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ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Is Electrostatics a Winter Sport?

Here in Boston, the winds have started to shift to the northeast, my morning commute begins in the dark, and the heat has kicked on a few times at night. Winter is around the corner. This brings to mind something a colleague said a while ago when I was working on an electrostatics consulting job: "Static season is approaching, and we need to get this problem solved before it does." In his mind, electrostatics and the problems it causes were inconsequential in the summer months but became deadly (to his product, not to people) in the winter. For you Floridians and other denizens of near-tropic climes, let me explain what we here in the temperate zones have to put up with. When normally humid, but cold, air enters a warm house, its relative humidity declines noticeably. The tendency of many hydroscopic surfaces to absorb moisture, thereby increasing surface conductivity, is sharply curtailed. The decay of triboelectric charges to ground over surface-conducting pathways is slowed dramatically, so that simply walking across a carpet and touching a light switch or the hand of another person can result in an unpleasant static shock. This same principle kills integrated circuits via ESD, jams process webs in their machinery, prematurely exposes photographic film, and locks up unlucky computers. I recall being a graduate student in a lab that had a state-of-the-art PDP 11 (dating myself). In the winter, every time someone rolled across the floor in an office chair and touched the console, the computer ceased to function. No one knew about ESD in those days. Indeed, an entire billion-dollar industry, as well the very large Electrostatic Discharge Association, have emerged over the past several decades to help mitigate the problem of unwanted static electricity. This song and dance between electrons and humans is clearly a winter sport.

But hark! I hear a large segment of our membership calling from afar. Not all who deal with electrostatics despise those unruly electrons. The ubiquitous copy machine relies on static charge to produce documents such as this newsletter. So does the laser printer. I'm not an expert in these devices, but I wouldn't be surprised if those who design them love the winter when static charges stay put and make these devices work all the more reliably. Likewise those who engage in museum and science classroom demonstrations of electrostatics rely on devices such as the Van de Graaff generator, the Wimshurst generator, polystyrene cups, and Mylar films. These educational wonders of electrostatics thrive in the winter months. For example, those who use a Van de Graaff generator know that the machine shines in winter but falls flat on its face in summer. The surfaces of the charge transport belt and the insulating columns that hold static charge on the dome of the Van de Graaff become much too conductive to function well in the humid summer months. And what about electrostatic coating of insulating powders? Again, not my field, but I suspect these folks love the winter because the particles more readily retain their charge. The same might be said for those who use electret filters. Mobile charges that crawl along conduction paths caused by humid, summer air can act to screen out the fields established by permanently polarized polymers. For all these folks, dueling with the perils of electrostatics is undoubtedly a summer sport.

Nuisance or technology partner - these are the two roles that electrostatics plays for many who experience its wonders. If you think about the examples I've given above, you realize that those for whom electrostatics is a winter sport are primarily concerned with getting rid of charge, while those for whom it is a summer sport worry about producing it. Interesting corollary.

There is a third environment in which electrostatics is oblivious to summer and winter. I refer, of course, to role of electrostatics in micro-mechanics, nanotechnology, and cellular mechanics. In these size regimes, meaningful electrostatic forces are possible in air, dielectric liquids, and even conducting liquids. As many recent ESA conference speakers have related, the inner workings of a cell's nucleus appear to be governed by electrostatics. Likewise, the myriad of self-assembling nano-devices being created by humans, still in their infancy (the structures, not the humans), involve electrostatic attraction and repulsion of objects only several hundreds of molecules in diameter. Why are such devices unaffected by seasonal humidity? In the case of micro-machines, electrostatic forces are established between adjacent conductors, hence the phenomenon of charge bleed off, or decay, does not apply. Charges will be placed in their proper locations by the voltage sources that drive the device. Electrostatic forces capable of moving structural members are possible in the micron-sized regime because the breakdown field strength of air, typically 30 kV/cm for large gaps, begins to increase sharply below about 50 microns. Nanostructures are often deployed in liquids, which aren't affected much by humidity. Nanodevices in air enjoy the same benefits afforded microstructures. Electrostatic phenomena in the nuclei of cells are similarly unaffected by humidity, because the cell is mostly filled with a liquid medium. These new venues for electrostatics are revolutionizing our field. And they, like radial tires, are all-season affairs. Let's continue to watch micro, nano, and cellular technology stretch the frontiers of electrostatics. And let's do it year round.

Just a few ponderings as I prepare my snow blower for winter.

For the Friendly Society,

Mark Horenstein
ESA President

Current Events

Static and Cartilage
The cartilage layers in our knees are only about one millimeter thick. But these thin layers can withstand huge compressive stresses and even larger tensile stresses. When this setup goes awry we call it osteoarthritis.

Recent work has shown that a major portion of compressive strength is related to electrostatic repulsion. The molecules are called - take a deep breath - glycosaminoglycans. They have large negative charges.

The research used atomic force microscopy (AFM) to show that the molecules are held so that they push against each other rather than moving out to the side.

Glenn Schmeig

Lightning in Brazil sets shocking record
Tuesday, November 5, 2002 Posted: 11:38 AM EST (1638 GMT)

RIO DE JANEIRO, Brazil (Reuters) -- Tropical Brazil is the country most struck by lightning in the world and it suffers the highest death toll and serious economic damage from electric thunderstorms, new research showed Tuesday.

Osmar Pinto, a researcher of Atmospheric Electricity Group with the Brazilian Institute for Space Studies which mapped lightning incidence using satellite data, said the country was struck by 70 million lightning bolts a year, or between two and three electric discharges per second.

"That is about double the amount of lightning in the United States, which is approximately the same size as Brazil," Pinto told Reuters. Brazil is the world's biggest tropical country, and electric thunderstorms are more common in the tropics.

About 100 people die in Latin America's largest country after being hit by lightning bolts per year. The total makes up some 10 percent of all lightning-related deaths in the world.

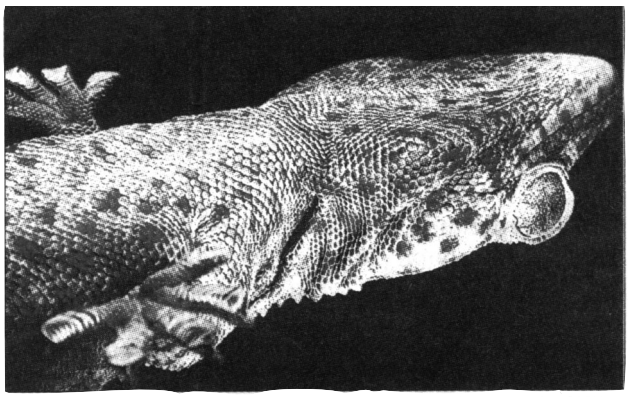
Thunderbolts also inflict up to $200 million in annual damage to power and telecommunications lines, other companies and private property. Pinto said 70 percent of frequent power blackouts across Brazil resulted from lightning.

Mapping the areas with the highest incidence of atmospheric electricity discharges should help protect installations in the most-affected regions, he said.

Researchers find secret of gecko's climbing skill
Scientists have long sought cause

Michael Stroh
The Baltimore Sun

For centuries geckos have been revered as one of nature's coolest climbers. Whether they're skedaddling up smooth glass at three feet a second or dangling from a hotel ceiling by a single toe, there's almost nothing the little lizards can't scale.


KELLER AUTUMN, LEWIS & CLARK COLLEGE AP

The gecko's sticky secret: microscopic *hairs* and quantum physics

Now a group of biologists and engineers, who call themselves the Gecko Team, has solved the longstanding mystery and created the first artificial adhesive based on the gecko's sticky secret. Their research could lead to everything from exotic new Post-It notes to sure-footed space robots.

The secret to the gecko's grip, it turns out, hinges on one of the animal world's worst cases of split ends, and a quirky property of quantum physics known as the van der Waals force.

Geckos have millions of microscopic hairs sprouting from the bottom of their feet. The hairs, called setae (the plural of seta), split into as many as 1,000 tinier hairlets.

In the 1960s German scientist Uwe Hiller proposed another idea: Perhaps the creatures stick using the van der Waals force, faint electrical attraction. A single seta, the researchers found, could lift an ant through the force. If all the hairs worked simultaneously, they could theoretically hoist a 280-pound man.

(from the Ann Arbor News, Aug. 27, 2002, courtesy of Anne Benninghoff)

For a more complete article look at the following web article:
http://www.berkeley.edu/news/media/releases/2002/08/26_gecko.html *(courtesy of Joe Bernier)*

Current Events (cont'd.)

ESPIN Technologies Receives $2 Million Award For Nanofiber Technology Development From Advanced Technology Program (ATP)

October 8, 2002

Chattanooga, TN - eSpin Technologies, Inc., a nanotechnology start-up based in Chattanooga, TN, announced today that it is the recipient of a $2M award from the U.S. Department of Commerce's Advanced Technology Program (ATP). This award will fund engineering efforts related to eSpin's nanofiber technology platform for developing a high-throughput process to enable large-scale and economical production of nanofibers.

Nanofibers are minute fibers 1/1000th the diameter of a human hair, with a very high surface area to mass ratio. As part of the emerging nanotechnology field, eSpin's nanofibers are applicable across many traditional and emergent sectors of diverse industries including filtration, aerospace, energy, healthcare, biotechnology, and cosmetics.

The ATP award, often regarded as the "gold medal in the research Olympics", recognizes eSpin's potential in creating opportunities for new, world-class products, services and industrial processes benefiting not just eSpin, but other companies, industries, and ultimately consumers and taxpayers as well. eSpin was selected as one of 40 finalists from 473 companies competing nationwide in the program and is the first company from the State of Tennessee to win such an award.

Dr. Jayesh Doshi, Founder and CEO of eSpin, stated "We are honored to be the recipients of the prestigious ATP award. Our technology will bring about a paradigm shift in nanofiber manufacturing technology."

This award also highlights the role of local government in high technology incubation. "This award not only allows eSpin to develop the technology, but will create an engine of technology creation around nanofiber-based products in the Chattanooga area leading to economic growth and professional and technical job creation," continued Dr. Doshi.

The development of this phase of nanofiber technology will enable eSpin to establish its position as a world leader in nanofiber manufacturing technology and at the same time reaffirm the United States' position as a global leader in nanotechnology research and applications. ATP's funding is critical in supporting such high-risk research with broad-based economic potential and is in line with the National Nanotechnology Initiative (NNI) for the rapid development and commercialization of nanotechnology applications.

"We are especially excited about our disruptive technology's potential to revolutionize the performance of everyday products such as water and air filters, batteries, baby wipes, band aids, and even mascara," said Mr. Prakash Kunda, Business Development Manager.

About the Advanced Technology Program: The Advanced Technology Program (ATP) is a rigorous, highly competitive, cost-shared award program administered by the National Institute of Standards and Technology (NIST). It provides cost-shared funding to industry, non-profits and universities to help advance particularly challenging, high-risk research and development projects that have the potential to spark important, broad-based economic or social benefits for the United States. Additional details on the program goals and awards can be found at the NIST website (*www.atp.nist.gov*).

About eSpin Technologies: eSpin Technologies, Inc., of Chattanooga, TN, is a high technology company specializing in the research, development and commercialization of nanofibers and nanofiber-based products. The company has several global customers and has partnered with select Fortune 50 companies, government and military laboratories, research institutions and other high technology companies around the world. For more information about eSpin Technologies, Inc. please visit the company website (*http://www.nanospin.com*).

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Current Events Calendar

- Electrostatics 2003, March 23-27, Edinburgh, Scotland, Contact: Dr. Hywel Morgan, Tel.: +44-141-330-5237, email: *hywel@elec.gla.ac.uk* and *http://electrostatics2003.iop.org*
- Joint Symposium of the ESA and the Electrostatic Processes Committee of the IEEE, June 24-27, Little Rock, AR, Contact: Mark Horenstein, Tel.: +1-617-353-5437, email: *mnh@bu.edu*, or Toshiaki Yamamoto, Tel.: +81-72-254-9230, email: *yamamoto@energy.osakafu-u.ac.jp*, or Malay Mazumder, Tel.: +1-501-569-8007, email: *mkmazumder1@ualr.edu* and *http://www.electrostatics.org*
- 25th Annual EOS/ESD Symposium, Las Vegas, NV, Contact: Christian C. Russ, email: *cruss@sarnoff.com* and *http://www.esda.org/news/call-for-papers2003.cfm*

Sources & Sinks

Benjamin Franklin
Edmund S. Morgan '37, Ph.D. '42 (Yale University Press, $24.95).

This celebrated scholar, Sterling professor of history emeritus at Yale, describes his book as "a character sketch that got out of hand," but others have called it wise, brilliant, and a tour de force. It's good reading, too, and not over long. Morgan will be featured in a PBS miniseries about Franklin, A.M. (hon.) 1753, in November. (Apologies for the late notice - ed.)

from Harvard Magazine, Sept.-Oct., 2002, p. 28.

NORMAN ROCKWELL 1990 Tiny Folio by Abbeville Press, Publ. Christopher Finch complied magazine covers. ISBN 0 7892 0409 6 copyright 1979

Demos
At the 2002 ESA conference, an interesting talk on simple, electrostatic demonstrations was given by Robert Morse of St. Albans School, Washington, DC. A book containing these and other demonstrations can be ordered on-line at
http://www.enc.org/resources/records/full/0,1240,018717,00.shtm

Sparks from Leyden Jar
In your July August newsletter you mentioned that Lance Jerale's electrostatic generator (ESG) gave feeble sparks from the Leyden jar until you drew a little spark with your finger. No diagram was shown for the setup.

If your ESG has one side grounded (in effect) and you ground one terminal of the Leyden jar, you can get big sparks. If your Leyden jar is not grounded on one side, you will get feeble sparks. The effect of the finger is, I believe, to furnish a temporary ground for the Leyden. This seems especially true since you say put your finger on either terminal. If the Leyden jar is floating, electrons entering one terminal push electrons on the other side, and they push back! If the other side is grounded, charge is gratefully accepted and the Leyden glass charges right up. Of course, you are in the business, and I am a theoretician (and worse, not a member!).

Do members have any doubt that electric charge and energy is stored in the dielectric instead of on the plates (only)? I am looking for experimental evidence.

Thank you for any reply

John C. Polasek
(Author of Dual Space theory).

Water Vapor Removal System - Builders Needed
You may recall the water vapor removal system that we were working on the last time I talked to you, I have enclosed one figure. Well we have the first order coming in from the Navy and they are asking "who will build these in quantity". I have enclosed one photo of the gadget to show it in operation.

I thought of you as a good source of potential builders, if you are interested I can send a complete write up on the unit. We have a Patent 6,302,944 B1.

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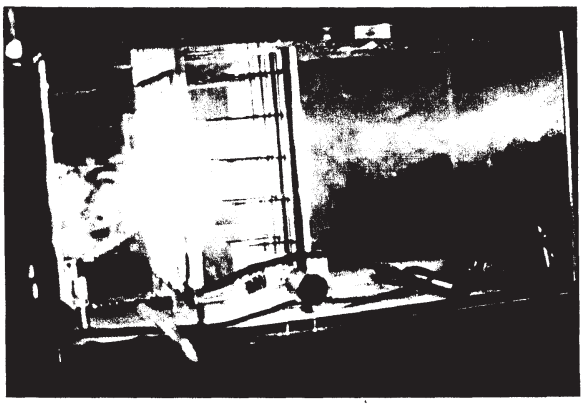

WATER FOG COMING INTO DRYER
FROM THE LEFT VOLTAGE OFF

WATER FOG COMING INTO DRYER
FROM THE LEFT VOLTAGE ON (5kV)

Notes from the Editor

This is my inaugural issue as editor of the ESA newsletter and, as such, I'd like to make a few comments. First, I'd like to acknowledge all the work and effort of Bill Smart, the previous editor, in consistently issuing an informative newsletter for so many years (17). A truly great and important contribution to the ESA.

This brings me to my second comment - I'd like to apologize to all the ESA members for the extreme delay in issuing this newsletter. Unfortunately, circumstances at home required me to focus my attention elsewhere. However, the situation is much improved now and I am able to take the time needed to fulfill my duty as editor. I look forward to taking the mantle from my esteemed predecessor and continuing to provide a quality newsletter. I'd like to thank and acknowledge my wife, Judy, for her assistance in the layout and design of the newsletter.

Finally, I hope you will continue to find the newsletter interesting and worthwhile. I'm a believer of continual improvement and am very open to any constructive criticism on the content or look of the newsletter. As always, submissions of content for newsletter publication are greatly appreciated. One new feature I'm interested in getting feedback on is the **Electrostatic Profiles** section - please be sure to read and comment. Feel free to email me at: *mark.zaretsky@kodak.com* or write to: 30 Shalimar Drive, Rochester, NY, 14618.

Electronic Delivery of Newsletter Please Read and Respond!!

In the interest of saving some money (and effort on behalf of your editor) I'd like to find out how many people would be interested in electronic delivery of the newsletter, instead of getting a hard copy in the mail. We could establish an email distribution list and email those on the list either the newsletter itself or a notification that the newsletter is available on the ESA website. This would reduce the cost due to printing and postage, as well as the efforts of the editor's family to fold, staple, and label/stamp.

If you would be interested in receiving an electronic version only of the newsletter (no paper copy), then please let me know at *mark.zaretsky@kodak.com*. I will then begin to compile an electronic distribution list. Thanks.

Electrostatic Profiles

One of the best aspects of the ESA conference is the opportunity to meet new people and share experiences, both on a professional and personal level. Unfortunately, the majority of ESA members do not attend the annual conference. I believe strongly in Al Seaver's motivational challenge for conference attendees, "Learn at least one new idea and meet at least one new person". However, I still find it difficult to engage in a meaningful conversation with as many attendees as I would like.

With this in mind, I would like to propose an alternative forum for introducing ESA members to each other. I would like to use this space for people to introduce themselves to the ESA and share a bit of their work and personal environments, to whatever extent they are comfortable with, so as to help maintain and further expand the "Friendly Society".

I'm volunteering myself as the first guinea pig in this experiment but hope to feature other members in future newsletters. Please don't be shy - drop me a profile for a future issue at *mark.zaretsky@kodak.com* or mail to 30 Shalimar Drive, Rochester, NY 14618. I hope to hear from you soon.

MARK ZARETSKY

I would like to say I'm one of those folks who enjoyed tinkering with old radios, motors, cars, and other electromechanical devices during my formative, childhood years. The truth, however, is far from that. I spent most of those years either ravenously reading science fiction stories, practicing saxophone for concert and jazz band, or playing sports in pick-up games in the playgrounds of Brooklyn, NY. Though I've always enjoyed math and science, it wasn't until college (MIT) that I began to really "get my hands dirty" in the lab. I somehow was lucky enough to work for Professor Jim Melcher for all my thesis work, bachelor's through PhD., getting my hands very dirty indeed during my master's thesis investigation of electrostatic fluidized bed filtration of diesel exhaust.

All my corporate work experience has been with Eastman Kodak. Seven of those years were in the area of electrophotography, where I spent considerable time exploring the various aspects of toner transfer in color systems, as well as applying some of the microdielectrometry experience developed in my PhD. work to the study of doped polyurethane materials. Since 1993 I have been engaged in the area of electrostatics related to media manufacturing (primarily photographic film and paper products). This work has allowed me to experience the breadth of product development and manufacturing processes here at Kodak - from the creation of plastic and paper webs, to the coating and converting of these webs, and ultimately the usage of our products in customer equipment. I get involved in issues ranging from fundamental & applied R&D in a lab environment to trouble-shooting in manufacturing and customer sites worldwide. Some aspects of the work include electrostatic monitoring and control in our manufacturing processes to minimize problems that can be created by unwanted charge, development and application of electrostatics to enable new manufacturing processes, and assisting in product formulation design for electrostatic performance.

I really enjoy and value the opportunities I have had at Eastman Kodak so far and am working hard to see these opportunities continue as we move into our digital future.

Electrostatics
Society of America

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Rochester, NY 14618

Begin planning now to attend

Joint Symposium of the ESA & IEEE-IAS

June 24-27, 2003
University of Arkansas at Little Rock

ESA Information

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

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