Mar/Apr 2014 • No. 224

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Dear ESA Colleagues,

One thing I enjoy about being a professor is the opportunity to explore new ideas. My work in electrostatics, for example, was a mid-career shift to an area unrelated to my previous research activities -- it started essentially by chance, but it has now become my main research thrust.

This academic year I have been exploring something else new. I have been participating in the Ethics Table Fellows Program at my university. The program, led by a philosophy professor, brings together nine members of the university community who are interested in ethics. The group includes faculty, staff, undergraduate students and graduate students; the broad composition of the group brings diverse points-of-view. The group met regularly throughout the academic year, including several extended retreats, to discuss the role of ethics in the university. For example, the group addressed how ethics should be incorporated in the curriculum and in extracurricular activities, and whether a university can teach ethical behavior. The program included readings on ethical theories, which provided frameworks for our discussions.

I chose to participate in this program so that I would be better able to incorporate engineering ethics in the courses I teach. The engineering accreditation board requires that students in an accredited program develop "an understanding of professional and ethical responsibility". Since I have been teaching the chemical engineering senior design course, where ethics could naturally be incorporated into our program, I thought it would be good for me to develop some knowledge in this regard. I envisioned addressing ethical dilemmas such as balancing the benefits of an engineering process with the inherent risks (e.g., safety, environmental) that accompany the process ... and my interactions with the Ethics Table helped me do this. But I also came to appreciate another side of ethics – instead of just avoiding "unethical behavior", ethical decisions can also lead to actions with positive social impact.

So I collaborated with an Ethics Table participant who is active in the Cleveland community, to come up with a project for my senior design project course that would have a positive social impact. Cleveland has many foreclosed and torn-down homes, often concentrated in distressed areas. This semester, a team of five chemical engineering students converted a vacant lot on one of these distressed blocks into an urban garden. My role was simply to provide contact with the property owner, and the students did the rest. Their work included all planning and designing, obtaining permits, securing funding and other resources, performing soil testing, implementing the design and constructing structures, planting, and getting community involvement. The "Community Peace Garden" will be used as an after-school gardening program for children and as a site for community-building activities.

I have now been thinking about how the ESA can provide positive impacts on the broader society. I think our student paper contest is one such activity. Are there other activities we can do, perhaps with high school students? I believe the ESA was more involved with activities like this in the past – perhaps some activities could be revived? Let me know if you have any ideas.

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)

ESA Archive Request

There is a request regarding a taped interview with A.D. Moore in 1977. Does anyone know of a digital version of this interview? If so, please contact Dan Lacks, *daniel.lacks@case.edu* so that he can pass this along to the requestor. Thank you.

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 17, 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 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

Why Do Lights Sometimes Appear in the Sky During An Earthquake?

Joseph Stromberg

For centuries, eyewitnesses have occasionally reported seeing an inexplicable phenomenon minutes before, during or after an earthquake: strange bright lights in the sky. Just after an 1888 quake that hit New Zealand, for instance, there were reports of "luminous appearances" and "an extraordinary glow" visible for several hours. They were spotted in 1930, during an earthquake in Idu, Japan, visible up to 70 miles away from the epicenter. Among the dozens of earthquakes that reportedly produced strange lights, their qualities varied widely: People reported seeing white flares, or floating orbs, or rainbow-colored flickering flames. The lights sometimes appeared for just a few seconds, but other times they hovered in the sky for minutes or hours at a time.

For much of modern history, these reports were considered apocryphal. It wasn't until a series of photographs of strange lights snapped during a 1965 earthquake in Nagano, Japan—including the one below—that scientists acknowledged the validity of the phenomenon. But for scientists, accepting that earthquake lights exist presents a new problem: How do you explain them?

Current Events (cont'd.)

Earthquake lights seen Tagish Lake, in the Yukon Territory, in 1972. Large orbs are visible in the foreground, while smaller ones (highlighted by arrows) are seen higher up. (Photo by Jim Conacher)

Over the past few decades, a variety of hypothesis have been offered. Some have proposed that tectonic movement of rocks that include quartz could generate a piezoelectric field that produces flashes of light. Others have suggested that tectonic stress temporarily allows rocks to conduct electromagnetic energy, triggering changes in the magnetic charge of the ionosphere, the uppermost level of the atmosphere. But it's extremely hard to test either of these hypotheses, because earthquakes are so unpredictable, and the conditions are so difficult to replicate in a lab.

In a study published in Seismological Research Letters, a team of scientists by Robert Thériault used an alternate strategy to figuring out the answer—they analyzed the geologic circumstances of 65 earthquakes starting in the year 1600 that produced reports of light to see what these events had in common. "We built a pretty large database of earthquakes with earthquake lights that happened around the world," says Thériault, a geologist with the Quebec Ministry of Natural Resources. "And eventually, when we started to look at them, we found a really striking pattern." Worldwide, roughly 95 percent of seismic activity occurs at the boundaries between two or more tectonic plates. But the vast majority of earthquake lights (85 percent) occurred in association with a quake within a tectonic plate at sites of continental rifting, a category that represents just five percent of all earthquakes. Additionally, most of the remaining 15 percent occurred with earthquakes caused by two plates sliding past each other (a transform fault), rather than one plate is pushed underneath another (a subduction zone).

Additionally, the scientists found that earthquake lights appear disproportionately before or during earthquakes, rather than afterward. They don't yet have an explanation for the unusual location patterns of earthquake lights, but they think they can explain this trend in timing.

Their model, developed over the past few years by co-author Friedemann Freund of San Jose State University, also involves rocks conducting energy up to the surface, but not all the way up to the ionosphere. "The process starts deep in the crust, where rocks are subjected to high stress levels, prior to the stress being released to produce an earthquake," Thériault says. In certain types of rock, Freund has shown in lab experiments, this stress can break apart pairs of negatively-charged oxygen atoms that are linked together in peroxy bonds. When this happens, each of the oxygen ions are released, and these can flow through cracks in the rock, towards the surface. At that point, the thinking goes, high-density groups of these charged atoms will ionize pockets of air, forming a charged gas (a plasma) that emits light.

Tectonic stresses gradually build up for an extended period of time before being released in a quake. Their model, which relies upon this stress to create lights—rather than actual seismic activity—could explain why the lights often occur minutes, hours or even days before a quake.

As a result, they say, earthquake lights could be more than an intriguing phenomenon—they could be a vital indicator, for some, that the ground is about to start shaking. "If you see visible lights in the sky, and you live in an earthquake-prone area, they might be an early-warning sign that an earthquake is approaching," Thériault says.

(from http://www.smithsonianmag.com/science-nature/why-do-lights-sometimes-appear-in-the-sky-during-an-earthquake-180948077/#7RS7vRIDjUgx11o4.99)

CU-Boulder researchers use climate model to better understand electricity in the air

Electrical currents born from thunderstorms are able to flow through the atmosphere and around the globe, causing a detectable electrification of the air even in places with no thunderstorm activity. But until recently, scientists have not had a good understanding of how conductivity varies throughout the atmosphere and how that may affect the path of the electrical currents. Now, a research team led by the University of Colorado Boulder has developed a global electric circuit model by adding an additional layer to a climate model created by colleagues at the National Center for Atmospheric Research (NCAR) in Boulder. The results, published in the Journal of Geophysical Research, show that the atmosphere is generally less conductive over the equator and above Southeast Asia and more conductive closer to the poles, though the atmosphere's conductivity changes seasonally and with the weather.

Research into atmospheric electrification stretches back to the 1750s, when researchers, including Benjamin Franklin, were trying to better understand the nature of lightning. In the 1800s, scientists measured changes in the atmosphere's electric field from the Kew Observatory near London, and in the 1900s, the Carnegie, an all-wooden ship built without any magnetic materials, crisscrossed the ocean while taking atmospheric electricity measurements that are still referenced today. But obtaining a global picture of atmospheric conductivity has been difficult, in part because the atmosphere's ability to channel electricity is not static. Ions, which allow current to move through the air, are added to the upper atmosphere by a continuous bombardment of galactic cosmic rays and to the lower atmosphere through radioactive decay. But those ions can be removed from the atmosphere in a variety of ways. "They can recombine, to some degree, but they also attach themselves to aerosols and water droplets," said Andreas Baumgaertner, a research associate in CU-Boulder's aerospace engineering sciences department and lead author of the study. "Once they are attached to a heavy particle, like a water droplet, then you've lost the ability for it to conduct a current." The amount of water droplets in the atmosphere varies as moisture-laden clouds move through an area, and the quantity of aerosols varies depending on their source. Aerosols are pumped into the atmosphere from tailpipes and smokestacks as well as from erupting volcanoes.

Baumgaertner and his colleagues—including CU-Boulder Professor Jeffrey Thayer, director of the Colorado Center for Astrodynamics Research; Ryan Neely, an atmospheric scientist at NCAR; and Greg Lucas, a CU-Boulder doctoral student in aerospace engineering sciences—came up with the idea of using NCAR's existing Community Earth System Model to get a global picture of conductivity because the model already took into account both water vapor and aerosols. The team added in equations that represent how many ions are produced by cosmic rays from space and by radioactive decay through radon emissions from the Earth's surface. They also added equations for how those ions react in the atmosphere. The resulting 2,000 lines of code allowed them to create the first global picture of conductivity and how it evolves with time. What they found was that, during a year, the atmosphere was on average less able to conduct electricity above areas of the globe that also have high emissions of aerosols, especially in Southeast Asia. In general, the atmosphere above the equator also was less conductive, mainly due to fewer galactic cosmic rays than at the poles. The researchers also found that the conductivity of the atmosphere as a whole varied with the seasons and was generally less conductive in June and July than in December and January.

The research team is now working to feed data on frequency and location of storms into the model so they can better understand how the current provided by lightning actually moves. "The next step is to incorporate the distribution of thunderstorms," Lucas said. "Currents generally travel upwards above thunderstorms distributed around the equator and return down over the poles, away from the thunderstorms. Part of the future work is going to be determining what influence those thunderstorms have on the global system."

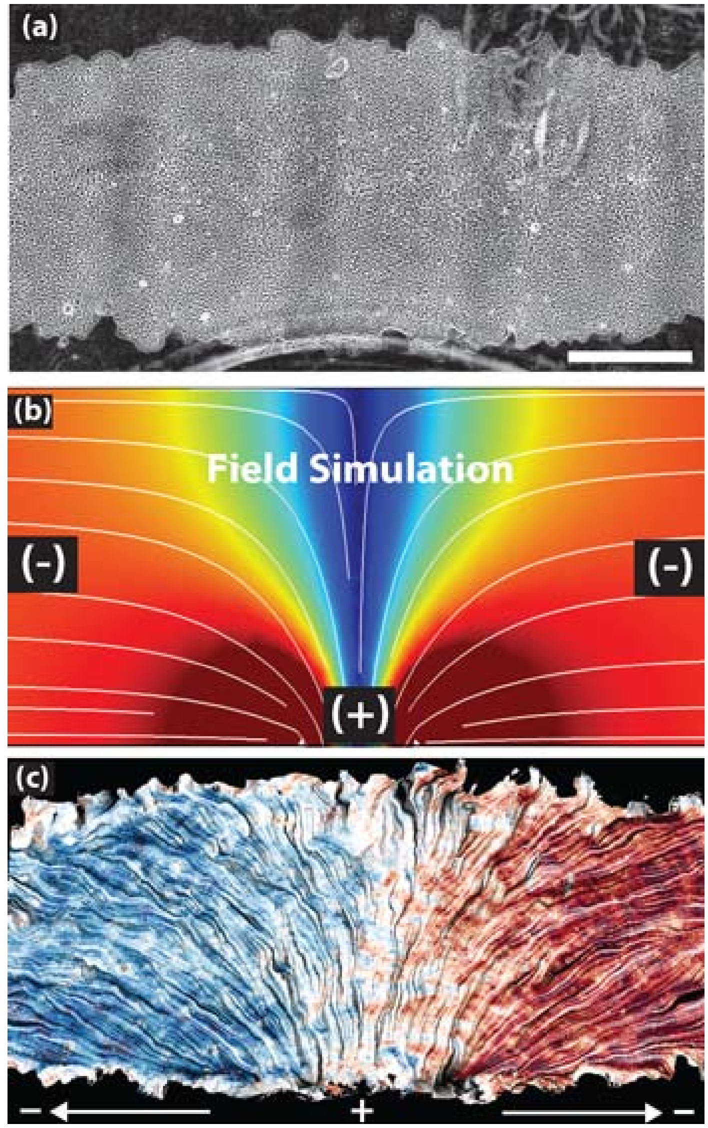
(from *http://www.colorado.edu/news/releases/2013/10/03/cu-boulder-researchers-use-climate-model-better-understand-electricity-air#sthash.jSS8tlcV.dpuf*)

Scientists 'herd' cells in new approach to tissue engineering

Sarah Yang

Researchers at UC Berkeley found that an electrical current can be used to orchestrate the flow of a group of cells, an achievement that could establish the basis for more controlled forms of tissue engineering and for potential applications such as "smart bandages" that use electrical stimulation to help heal wounds. In the experiments, described in a study published this week in the journal Nature Materials, the researchers used single layers of epithelial cells, the type of cells that bind together to form robust sheathes in skin, kidneys, cornea and other organs. They found that by applying an electric current of about five volts per centimeter, they could encourage cells to migrate along the direct current electric field. They were able to make the cells swarm left or right, to diverge or converge and to make collective U-turns. They also created elaborate shapes, such as a triceratops and the UC Berkeley Cal bear mascot, to explore how the population and configuration of cell sheets affect migration.

"This is the first data showing that direct current fields can be used to deliberately guide migration of a sheet of epithelial cells," said study lead author Daniel Cohen, who did this work as a student in the UC Berkeley-UC San Francisco Joint Graduate Program in Bioengineering. "There are many natural systems whose properties and behaviors arise from interactions across large numbers of individual parts – sand dunes, flocks of birds, schools of fish, and even the cells in our tissues. Just as a few sheepdogs exert enormous control over the herding behavior of sheep, we might be able to similarly herd biological cells for tissue engineering."



The top image shows a patch of epithelial cells. The white lines in the middle image mark the electric current flowing from positive to negative over the cells. The bottom image shows how the cells track the electric field, with blue indicating leftward migration and red signaling rightward movement. (Images by Daniel Cohen)

Galvanotaxis – the use of electricity to direct cell movement – had been previously demonstrated for individual cells, but how it influences the collective motion of cells was still unclear. "The ability to govern the movement of a mass of cells has great utility as a scientific tool in tissue engineering," said study senior author Michel Maharbiz, UC Berkeley associate professor of electrical engineering and computer sciences. "Instead of manipulating one cell at a time, we could develop a few simple design rules that would provide a global cue to control a collection of cells."

The work was borne from a project, led by Maharbiz, to develop electronic nanomaterials for medical use that was funded by the National Science Foundation's Emerging Frontiers in Research and Innovation program. The researchers collaborated with W. James Nelson, professor of molecular and cellular physiology at Stanford University and one of the world's top experts in cell-to-cell adhesion. Cohen is now a postdoctoral research fellow in Nelson's lab.

With our bodies full of flowing ions and salt solutions, it is no surprise that electrical signals play a big role in our physiology, from neural transmissions to muscle stimulation. "The electrical phenomenon we are exploring is distinct in that the current produced is providing a cue for cells to migrate," said Maharbiz. The study authors are exploring the role of bioelectrical signals in the wound healing process, building upon the discovery in 1843 that an injury to the body creates a change in the electrical field at the wound site. By mapping the changes in the electrical field when an injury occurs and as it heals, the researchers may be able to develop technology to help speed and improve the repair process. "These data clearly demonstrate that the kind of cellular control we would need for a smart bandage might be possible, and the next part of our work will focus on adapting this technology for use in actual injuries," said Cohen.

(from *http://newscenter.berkeley.edu/2014/03/11/herding-cells-new-approach-to-tissue-engineering/*)

Wind Turbines Generate "Upside-Down" Lightning

Geoffrey Giller

Lightning strikes have been known to incapacitate wind turbines by destroying their blades. But while most tall structures are prone to lightning strikes, wind turbines seem to be especially susceptible. Recently scientists captured high-speed footage of these strikes, and they discovered that the wind turbines may in fact be the architects of their own demise: the nature of the turning turbine helps to cause these strikes.

Typically when lightning strikes a tall object, the strike is initiated from the cloud. A channel of negatively charged plasma, called a negative downward leader, moves from areas of negative charge in a storm cloud down toward a positively charged building, tree or wind turbine. As the negative leader nears the structure, it induces a positive upward leader, which jumps up to meet the negative leader. The connection forms a current, and the bright lightning flash we observe is actually to the result of a shock wave flowing up the connected channels, called a return stroke. In the case of these wind turbines, positive upward leaders are generated from the turbine blades in the absence of a negative downward leader from the clouds above. These upward leaders are the zigzagging lines that grow up toward the sky in the beginning parts of the video (below).

In the paper describing their findings, published online February 6 in the Journal of Geophysical Research, the researchers describe the phenomenon they think is responsible for this lightning. When tall objects build up a positive charge underneath a negatively charged storm cloud, they form a cloud of positively charged ions, which helps to dissipate the electric field around them. But, says Oscar van der Velde, a researcher at the Polytechnic University of Catalonia and a co-author of the paper, "if your blade can escape this cloud of ions, then the field will remain high. And if the field is high enough, you can trigger a real lightning flash." In the video—which takes place over just 150 milliseconds—the lines that stay illuminated have formed currents with the clouds above. Still, there is no bright flash and thus no return stroke, van der Velde says: "If you get a return stroke… it saturates the image." This is just as well for the turbines because the return stroke is the most damaging part of a lightning strike. Yet "even discharges without return strokes can cause progressive damage to the turbine materials, ultimately leading to their failure," van der Velde points out.

(from *http://blogs.scientificamerican.com/observations/2014/03/03/wind-turbines-generate-upside-down-lightning-video/*)

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