

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

It has been four years since we met in Cambridge Ontario with our fellow colleagues from four other organizations during the 2012 Joint Electrostatics Conference. It was the largest meeting held in North America devoted to electrostatics. It is that time again for the Electrostatic Society of America (ESA) to host the 2016 Joint Electrostatics Conference, together with the Institute of Electrostatic Japan (IEJ), the IEEE Industry Applications Society (IAS) Electrostatic Processes Committee (EPC), and La Société Française d'Electrostatique (SFE). The chairs/presidents of IEJ, EPC, SFE and ESA are happy to invite you to join us in June 2016. This time, we are going back to Purdue University in West Lafayette, Indiana. You may be reminded of the excellent moments from the 2007 ESA meeting held on the Purdue campus, and it is going to be another memorable meeting this summer. The host, Prof. Raji Sundararajan, is set to repeat the history of her excellent organization of the 2007 meeting. Joining Prof. Sundararajan will be Prof. Keith Forward, our young and energetic ESA member, chairing the technical program committee. Despite their busy university related activities, both Raji and Keith have been working very hard on this conference. Please do not hesitate to ask them for any assistance or clarification you may need.

Regarding clarification, I would like to remind everyone about the new deadline for submitting your abstracts, extended to March 15th, 2016. Is there any relationship between the mild winter and the slow abstract submissions? The temperature in the Canadian Prairies has reached +15°C during this February. But if you are thinking about spring and summer activities; then it is perfect for you to plan your trip to West Lafayette. The campus is beautiful and there are plenty of things to do in and around the city.

As always, this year we will have a wonderful forum to discuss and learn during the conference. The meeting starts with a welcome reception on the evening of June 13th, and technical sessions start on the following morning of the 14th. There will be plenty of time during the breaks, evenings, and of course, during the sessions, to interact, make new friends, and rejuvenate old friendships. Due to the nature of the Joint Conference, you can present to a broader audience. Also, papers presented at the 2016 Joint Conference can be submitted to the IAS Transactions as well as the Journal of Electrostatics for archival publication.

Talking about conferences, it is good to think about venues for our future meetings. Next year, it will be a regular ESA Annual meeting. Are you thinking of bringing us to your city or to an exotic location nearby? Then, please volunteer to host the 2017 ESA Annual Meeting next year. During the committee meeting in June we can have a discussion on the venue and the ways in which our ESA executives can help.

We cannot forget the past when thinking about the upcoming meetings. This is a time for us to recognize the contributions made by individuals to the society and to the field of electrostatics. In this issue there is a column about ESA Award nominations (information may also be found at <http://electrostatics.org/esaawards1.html>). Please help us in identifying those individuals who deserve the recognition.

I am looking forward to seeing you all in West Lafayette and learning from many interesting presentations on electrostatics and its applications in industry, environment, medicine, energy, agriculture and other fields.

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

ESA Officers

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Maciej Noras, Univ. of North Carolina

Executive Council:

David Go, Univ. of Notre Dame

Poupak Mehrani, Univ. of Ottawa

Rajeswari Sundararajan, Purdue Univ.

Calendar

- ✦ 2016 Electrostatics Joint Conference, June 13-16, 2016, Purdue University, West Lafayette, IN, USA, <http://www.electrostatics.org/conferences.html>
Contact: Raji Sundararajan, rsundara@purdue.edu
- ✦ IEEE 34th Electrical Insulation Conf (EIC), June 19-22, 2016, Montreal, Quebec, <http://sites.ieee.org/eic/> Contact: Bernard Noirhomme, noirhomme.bernard@ireq.ca
- ✦ 1st Int'l Conf. on Dielectrics (ICD), July 3-7, 2016, Montpellier, France, <http://www.ies.univ-montp2.fr/icd2016/> Contact: Jérôme Castellon, chairman@icd-2016.org
- ✦ STEP-2, 2nd Int'l Workshop on Static-Tribo-Electricity of Powder, August 4-6, 2016, Compiègne, France, <http://www.t.soka.ac.jp/powder/STEP2/index.html>
- ✦ SFE-2016, August 29-31, 2016, Poitiers, France, <http://sfe2016.conference.univ-poitiers.fr/en/> Contact: Thierry Paillat (thierry.paillat@univ-poitiers.fr) or Gérard Touchard (gerard.touchard@univ-poitiers.fr)
- ✦ 38th Annual EOS/ESD Symposium, Sept. 11-16, 2016, Garden Grove, California https://www.esda.org/events/eosesd-symposia/symposia/?utm_content=ed5cad18ba077c3aeb23013de9cbe3a9&utm_campaign=2016%20Symposium%20Call%20for%20Papers&utm_source=Robly.com&utm_medium=email Contact: info@esda.org
- ✦ XIV Int'l. Conf. on Electrostatic Precipitation (ICESP 2016), Sept. 19-23, 2016, Wroclaw, Poland, <http://www.icesp2016.pwr.edu.pl> Contact: Arkadiusz Świerczok, icesp2016@pwr.edu.pl
- ✦ CEIDP, Conf. on Elec. Insul. & Diel. Phen., Oct. 16-19, 2016, Toronto, Canada, <http://sites.ieee.org/ceidp/2016-ceidp-info/> Contact: Resi Zarb, rzarb@irispower.com (**abstracts due March 13**)
- ✦ Electrostatics 2017, April 10-13, 2017, Frankfurt/Main, Germany, <http://www.dechema.de/en/electrostatics2017.html> Contact: Nadja Strein, strein@dechema.de (**abstracts due April 1**)

Current Events

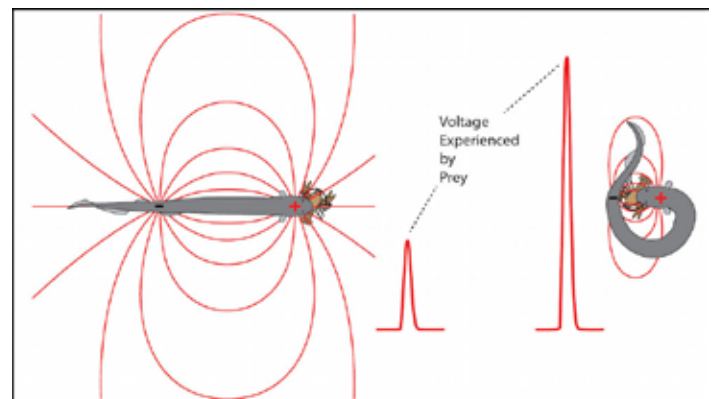
Electric Embrace: Eels Curl Up to Supercharge Shocks

Elizabeth Palermo

It's kind of like walking straight into an electric fence, or getting shot with a stun gun. That's how one biologist describes the experience of getting zapped by an electric eel. "You wouldn't voluntarily do it over and over again," said Kenneth Catania, a professor of biological sciences at Vanderbilt University in Nashville, Tennessee, and author of a new study about the electric eels' shocking behavior.

Catania has been zapped a few times since he began studying the electric eel (*Electrophorus electricus*), a fish that's indigenous to the murky waters of the Amazon. Endowed with three electricity-producing organs, *E. electricus* can send a pulse, or volley, of high-voltage electricity through the water toward prey items. These shocks aren't meant to kill the prey, just demobilize it so the eel can more easily consume its victims, Catania told Live Science.

To envision how the eel uses its electric charge, try picturing the critter's long, thin body as a skinny magnet. Like a magnet, the eel has two ends, or poles. When the animal sends out an electric pulse, most of the charge comes from its head, which Catania calls the "positive pole." The eel's tail serves as the "negative pole," sending out a much weaker electric pulse than the head, Catania said. Most of the time, *E. electricus* just needs the charge from its head to demobilize prey. However, the tail end of the eel is actually quite important, Catania's new study shows. By bringing its tail around toward its head, an electric eel can double the strength of the electric pulse it sends out into the water, allowing it to



An illustration of the eel's curling behavior.

Credit: Kenneth C. Catania



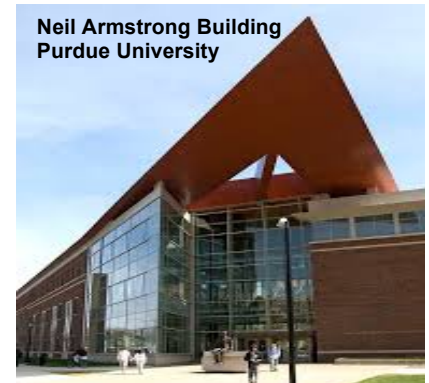
2016 Electrostatics Joint Conference

Purdue University
West Lafayette, Indiana, USA
June 13 - 16, 2016

The Electrostatic Society of America (ESA), Institute of Electrostatic Japan (IEJ), International Electrostatic Assembly (IEA), Industry Applications Society (IEEE-IAS) Electrostatic Processes Committee, and La Société Française d'Electrostatique (SFE) invite papers in all scientific and technical areas involving electrostatics. The scope of the conference ranges from the fundamental physics underlying electrostatics to applications in industry, atmospheric and space sciences, medicine, energy, and other fields. The meeting will bring together experts across the diverse field to present the latest developments in electrostatics.

Anticipated Technical Session Topics

- Atmospheric and space applications
- Biological and medical applications
- Breakdown phenomena, safety and hazards
- Contact charging and triboelectric effects
- Electrically-induced flows and electrokinetics
- Flows, forces and fields
- Gas discharges and microplasmas
- Electrospinning and material processing
- Measurements and instrumentation
- Particle control and charging



Conference information, including abstract submission, registration, student travel grants and lodging, will be updated and available at <http://www.electrostatics.org>

Student paper competition: Presentations by students (undergraduate and graduate) are eligible; please indicate participation when submitting abstract.

Important dates:

March 15, 2016 Abstract submission deadline (**Extended**) (submit on-line at <http://www.electrostatics.org>)

March 17, 2016 Notification of paper acceptance

May 16, 2016 Final manuscripts due

June 13, 2016 Reception (6-9PM)

June 14, 2016 Conference begins (8AM)

June 16, 2016 Conference ends after evening banquet (7 PM – 10 PM)

Contact information:

For questions regarding the technical program and abstract submission, contact

Technical Chair: Dr. Keith Forward, California State Polytechnic University, Pomona, kmforward@cpp.edu, (909) 869-3

For all other questions, contact

General Chair: Dr. Raji Sundararajan, Purdue University, raji@purdue.edu, (765) 494-6912

ESA Award Nominations

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 **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.

Nominations should be submitted electronically to the ESA Award Chair, Prof. Maciej Noras at mnoras@uncc.edu, by **April 15**. 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 should substitute for the ESA member endorsements.

Current Events (cont'd.)

demobilize larger prey items, the study found.

To measure the energy output of a curling eel, Catania rigged up a sort of eel chew toy by attaching a dead fish to a piece of wire. The fish was fitted with electrodes that could measure the voltage produced by the eel. Then, Catania stuck the chew toy in the tank with the eel and wiggled the toy around, simulating struggling prey. Sure enough, the eels tended to wrap themselves around the fish, and when they did so, they delivered at least twice their usual zap of electricity, Catania found.

To understand how the eel doubles its charge, try picturing the critter in the shape of a horseshoe magnet. In one of these U-shaped magnets, the north and south poles of a single magnet are brought into close proximity to one another, which creates a strong magnetic field. When the eel curls up in this horseshoe shape, something similar happens — it

produces a strong electric field.

But electric eels don't actually double the amount of electricity they produce when they go after large prey; they just direct the charges from both ends of their bodies to one specific area, which makes the charge feel more powerful to unfortunate prey items. This is a good tactic for an eel to use, said Catania, adding that the zappy critters don't have to expend any more energy than usual when they curl up like this, but they could still end up with a bigger meal.

Small eels (some are just a few inches long) do a lot of curling, said Catania, who pointed out that these little animals need to focus their zaps to stun prey into submission. But big eels, which can measure a meter or two in length, engage in this behavior, as well. Catania said he'd like to know more about what kinds of prey items these large eels can take down

Current Events (cont'd.)

with their powerful electric charges.

“There’s virtually no evidence of what electric eels actually eat. But these guys get really big, and they live in the Amazon, where there’s a huge diversity of potential prey,” said Catania, who added that electric eels could wrestle all kinds of creatures. He said he hopes his new study might get other researchers wondering just what the electric eel is capable of hunting in the wild.

(excerpted from <http://www.livescience.com/52616-eels-curl-to-supercharge-shocks.html>)

Shocking new way to get the salt out

David L. Chandler

As the availability of clean, potable water becomes an increasingly urgent issue in many parts of the world, researchers are searching for new ways to treat salty, brackish or contaminated water to make it usable. Now a team at MIT has come up with an innovative approach that, unlike most traditional desalination systems, does not separate ions or water molecules with filters, which can become clogged, or boiling, which consumes great amounts of energy.

Instead, the system uses an electrically driven shockwave within a stream of flowing water, which pushes salty water to one side of the flow and fresh water to the other, allowing easy separation of the two streams. The new approach is described in the journal *Environmental Science and Technology Letters*, in a paper by professor of chemical engineering and mathematics Martin Bazant, graduate student Sven Schlumpberger, undergraduate Nancy Lu, and former postdoc Matthew Suss.

This approach is “a fundamentally new and different separation system,” Bazant says. And unlike most other approaches to desalination or water purification, he adds, this one performs a “membraneless separation” of ions and particles.

Membranes in traditional desalination systems, such as those that use reverse osmosis or electrodialysis, are “selective barriers,” Bazant explains: They allow molecules of water to pass through, but block the larger sodium and chlorine atoms of salt. Compared to conventional electrodialysis, “This process looks similar, but it’s fundamentally different,” he says.

In the new process, called shock electrodialysis, water

flows through a porous material —in this case, made of tiny glass particles, called a frit — with membranes or electrodes sandwiching the porous material on each side. When an electric current flows through the system, the salty water divides into regions where the salt concentration is either depleted or enriched. When that current is increased to a certain point, it generates a shockwave between these two zones, sharply dividing the streams and allowing the fresh and salty regions to be separated by a simple physical barrier at the center of the flow.

Even though the system can use membranes on each side of the porous material, Bazant explains, the water flows across those membranes, not through them. That means they are not as vulnerable to fouling — a buildup of filtered material — or to degradation due to water pressure, as happens with conventional membrane-based desalination, including conventional electrodialysis. “The salt doesn’t have to push through something,” Bazant says. The charged salt particles, or ions, “just move to one side,” he says.

The underlying phenomenon of generating a shockwave of salt concentration was discovered a few years ago by the group of Juan Santiago at Stanford University. But that finding, which involved experiments with a tiny microfluidic device and no flowing water, was not used to remove salt from the water, says Bazant, who is currently on sabbatical at Stanford.

The new system, by contrast, is a continuous process, using water flowing through cheap porous media, that should be relatively easy to scale up for desalination or water purification. “The breakthrough here is the engineering [of a practical system],” Bazant says.

(excerpted from <http://news.mit.edu/2015/shockwave-process-desalination-water-1112>)

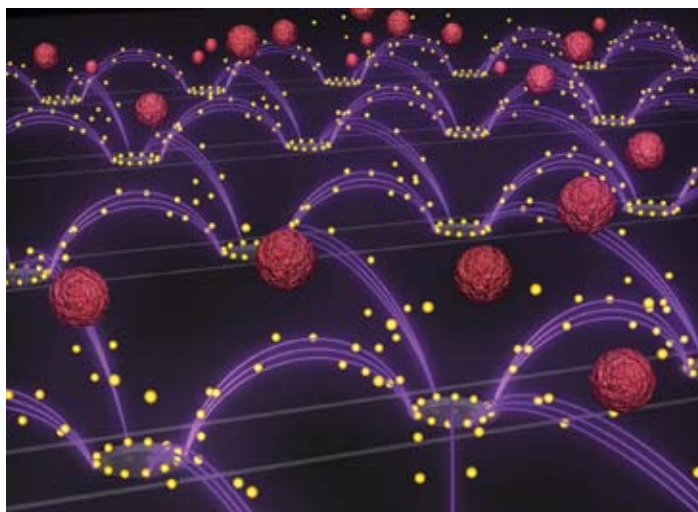
Electric fields remove nanoparticles from blood with ease

Engineers at the University of California, San Diego developed a new technology that uses an oscillating electric field to easily and quickly isolate drug-delivery nanoparticles from blood. The technology could serve as a general tool to separate and recover nanoparticles from other complex fluids for medical, environmental, and industrial applications.

Current Events (cont'd.)

Nanoparticles, which are generally one thousand times smaller than the width of a human hair, are difficult to separate from plasma, the liquid component of blood, due to their small size and low density. Traditional methods to remove nanoparticles from plasma samples typically involve diluting the plasma, adding a high concentration sugar solution to the plasma and spinning it in a centrifuge, or attaching a targeting agent to the surface of the nanoparticles. These methods either alter the normal behavior of the nanoparticles or cannot be applied to some of the most common nanoparticle types.

This new nanoparticle separation technology will enable researchers — particularly those who design and study drug-delivery nanoparticles for disease therapies — to better monitor what happens to nanoparticles circulating in a patient's bloodstream. One of the questions that researchers face is how blood proteins bind to the surfaces of drug-delivery nanoparticles and make them less effective. Researchers could also use this technology in the clinic to determine if the blood chemistry of a particular patient is compatible with the surfaces of certain drug-delivery nanoparticles.



An artist's representation of the nanoparticle removal chip developed by researchers in Professor Michael Heller's lab at the UC San Diego Jacobs School of Engineering. An oscillating electric field (purple arcs) separates drug-delivery nanoparticles (yellow spheres) from blood (red spheres) and pulls them towards rings surrounding the chip's electrodes. The image is featured as the inside cover of the Oct. 14 issue of the journal *Small*. Image credit: Stuart Ibsen and Steven Ibsen.

The device used to isolate the drug-delivery nanoparticles was a dime-sized electric chip manufactured by La Jolla-based Biological Dynamics, which licensed the original technology from UC San Diego. The chip contains hundreds of tiny electrodes that generate a rapidly oscillating electric field that selectively pulls the nanoparticles out of a plasma sample. Researchers inserted a drop of plasma spiked with nanoparticles into the electric chip and demonstrated nanoparticle recovery within 7 minutes. The technology worked on different types of drug-delivery nanoparticles that are typically studied in various labs.

The breakthrough in the technology relies on designing a chip that can work in the high salt concentration of blood plasma. The chip's ability to pull the nanoparticles out of plasma is based on differences in the material properties between the nanoparticles and plasma components. When the chip's electrodes apply an oscillating electric field, the positive and negative charges inside the nanoparticles reorient themselves at a different speed than the charges in the surrounding plasma. This momentary imbalance in the charges creates an attractive force between the nanoparticles and the electrodes. As the electric field oscillates, the nanoparticles are continually pulled towards the electrodes, leaving the rest of the plasma behind. Also, the electric field is designed to oscillate at just the right frequency: 15,000 times per second.

(excerpted from http://jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1846&)

Shocking! 'Electric Eel' Fibers Could Power Wearable Tech

Charles Q. Choi

Stretchy fibers that mimic electric eels could be woven into clothing to power wearable technology one day, new research suggests. In experiments, these flexible fibers produced enough power to run electronic lights and watches.

Electric eels (*Electrophorus electricus*) can generate deadly shocks to stun prey and defend against predators. These fish have cells known as electrocytes, which store and release electrically charged ions to generate powerful electric fields. By themselves, electrocytes in electric eels generate low voltages of only about 0.15 volts. However, in eels, thousands of these disc-like electrocytes line up, working in concert to

Current Events (cont'd.)

produce deadly shocks of up to 600 volts, or about five times the voltage emitted from a U.S. electrical outlet.

Hao Sun, a materials scientist at Fudan University in Shanghai, and his colleagues, wanted to harness the power of the electric eel in a man-made material. To do so, they created fibers that mimicked the shocking creatures' ability to stack up tiny voltage-producing cells in concert. The scientists fabricated the capacitors by first wrapping sheets of carbon nanotubes around elastic rubber fibers 500 microns wide, or about five times the average width of a human hair. The researchers made sure that the electrically conductive carbon nanotube sheets did not completely cover the electrically insulating rubber. Instead, there were gaps where the insulating rubber was exposed. Such gaps are key, because capacitors consist of both conductive and insulating units.

Then, the scientists applied patches of electrically conductive electrolyte gel onto these fibers. The pattern of patches the researchers used converted the fibers into capacitors. The more alternating segments of electrically conductive nanotube sheets and electrically insulating rubber gaps a fiber had, the greater the voltage it could generate. A fiber about 39 feet (12 meters) long could generate 1,000 volts, the researchers reported online Jan. 14 in the journal *Advanced Materials*.

Previous research also sought to mimic electric eels by connecting many electrocyte-like units together. However, those units were impractical because they were strung together with metal wires, and generally had poor flexibility, the researchers said. This new device instead connected all of its electrocyte-like units together on a single fiber.

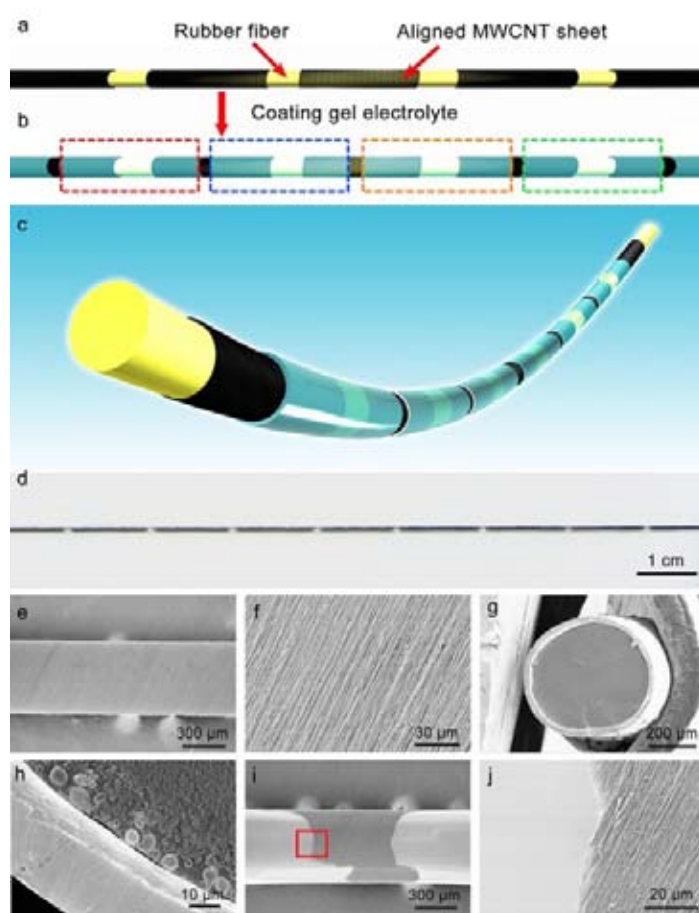
The elastic fibers could stretch up to 70 percent more than their usual length without losing their electrical or structural properties, the researchers said. The team also showed that the fibers could be woven together with conventional elastic fibers to create fabric that could be incorporated into clothes.

The researchers suggested that the eely fibers could help power miniature electronic devices. For example, in experiments, they created energy wristbands to power electronic watches, and wove fibers into T-shirts to power 57 light-emitting diodes (LEDs). In

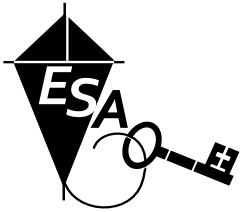
the future, these energy fibers "might be incorporated into our daily clothes to power our wearable devices, such as the Apple Watch and Google Glass," Sun said.

The scientists also connected their capacitor fibers to fiber-shaped solar cells to create material that could both harvest and store energy. In experiments, these combination fibers generated 10 volts of electricity when exposed to light — enough to power some types of small electronic devices, they said. Solar cell fibers could also recharge battery fibers in wearable devices, the researchers said.

(excerpted from)



A new fiber inspired by the electricity-generating cells in electric eels could power wearable devices. The fibers (shown in the schematic above) combine conducting carbon nanotubes with insulating rubber wires and electrolyte gel to create tiny capacitors. The capacitors are placed in series to generate large voltage. At bottom, scanning electron micrograph images of the new fibers. Credit: H. Sun et al, *Advanced Materials*



ESA Information

ESA Home Page: <http://www.electrostatics.org>

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