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ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Dear ESA Colleagues,

I am happy to say that the ESA is going very strong, and our meetings are the most active in many years. In 2012, we hosted the Joint Electrostatics Meeting in Ontario, Canada, in conjunction with the IEEE Electrostatic Processes Committee and the French and Japanese electrostatics societies. That meeting had 138 participants, which was our largest meeting in 40 years. Our meeting last year in Cocoa Beach, Florida, had 76 participants, which was the largest meeting that we hosted alone since 1995.

And our upcoming meeting, which will be held at the University of Notre Dame in June, will be even larger than last year's meeting. The abstract deadline has just passed, and we received 70 submissions for presentations. These presentations include the usual technical papers, as well as presentations in an electrostatics demonstration session; this type of session was a big hit at our 2012 conference. Our Conference Chair, Prof. David Go from the University of Notre Dame, and our Technical Program Chair, Prof. Poupak Mehrani from the University of Ottawa, have been doing a great job!

A nice aspect of our meetings is the friendliness and collegiality. Our meetings include lunches and some dinners, to encourage interaction between participants – you can just sit down at any table and talk with whoever is there, whether you knew them before or not. In my opinion these informal interactions are the most important part of the meeting – I've gotten many important insights that helped my research program through these conversations.

The ESA friendliness extends beyond the confines of the meetings. I have been welcomed in the labs of ESA colleagues literally all over the world – in Botswana, Finland and Brazil! And just a couple of weeks ago I welcomed ESA member Thiago Burgo for a visit to my lab here at Case Western Reserve University in Cleveland. Thiago gave talks at our previous two ESA meetings, when he was a graduate student at the University of Campinas in Brazil, and will be giving another talk at our upcoming meeting. He gives great presentations, and last year was a First Place winner of the Student Paper Competition. Having completed his PhD last summer, Thiago now has a postdoctoral research position at Argonne National Laboratory near Chicago. He was coming through Cleveland a couple of weeks ago and contacted me about a visit, resulting in an enjoyable tour of my lab and nice discussions about ongoing work in electrostatics.

If you are coming through Cleveland, please get in touch and plan a visit to my lab!

And if you're not coming through Cleveland, I hope to see you at the ESA Meeting at Notre Dame in June!

Regards,
Dan Lacks,
President, ESA
daniel.lacks@case.edu

ESA Officers

President:
Dan Lacks, Case Western Reserve Univ.
Vice President
Shesha Jayaram, Univ. of Waterloo
Executive Council
Sheryl Barringer, Ohio State Univ.
Kelly Robinson, Electrostatic Answers, LLC
Rajeswari Sundararajan, Purdue Univ.

Calendar

- EIC 2014, June 8-11, 2014, Philadelphia, PA, USA, http://sites.ieee.org/eic/
- ESA 2014, June 17-19, 2014, Univ. of Notre Dame, South Bend, Indiana, USA, David Go, *dgo@nd.edu*
- SFE 2014 (9th Conf.) Aug. 27-29, 2014, Toulouse, France, *secretariat-sfe2014@laplace.univ-tlse.fr* (abstract due Jan. 31, 2014)
- 2014 EOS/ESD Symposium Sep. 7-12, 2014, Tuscon, AZ, USA, *http://www.esda.org/symposia.html*, Contact: *info@esda.org*
- IEEE/IAS Annual Mtg. Oct. 5-9, 2014, Vancouver, BC, Canada, *http://www.ewh.ieee.org/soc/ias/2014/* Contact: Rajesh Sharma, *rsharma@astate.edu*
- ESA 2015, June, 2015, Cal Poly Pomona, Pomona, CA, USA, Keith Forward, *kmforward@csupomona.edu*

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).

(cont'd. on p4)

ESA2014: Electrostatics Demos

At the upcoming ESA Meeting set for June 17-19, 2014 at the University of Notre Dame in Notre Dame, Indiana, we will have a special evening workshop and reception devoted to electrostatics demonstrations. The goal is to provide a variety of demonstrations from educational experiments to safety and consultation topics, building upon the very successful demonstration workshop at the 2012 ESA/IEJ/IAS/SFE joint meeting at the University of Waterloo. The event is slated to take place on the campus of University of Notre Dame in the New Stinson-Remick Hall of Engineering, directly adjacent to where the conference talks will be held and within walking distance of all the lodging options.

Several well-known leaders in industrial static control and applied electrostatics will be presenting demonstrations including

- Ted Dangelmayer, Dangelmayer Assoc., a leader in preventing ESD in electronics manufacturing will show several educational demonstrations.
- Sethar (Duke) Davis, Wabash Instruments, will be showing us some of the electrostatics demonstration equipment available from Wabash Instruments.
- Steve Fowler, Fowler Associates, a leading consultant in electrostatic hazards and safety will offer an interesting demonstration.
- Bill Larkin, Stop-Static.com, a division of Alpha Innovations, inventor of Static String™, will be demonstrating passive static dissipators.
- Jim Perry, Simco-Ion, a leader in industrial static control, will demonstrate active static dissipators.
- Kelly Robinson, Electrostatic Answers, will show that web charge density can be estimated from electrostatic fieldmeter readings, and that static sparks can ignite solvent vapors.

Please plan on attending our 2014 ESA Annual Meeting and join us for our Special Session devoted to electrostatic demonstrations. If you have any questions or if you need additional information, please contact Kelly Robinson, who is coordinating the session.

Kelly Robinson, PE, PhD
Owner, Electrostatic Answers
kelly.robinson@electrostaticanswers.com

2014 Annual Meeting of the Electrostatics Society of America
University of Notre Dame, Notre Dame, IN
June 17-19, 2014

The Electrostatic Society of America (ESA) invites papers in all scientific and technical areas involving electrostatics for the 2014 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. Giles Harrison**, University of Reading, UK
- **Dr. Sung-Jin Park**, University of Illinois Urbana-Champaign and Eden Park Illumination, USA
- **Dr. Hak-Kim Chan,** University of Sydney, Australia
- **Dr. Junhong Chen**, University of Wisconsin-Milwaukee, USA
- **Dr. Peter Ireland**, University of Newcastle, Australia

Special Events
Electrostatics Demonstration Workshop and Reception, and the Annual ESA Banquet.

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, 2014	*Abstract submission open*
March 1, 2014	*Abstract submission deadline*
March 15, 2014	*Notification of abstract acceptance*
May 10, 2014	*Early registration deadline*
May 15, 2014	*Final manuscript deadline*

Abstract Submission & Conference Travel Information
http://www.electrostatics.org

Contact Information

General Chair
Prof. David B. Go (dgo@nd.edu)
University of Notre Dame, USA

Technical Chair
Prof. Poupak Mehrani (poupak.mehrani@uottawa.ca)
University of Ottawa, Canada

ESA Archives

Anne Benninghoff, ESA Archivist

Mark Zaretsky

For many years (more than I am aware of) the ESA has been fortunate enough to have an archivist, Anne Benninghoff. She took the responsibility of collecting, saving, and managing various historical documents of both the ESA (newsletters, papers, conference reports, council minutes, etc.) and Professor A.D. Moore. Through her efforts, these documents are stored in the Bentley Historical Library at the University of Michigan in Ann Arbor. There are 8 boxes of archives, including a videocassette with Bob Gundlach and A.D. Moore. If anyone is interested in viewing this archive the contact information for the Bentley Historical Library is 1150 Beal Ave., Ann Arbor, MI 48109, phone: 734-764-3482, email: *bentley.ref@umich.edu*, http://www.bentley.umich/edu and the archive call number is 851959 Aa/2. A debt of gratitude is owed to Anne for generously carrying on this job for so many years.

ESA Award Nominations

(cont'd. from p2)

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. Shesha Jayaram at *shesha.jayaram@uwaterloo.ca*, 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

Cartilage made easy with novel hybrid printer

The printing of 3D tissue has taken a major step forward with the creation of a novel hybrid printer that simplifies the process of creating implantable cartilage. The printer is a combination of two low-cost fabrication techniques: a traditional ink jet printer and an electrospinning machine. Combining these systems allowed the scientists to build a structure made from natural and synthetic materials. Synthetic materials ensure the strength of the construct and natural gel materials provide an environment that promotes cell growth.

In this study, the hybrid system produced cartilage constructs with increased mechanical stability compared to those created by an ink jet printer using gel material alone. The constructs were also shown to maintain their functional characteristics in the laboratory and a real-life system. The key to this was the use of the electrospinning machine, which uses an electrical current to generate very fine fibres from a polymer solution. Electrospinning allows the composition of polymers to be easily controlled and therefore produces porous structures that encourage cells to integrate into surrounding tissue.

In this study, flexible mats of electrospun synthetic polymer were combined, layer-by-layer, with a solution of cartilage cells from a rabbit ear that were deposited using the traditional ink jet printer. The constructs were square with a 10cm diagonal and a 0.4mm thickness.

The researchers tested their strength by loading them with variable weights and, after one week, tested to see if the cartilage cells were still alive. The constructs were also inserted into mice for two, four and eight weeks to see how they performed in a real life system. After eight weeks of implantation, the constructs appeared to have developed the structures and properties that are typical of elastic cartilage, demonstrating their potential for insertion into a patient.

The researchers state that in a future scenario, cartilage constructs could be clinically applied by using an MRI scan of a body part, such as the knee, as a blueprint for creating a matching construct. A careful selection of scaffold material for each patient's construct would allow the implant to withstand mechanical forces while encouraging new cartilage to organise and fill the defect.

(from http://www.iop.org/news/12/nov/page_58984.html)

Antioxidants: Good for You, Good for Your Smartphone

Lily Hay Newman

Health claims that "free radicals"—particles that are highly reactive because they have an unpaired electron—can damage human cells and possibly even cause cancer are pretty widespread. But by facilitating the buildup of static, these same malicious molecules wreak havoc on electronics too, scientists say.

Researchers from Northwestern University report in the journal Science that antioxidants such as vitamin E have the potential to combat free radicals—not just in the human body but also in polymers used for electronic equipment. The scientists showed that static electricity dissipates quickly if polymers are infused with vitamin E or other free radical "scavengers."

Today's methods for dissipating static electricity focus on eliminating charges by ionizing the air or by applying chemical coatings that absorb water from the air to make a conductive surface. But these methods require special conditions, such as high humidity, and can take hours to eliminate static buildup.

"What if you remove not the charges per se but the helpers, the radicals?" asks Bartosz Grzybowski, a professor of physical chemistry at Northwestern, who led the research. "It's so simple." Grzybowski and his team began testing theories of static electricity in 2009, when his lab bought a Kelvin probe force microscope with a grant from the U.S. Department of Energy. The microscope maps surfaces on an atomic or molecular scale by measuring the energy it takes to remove an electron from that surface. The team found that when a polymer is charged—such as when radiation breaks chemical bonds—the charges appear in positive and negative patches on the surface in a sort of heterogeneous, fractal structure. But in addition to these charged particles, the researchers reasoned, there should also be bonds breaking in another way, producing free radicals.

By upgrading their microscope, the team was able to look for free radicals, and they found them, as predicted, on the surface of various types of charged polymers. But surprisingly, the researchers also noticed that the radicals tended to stay near the patches of charge. "It could be coincidence, but I don't believe in coincidences," Grzybowski says. So the group investigated further and discovered that the radicals were stabilizing the charges by giving up or receiving electrons. The team realized then that if the radicals were playing a supporting role in the buildup of static electricity, they could also be the key to dispersing it.

The group treated, or "doped," every polymer they could think of, from Scotch tape to resins like polystyrene, with vitamins and other radical scavengers, either by mixing them in liquid form or by soaking solid polymers in a mixture of organic solvent and the scavenger. They then imaged the polymer with the Kelvin probe force microscope as well as a magnetic force microscope, and they compared the data to readings of the same materials in untreated form. Their results showed that doped polymers discharged static electricity in minutes, while the untreated polymers took hours.

Takeo Suga, who studies charge-storage polymers at Waseda University, in Tokyo, says there is broad potential for applying the radical scavenger method to reduce static electricity in electronics. But there is a hitch: "Based on the radical scavenging mechanism, the radical additives are consumed by the repeated contact electrification," he says. "A regenerative mechanism will be required for actual applications."

(from *http://spectrum.ieee.org/computing/hardware/antioxidants-good-for-you-good-for-your-smartphone/?utm_source=techalert&utm_medium=email&utm_campaign=092613*)

Droplets get a charge out of jumping

David L. Chandler, MIT News Office

In a completely unexpected finding, MIT researchers have discovered that tiny water droplets that form on a superhydrophobic surface, and then "jump" away from that surface, carry an electric charge. The finding could lead to more efficient power plants and a new way of drawing power from the atmosphere, they say. The finding is reported in a paper in the journal Nature Communications written by MIT postdoc Nenad Miljkovic, mechanical engineering professor Evelyn Wang, and two others.

Miljkovic says this was an extension of previous work by the MIT team. That work showed that under certain conditions, rather than simply sliding down and separating from a surface due to gravity, droplets can actually leap away from it. This occurs when droplets of water condense onto a metal surface with a specific kind of superhydrophobic coating and at least two of the droplets coalesce: They can then spontaneously jump from the surface, as a result of a release of excess surface energy.

In the new work, "We found that when these droplets jump, through analysis of high-speed video, we saw that they repel one another midflight," Miljkovic says. "Previous studies have shown no such effect. When we first saw that, we were intrigued."

In order to understand the reason for the repulsion between jumping droplets after they leave the surface, the researchers performed a series of experiments using a charged electrode. Sure enough, when the electrode had a positive charge, droplets were repelled by it as well as by each other; when it had a negative charge, the droplets were drawn toward it. This established that the effect was caused by a net positive electrical charge forming on the droplets as they jumped away from the surface.

Images such as this, showing droplets being shed from a superhydrophobic surface (light band at center), revealed the charging of the droplets.

IMAGE: NENAD MILJKOVIC AND DANIEL PRESTON

The charging process takes place because as droplets form on a surface, Miljkovic says, they naturally form an electric double layer — a layer of paired positive and negative charges — on their surfaces. When neighboring drops coalesce, which leads to their jumping from the surface, that process happens "so fast that the charge separates," he says. "It leaves a bit of charge on the droplet, and the rest on the surface."

The initial finding that droplets could jump from a condenser surface — a component at the heart of most of the world's electricity-generating power plants — provided a mechanism for enhancing the efficiency of heat transfer on those condensers, and thus improving power plants' overall efficiency. The new finding now provides a way of enhancing that efficiency even more: By applying the appropriate charge to a nearby metal plate, jumping droplets can be pulled away from the surface, reducing the likelihood of their being pushed back onto the condenser either by gravity or by the drag created by the flow of the surrounding vapor toward the surface, Miljkovic says. "Now we can use an external electric field to mitigate" any tendency of the droplets to return to the condenser, "and enhance the heat transfer," he says.

But the finding also suggests another possible new application, Miljkovic says: By placing two parallel metal plates out in the open, with "one surface that has droplets jumping, and another that collects them … you could generate some power" just from condensation from the ambient air. All that would be needed is a way of keeping the condenser surface cool, such as water from a nearby lake or river. "You just need a cold surface in a moist environment," he says. "We're working on demonstrating this concept."

(from *http://web.mit.edu/newsoffice/2013/droplets-get-a-charge-out-of-jumping-1002.html*)

Harvesting Electricity: Triboelectric Generators Capture Wasted Power

With one stomp of his foot, Zhong Lin Wang illuminates a thousand LED bulbs – with no batteries or power cord. The current comes from essentially the same source as that tiny spark that jumps from a fingertip to a doorknob when you walk across carpet on a cold, dry day. Wang and his research team have learned to harvest this power and put it to work.

A professor at the Georgia Institute of Technology, Wang is using what's technically known as the triboelectric effect to create surprising amounts of electric power by rubbing or touching two different materials together. He believes the discovery can provide a new way to power mobile devices such as sensors and smartphones by capturing the otherwise wasted mechanical energy from such sources as walking, the wind blowing, vibration, ocean waves or even cars driving by. "We are able to deliver small amounts of portable power for today's mobile and sensor applications," said Wang, a Regents professor in Georgia Tech's School of Materials Science and Engineering. "This opens up a source of energy by harvesting power from activities of all kinds." "The fact that an electric charge can be produced through triboelectrification is well known," Wang explained. "What we have introduced is a gap separation technique that produces a voltage drop, which leads to a current flow in the external load, allowing the charge to be used. This generator can convert random mechanical energy from our environment into electric energy."

Since their first publication on the research, Wang and his research team have increased the power output density of their triboelectric generator by a factor of 100,000 – reporting that a square meter of single-layer material can now produce as much as 300 watts. They have found that the volume power density reaches more than 400 kilowatts per cubic meter at an efficiency of more than 50 percent. The researchers have expanded the range of energy-gathering techniques from "power shirts" containing pockets of the generating material to shoe inserts, whistles, foot pedals, floor mats, backpacks and floats bobbing on ocean waves. They have learned to increase the power output by applying micron-scale patterns to the polymer sheets. The patterning effectively increases the contact area and thereby increases the effectiveness of the charge transfer.

Wang and his team accidentally discovered the power generating potential of the triboelectric effect while working on piezoelectric generators, which use a different technology. The output from one piezoelectric device was much larger than expected, and the cause of the higher output was traced to incorrect assembly that allowed two polymer surfaces to rub together. Six months of development led to the first journal paper on the triboelectric generator in 2012.

Since their initial realization of the possibilities for this effect, Wang's team has expanded applications. They can now produce current from contact between water – sea water, tap water and even distilled water – and a patterned polymer surface. Their latest paper, published in the journal ACS Nano in November, described harvesting energy from the touch pad of a laptop computer. They are now using a wide range of materials, including polymers, fabrics and even papers. The materials are inexpensive, and can include such sources as recycled drink bottles. The generators can be made from nearly-transparent polymers, allowing their use in touch pads and screens.

Beyond its use as a power source, Wang is also using the triboelectric effect for sensing without an external power source. Because the generators produce current when they are perturbed, they could be used to measure changes in flow rates, sudden movement, or even falling raindrops. "Everybody has seen this effect, but we have been able to find practical applications for it," said Wang. "It's very simple, and there is much more we can do with this."

(from *http://www.news.gatech.edu/2013/12/07/harvesting-electricity-triboelectric-generators-capture-wasted-power*)

Researchers Measure Flow from a Nanoscale Fluid Jet

A Northwestern University researcher with collaborators from Cambridge University, Oxford University, and Centro Nacional de Biotecnología have recently verified the classical Landau-Squire theory in the tiniest submerged jet. The diameter of their jets were in the range of 20 to 150 nanometers, which is the length of just a few hundred water molecules lined up in a row.

"The flow rate from this nanojet is in the range of tens of pico liters per second," said Sandip Ghosal, associate professor of mechanical engineering and (by courtesy) engineering sciences and applied mathematics at Northwestern's McCormick School of Engineering and Applied Science. "At this rate, if you had started to fill a two-liter soda bottle at the time the first pyramid was being built in Egypt, the bottle would be about half full now."

The nanojet is designed around a glass "nano capillary," which the researchers fabricated by heating an ordinary glass capillary — a hollow glass tube — with a laser and gently pulling it until it broke, creating a fine tip. The researchers applied an electric voltage across the capillary, which was submerged in a salt solution to create an electroosmotic flow that then emerged as a jet.

To measure the jet stream, the researchers built a tiny anemometer — a windmill-like device used for measuring wind speed — from a polystyrene bead less than one-fiftieth the width of a human hair. The bead was held in place by an "optical trap," a finely focused laser beam that served as a spindle for the tiny anemometer. When the bead was positioned in front of the jet, it spun around, and a video camera picked up tiny fluctuations of light from a dimple on the bead.

The novel anemometry technique allowed the researchers to map out the vorticity and velocity fields of the nanojet and compare it to those predicted by the classical Landau-Squire solution of the Navier–Stokes equations, the 200-year-old equations that form the bedrock of classical physics. Their observations proved to be in remarkable agreement with the theory. "The Navier-Stokes equations and everything derived from it are expected to go awry as we approach molecular scales, but no one knows how far down one can push before it breaks," Ghosal said. "We found that it works very nicely down to tens of nanometers."

The researchers also observed a phenomenon they call flow rectification: an asymmetry in the flow rate with respect to voltage reversal. They found that when the voltage is reversed, the capillary sucks in fluid as expected, but at a much lower rate. The capillary thus behaves like a semiconductor diode — an electronic "valve" that allows current flow in only one direction — but with fluid flowing in place of electrons.

The nanojet has a number of potential novel applications. One possible use is as an ultra-low-volume injector for transferring biomolecules into cells or vesicles, a process used in recombinant DNA technologies important in the production of human insulin and disease-resistant crops. Other possibilities include use as a "flow rectifier" in microfluidic logic circuits, the functional equivalent of semiconductor diodes in microelectronics, and also in applications involving nanoscale patterning and micro manipulation.

(from *http://www.mccormick.northwestern.edu/news/articles/2013/10/researchers-measure-flow-from-a-nanoscale-fluid-jet.html*)

Electrostatics Society of America

30 Shalimar Drive
Rochester, NY 14618

ESA Information

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

Dan Lacks
ESA President
Department of Chem. Eng.
Case Western Reserve Univ.
Cleveland, OH 44106
(216)368-4238
daniel.lacks@case.edu

Steve Cooper
Secretary/Treasurer
540 Morton Rd.
Athens, GA 30605
706-255-5518
steve@mt-ind.com

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

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