and sending strange tones to radio detectors. It's called a "whistler." And now, scientists have observed bursts like this in more detail than ever before.

Whistlers, typically created during certain lightning strikes, usually travel along Earth's magnetic-field lines. Humans first detected them more than a century ago, thanks to their ability to make a "whistling" sound (really more like a ghostly recording of laser blasts in a "Star Wars" movie) when picked up by a radio receiver. Yesterday (Aug. 14), researchers from the University of California, Los Angeles reported that they've produced whistlers in a plasma — a very electrically active, difficult-to-control, gas-like state of matter — in their laboratory, and observed their shapes.

When scientists studied whistlers in the past, they typically relied on data from a handful of widely spaced radio receivers distributed all over the planet. That sort of data is useful but is also incomplete. It tells researchers only so much about how the waves form, how they're shaped and how different kinds of ambient magnetic fields in the atmosphere influence them. (Detections of whistlers near Jupiter back in 1979 were also the first evidence scientists had that the giant planet has lightning storms like those on Earth.)

In this smaller-scale study, the researchers were able to control both the magnetic-field lines of the plasma and the whistlers themselves, which they created with a magnetic device. "Our laboratory experiments reveal three-dimensional wave properties in ways that simply cannot be obtained from observations in space," Reiner Stenzel, a co-author of the paper and a professor at UCLA, said in a statement. "This enabled us to study continuous waves, as well as the growth and decay of waves, with amazing detail. This produced unexpected discoveries of wave reflections and of [other strange whistler behaviors]."



A lightning strike is visible in a photo taken from the International Space Station. Credit: NASA

The researchers showed that whistlers don't necessarily bounce and reflect inside magnetic fields the way physicists might expect, often following the lines of magnetic fields rather than bouncing off magnetic obstacles. Whistlers, the researchers found, are less subject to influence from outside sources of magnetic energy than researchers expected, and they can penetrate magnetic regions that theories suggest should be unbreachable for the wave fronts.

That means scientists now know more about how to shape a whistler than ever before. And that turns out to be a very big deal: Back in 2014, a team of Italian researchers proposed that whistler waves could be used as the driving force of a plasma thruster to drive a craft through space, thanks to their ability to push on matter. A plasma thruster of this sort would, in theory, require very little fuel mass to push a spacecraft along at high speeds. But if a machine like that is going to work, the researchers wrote, scientists will first need studies like this to understand whistlers well enough to use them.

(from *https://www.livescience.com/63337-lightning-space-plasma-whistler.html*)

Gut bacteria's shocking secret: They produce electricity

Robert Sanders

While bacteria that produce electricity have been found in exotic environments like mines and the bottoms of lakes, scientists have missed a source closer to home: the human gut. UC Berkeley scientists discovered that a common diarrhea-causing bacterium, Listeria monocytogenes, produces electricity using an entirely different technique from known electrogenic bacteria, and that hundreds of other bacterial species use this same process.

Many of these sparking bacteria are part of the human gut microbiome, and many, like the bug that causes the food-borne illness listeriosis, which can also cause miscarriages, are pathogenic. The bacteria that cause gangrene (Clostridium perfringens) and hospital-acquired infections (Enterococcus faecalis) and some disease-causing streptococcus bacteria also produce electricity. Other electrogenic bacteria, like Lactobacilli, are important in fermenting yogurt, and many are probiotics.

"The fact that so many bugs that interact with humans,

2018 ESA Annual Meeting Highlights

The 2018 Joint Electrostatics Joint Conference hosted by the Electrostatics Society of America (ESA) in collaboration with Institute of Electrostatics Japan (IESJ), Industry Applications Society (IEEE-IAS) Electrostatic Processes Committee, and La Societé Francaise d'Electrostatique (SFE) was held at Boston University (BU). Attending were about 130 electrostatics experts and enthusiasts from 14 countries worldwide. Participants were from as far as Algeria, Brazil, Czech Republic, China, France, India, Japan, New Zealand, Russia, South Korea, Taiwan, United Kingdom, in addition to Canada and Unites States. General Chair Prof. Mark Horenstein (Boston University) led the local organizing committee and Technical Chair Prof. Shubho Banerjee (Rhodes College) put together an excellent technical program of presentations and posters.

The technical program consisted of 71 oral presentations organized into 13 sessions and 25 posters presented in a poster session. In addition, there was a popular electrostatics demonstration session at the conclusion of the technical program. As the "friendly society," the ESA continues to encourage participation by students, providing them with a welcoming venue to present their latest research findings. This year, nearly 25% of the technical talks and posters were delivered by students. First, second and third place awards were given out to 22 students by a panel of judges. The first prize recipients were Michal Talmor, Oualid Imene, Kazuki Numayama, Daniel Martin, Deepthi Antony, Dylan Carter, Ayyoub Zouaghi, and Sebastian Olarte.

As an ESA tradition, the conference banquet included an entertaining talk given by Prof. Mark Horenstein from Boston University entitled "Fun with Fluids". Special honors and recognitions were also given at the banquet: David Go (ESA Rising Star Award) and both Mystic Tan, Inc. and Monroe Electronics, Inc. (ESA Entrepreneur Award). In addition, the President's Appreciation Award was given to the 2018 conference General Chair Prof. Mark Horenstein and the Technical Program Chair Prof. Shubho Banerjee.

The conference organizers would like to give a special thanks to the BU staff (reservation, accommodation, catering, and computing offices) for providing commendable support throughout the conference. We would also like to thank the sponsors from this year: Sunless Inc. and Boston University.

Next year, the meeting will be a regular ESA meeting and will be held in Rochester Riverside Hotel, Rochester, NY, USA (June 10-12, 2019). Kelly Robinson, Bill Vosteen, and Mark Zaretsky will serve as the joint General Chairs and Prof. N. K. Kishore from Indian Institute of Technology, Kharagpur will serve as the Technical Program Chair.

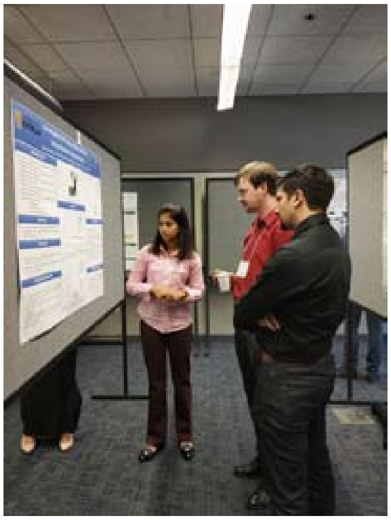
Mark Horenstein, General Chair

Shubho Banerjee, Technical Program Chair

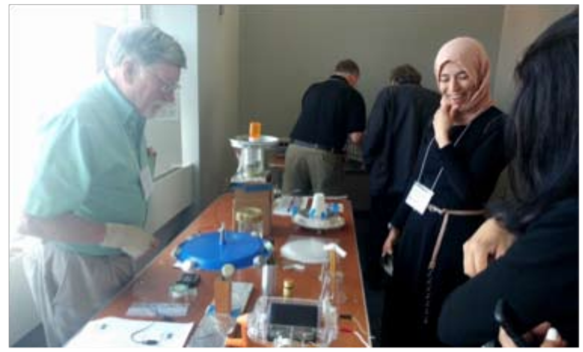
Presentations

2018 ESA Annual Meeting Highlights

Poster Session



Demonstration



Cocktail Party

Other photos may be found at
http://electrostatics.us/esa/2018/page_01.htm

Banquet

Awards

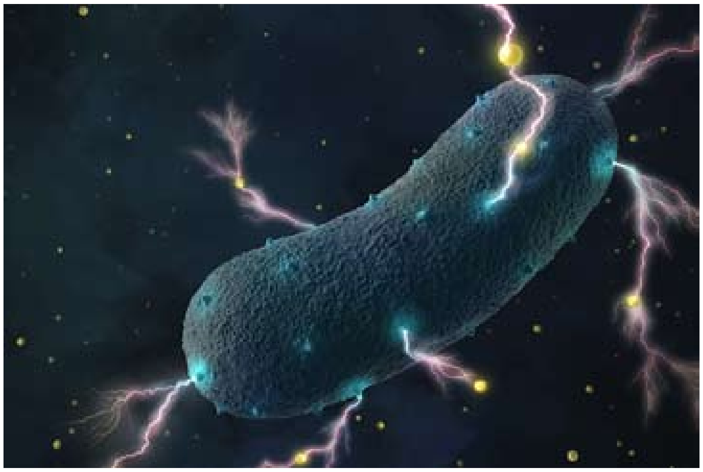
either as pathogens or in probiotics or in our microbiota or involved in fermentation of human products, are electrogenic — that had been missed before," said Dan Portnoy, a UC Berkeley professor of molecular and cell biology and of plant and microbial biology. "It could tell us a lot about how these bacteria infect us or help us have a healthy gut."

The discovery will be good news for those currently trying to create living batteries from microbes. Such "green" bioenergetic technologies could, for example, generate electricity from bacteria in waste treatment plants. The research will be posted online Sept. 12 in advance of Oct. 4 print publication in the journal Nature.

Bacteria generate electricity for the same reason we breathe oxygen: to remove electrons produced during metabolism and support energy production. Whereas animals and plants transfer their electrons to oxygen inside the mitochondria of every cell, bacteria in environments with no oxygen — including our gut, but also alcohol and cheese fermentation vats and acidic mines — have to find another electron acceptor. In geologic environments, that has often been a mineral — iron or manganese, for example — outside the cell. In some sense, these bacteria "breathe" iron or manganese.

Transferring electrons out of the cell to a mineral requires a cascade of special chemical reactions, the so-called extracellular electron transfer chain, which carries the electrons as a tiny electrical current. Some scientists have tapped that chain to make a battery: stick an electrode in a flask of these bacteria and you can generate electricity.

The newly discovered extracellular electron transfer system is actually simpler than the already known transfer chain, and seems to be used by bacteria only when necessary, perhaps when oxygen levels are low. So far, this simpler electron transfer chain has been found in bacteria with a single cell wall — microbes classified as gram-positive bacteria — that live in an environment with lots of flavin, which are derivatives of vitamin B2.



Listeria bacteria transport electrons through their cell wall into the environment as tiny currents, assisted by ubiquitous flavin molecules (yellow dots). (Amy Cao graphic, copyright UC Berkeley)

"It seems that the cell structure of these bacteria and the vitamin-rich ecological niche that they occupy makes it significantly easier and more cost effective to transfer electrons out of the cell," said first author Sam Light, a postdoctoral fellow. "Thus, we think that the conventionally studied mineral-respiring bacteria are using extracellular electron transfer because it is crucial for survival, whereas these newly identified bacteria are using it because it is 'easy.'"

To see how robust this system is, Light teamed up with Caroline Ajo-Franklin from Lawrence Berkeley National Laboratory, who explores the interactions between living microbes and inorganic materials for possible applications in carbon capture and sequestration and bio-solar energy generation.

She used an electrode to measure the electric current that streams from the bacteria — up to 500 microamps — confirming that it is indeed electrogenic. In fact, they make about as much electricity — some 100,000 electrons per second per cell — as known electrogenic bacteria.

Light is particularly intrigued by the presence of this system in Lactobacillus, bacteria crucial to the production of cheese, yogurt and sauerkraut. Perhaps, he suggests, electron transport plays a role in the taste of cheese and sauerkraut. "This is a whole big part of the physiology of bacteria that people didn't realize existed, and that could be potentially manipulated," he said.

Light and Portnoy have many more questions about how and why these bacteria developed such a unique system. Simplicity — it's easier to transfer electrons through one cell wall rather than through two — and opportunity — taking advantage of ubiquitous flavin molecules to get rid of electrons – appear to have enabled these bacteria to find a way to survive in both oxygen-rich and oxygen-poor environments.

(from *https://news.berkeley.edu/2018/09/12/gut-bacterias-shocking-secret-they-produce-electricity/*)

Flowing Salt Water Over This Super-Hydrophobic Surface Can Generate Electricity

Liezel Labios

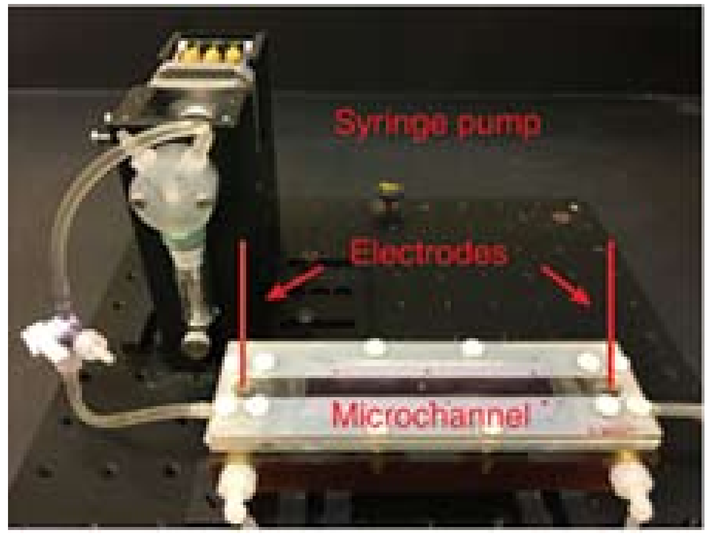
Engineers at the University of California San Diego have developed a super-hydrophobic surface that can be used to generate electrical voltage. When salt water flows over this specially patterned surface, it can produce at least 50 millivolts. The proof-of-concept work could lead to the development of new power sources for lab-on-a-chip platforms and other microfluidics devices. It could someday be extended to energy harvesting methods in water desalination plants, researchers said.

A team of researchers led by Prab Bandaru, a professor of mechanical and aerospace engineering at the UC San Diego Jacobs School of Engineering, and first author Bei Fan, a graduate student in Bandaru's research group, published their work in the Oct. 3 issue of Nature Communications.

The main idea behind this work is to create electrical voltage by moving ions over a charged surface. And the faster you can move these ions, the more voltage you can generate, explained Bandaru.

Bandaru's team created a surface so hydrophobic that it enables water (and any ions it carries) to flow faster when passing over. The surface also holds a negative charge, so a rapid flow of positive ions in salt water with respect to this negatively charged surface results in an electrical potential difference, creating an electrical voltage. "The reduced friction from this surface as well as the consequent electrical interactions helps to obtain significantly enhanced electrical voltage," said Bandaru.

The surface was made by etching tiny ridges into a silicon substrate and then filling the ridges with oil (such as synthetic motor oil used for lubrication). In tests, dilute salt water was transported by syringe pump over the surface in a microfluidic channel, and then the voltage was measured across the ends of the channel.



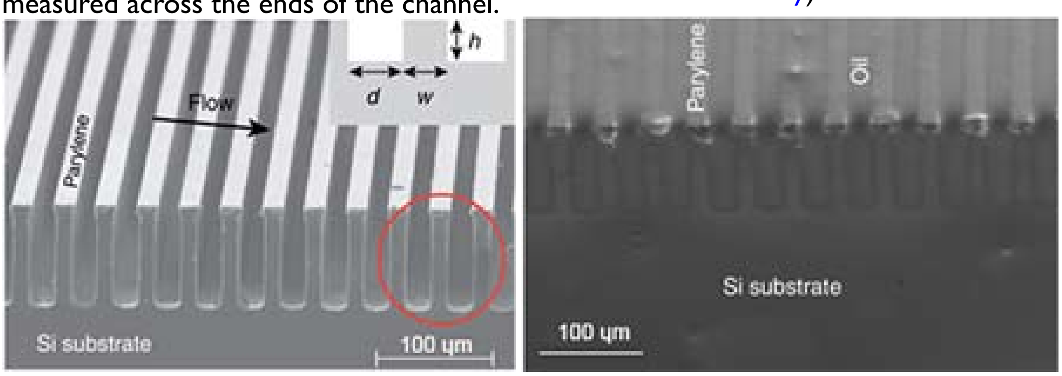
Experimental setup

There have been previous reports on super-hydrophobic, or so-called "lotus leaf" surfaces designed to speed up fluid flow at the surface. However, these surfaces have so far been patterned with tiny air pockets—and since air does not hold charge, the result is a smaller electric potential difference and thus, a smaller voltage. By replacing air with a liquid like synthetic oil—which holds charge and won't mix with salt water—Bandaru and Fan created a surface that produces at least 50 percent more electrical voltage than previous designs. According to Bandaru, higher voltages may also be obtained through faster liquid velocities and narrower and longer channels.

Moving forward, the team is working on creating channels with these patterned surfaces that can produce more electrical power.

Full paper: "Enhanced voltage generation through electrolyte flow on liquid filled surfaces." Co-authors include A. Bhattacharya, UC San Diego.

(from *https://ucsdnews.ucsd.edu/pressrelease/flowing_salt_water_over_this_super_hydrophobic_surface_can_generate_electricity*)



SEM images of the super-hydrophobic surface. Images courtesy of Fan et al./Nature Communications

Electrostatics
Society of America

30 Shalimar Drive
Rochester, NY 14618

ESA Information

ESA Home Page: *http://www.electrostatics.org*

Shesha Jayaram
ESA President
Dep't. of Elect. & Comp. Eng.
Univ. of Waterloo
Waterloo, Ontario
CANADA N2L 3G1
(519)888-4567, x35337
shesha.jayaram@uwaterloo.ca

Steve Cooper
Secretary/Treasurer
540 Morton Rd.
Athens, GA 30605
(706)255-5518
sandscooper1@gmail.com

Mark Zaretsky
Newsletter Editor
30 Shalimar Drive
Rochester, NY 14618
(585)588-6351
mark.zaretsky@kodak.com

2019 ESA Annual Meeting
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