May/June 2004 • No. 170

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

In our last newsletter I read Scott Stocking's note to Mark Horenstein regarding electrostatic shocks from a Mylar balloon. Thinking about this, and a birthday in my office that included a metallized Mylar balloon, prompted me to review the mechanics of the situation myself. First we start with the metallized Mylar balloon. Scott mentioned the warning on the balloon regarding the conduction of electricity, which cued me that this was metallized Mylar. I doubt that such an incident would have occurred with an unmetallized balloon.

Rather than a perfect sphere, my subject was a flattened sphere, 18 inches in diameter and 9 inches thick. I calculated the capacitance of a 12-inch sphere to be 33 pF in free space. (Would you believe there is a website that calculates the capacitance of a sphere in free space. See: http://www.csgnetwork.com/capacspherecalc.html). I measured the balloon with an inexpensive capacitance meter and got roughly the same reading.

I also measured the surface resistivity. This balloon was painted/coated with decorations. With a 100-volt test voltage, the average reading was about 1.0 megohm/square; a few of the readings were less than 1000 ohms/square at 10 volts. I feel that the low readings were due to direct contact with the metallization where there wasn't any coating.

The next experiment was to see how easily tribo or contact charging could generate charge. Using another employee's fleece jacket, I found I could readily produce hundreds of nanocoulombs of charge. This was on a very damp spring day.

My analysis of the events: The balloon held inside Scott's coat, and close to his body, had a probable capacitance of a few hundred picofarads. The contact and movement of the balloon, coat and clothing transferred 1000's of nanocoulombs of charge to the balloon. This resulted in 10's of millijoules of stored energy. Removing the balloon from his jacket caused the capacitance to greatly decrease. As the charge remained constant, the potential of the balloon increased proportionally (V=Q/C) to the point where arcing occurred.

The dry winter weather helped the charging situation. The metallized Mylar made a great capacitor and Scott learned how much energy could be stored. In the normal scheme of things, 10's of millijoules isn't very significant. In most of the literature, this would fall into the "prick" sensation range, which falls just beyond "detectable" and below "jerk". I feel the effect on Scott's ears and teeth was more due to the current path rather than its intensity. Most people do not take electrical shocks to the head. I don't think the wet shoes had any bearing on this event. I started thinking about the effect of conducting vs. insulating shoes in this situation, along with the charges on Scott's clothing being trapped or mobile, and realized there's another dimension to this problem (hopefully insignificant) which I hadn't considered. Maybe I'll approach it in the next issue after more thought. If anyone out there wants to tackle this please contact Mark Horenstein or myself.

If there truly was 10,000's of millijoules present, someone should do some more research with the materials used in Scott's shirt & jacket in combination with the Mylar balloon. Scott may have found some new, untried materials for another electrostatic generator system. This also makes me wonder what research has been done regarding shock sensitivity to different areas of the human body.

A simple solution to minimize this type of occurrence - use a conductive string, even with insulative shoes the capacitive swings would be minimized with the added capacitance of the human body. Another idea would be to add small conductive hairs to the metallized layer. I'm thinking the hairs would induce corona sooner, minimizing the possibility of a hard discharge.

I thought I was going to comment on a semi-simple incident. Now I'm reminded again, nothing is that simple in electrostatics. Maybe we'll see Glen Schmieg or Lance Jerale incorporate a metallized Mylar balloon into one of their demonstrations if they haven't done so already.

Hope to see you soon at the ESA Conference.

Bill Vosteen
ESA President

Electrostatics Society of America

ESA 2004 Registration Form

June 23-25, 2004
Rochester Institute of Technology
Rochester, New York

Mail or Fax Form to:

Kelly Robinson
Eastman Kodak Company
1669 Lake Avenue
Bldg. 23 Rm. 364
Rochester, NY 14652-4317
Fax: 585-477-1151

Tel: 585-477-4951
Email: Kelly.Robinson@Kodak.com

Note: You also can register online at www.electrostatics.org

Date: _____

Name: _____ Name on Badge: _____

Affiliation: _____

Address: _____

City: _____ State: _____ Zip: _____

Email: _____

Phone: _____ Fax: _____

Conference Registration Fees

Full Conference registration fee – ESA Members includes Tuesday welcome reception, Thursday banquet, meals from Wednesday breakfast thru Friday lunch, and conference proceedings	by 5/21/04	$195	$
	after 5/21/04	$220	
Full Conference registration fee – Non-Members includes all the above and a one year ESA membership	by 5/21/04	$215	
	after 5/21/04	$240	

Banquet meal: ☐ Beef ☐ Chicken ☐ Vegetarian

Single Day Registration member or non-member includes conference proceedings & snacks at breaks. No meals included.		$50	$
Extra Copies of Conference Proceedings	#	@ $30	$
Extra Banquet Tickets ☐ # Beef ☐ # Chicken ☐ # Vegetarian		@ $25	$
		TOTAL	$

Accommodations

Arrival Date:	Departure Date:
Approximate Arrival Time:	Approximate Departure Time:

1. RIT Student Apartment, 4 bedroom, shared bath ☐ Female ☐ Male (for apartment assignments only)	per person, per night	$26.00	$
	linen charge (1 time fee)	$15.90	$
	Registration required by 5/21/04.		

2. RIT Inn and Conference Center (hotel w/ restaurant) free shuttle service to campus	**$75 per room, per night** Call: 585-359-1800 – Mention the "ESA" for this room rate.
3. Radisson Inn (hotel w/ restaurant) free shuttle service to campus	**$119 per room, per night** Call: 585-475-1910 – Mention the "ESA" for this room rate. Book room by 5/28/04 to guarantee availability

Conference Tour

I am interested in the Friday afternoon tour of the Rochester Institute of Technology Center for Integrated Manufacturing (no additional fee)	YES	
	NO	

Payment

	I have enclosed an international money order or check in $US drawn on a US bank, made out to **"Electrostatics Society of America"**
	I will pay on-line using Pay-Pal (www.electrostatics.org).

Current Events

'Nano-lightning' could be harnessed to cool future computers

excerpted from Purdue News, March, 2004

http://news.uns.purdue.edu/UNS/html4ever/2004/040322.Garimella.nanolight.html

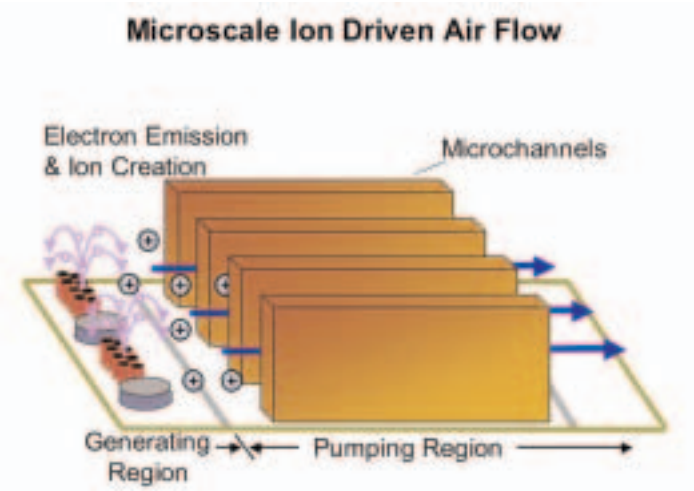
Mechanical engineers at Purdue University are developing a new type of cooling technology for computers that uses a sort of nano-lightning to create tiny wind currents. The researchers have shown that the underlying concept for a "micro-scale ion-driven airflow" device is sound and have recently filed for a patent. "This is a groundbreaking idea," said Suresh Garimella, a professor of mechanical engineering at Purdue who is working on the device with Timothy Fisher , an associate professor of mechanical engineering, Daniel J. Schlitz , who recently earned a doctoral degree from Purdue, and doctoral student Vishal Singhal. Schlitz and Singhal have created Thorrn Micro Technologies Inc. to commercialize the cooling system.

Future computer chips will contain more circuitry and components, causing them to generate additional heat and requiring innovative cooling methods. Engineers are studying ways to improve cooling technologies, including systems that circulate liquids to draw heat from chips. "The key attribute of this work is that it sticks with air cooling while possibly providing the same rate of cooling as a liquid," he said (Garimella).

The new technique works by generating ions – or electrically charged atoms – using electrodes placed close to one another on a computer chip. Negatively charged electrodes, or cathodes, are made of "nanotubes" of carbon with tips only as wide as five nanometers, or billionths of a meter. Voltage is passed into the electrodes, causing the negatively charged nanotubes to discharge electrons toward the positively charged electrodes. The electrons react with surrounding air, causing the air molecules to be ionized just as electrons in the atmosphere ionize air in clouds. This ionization of air leads to an imbalance of charges that eventually results in lightning bolts.

The ionized air molecules cause currents like those created by the "corona wind" phenomenon, which happens between electrodes at voltages higher than 10 kilovolts, or 10,000 volts. "To create lightning you need tens of kilovolts, but we do it with 100 volts or less, " Garimella said. "In simple terms, we are generating a kind of lightning on a nano-scale here." The researchers are able to create the ionizing effect with low voltage because the tips of the nanotubes are extremely narrow and the oppositely charged electrodes are spaced apart only about 10 microns, or one-tenth the width of a human hair.

Future cooling devices based on the design will have an "ion-generation region," where electrons are released, and a "pumping region," made up of another set of electrodes



needed to create the cooling effect. Clouds of ions created when electrons react with air can then be attracted by the second region of electrodes and "pumped" forward by changing the voltages in those electrodes. The voltages are rapidly switched from one electrode to the next in such a way that the clouds of ions move forward and produce a cooling breeze. "They are switching at the right frequency so that the ion cloud is constantly moving forward," Schlitz said. "As the ions move forward, they make repeated collisions with neutral molecules, producing the breeze."

The Purdue researchers have demonstrated that the pumping concept works with a region of electrodes made of many series, each series containing three electrodes. The first in the series is the most positively charged, followed by an electrode that has a less-positive charge and then a third electrode that is negative. Switching the voltages from one electrode to the next causes the charges to move forward, which in turn moves the ion clouds. "The switching itself is a well-known concept from physics, but we are the first to bring about ion pumping on a micro-scale like this," said Garimella, who is director of Purdue's Cooling Technologies Research Center, a consortium of corporations, university and government laboratories working to overcome obstacles in developing new, compact cooling technologies.

Another version of the design might replace the carbon nanotubes with a thin film of diamond, which would be sturdier and easier to fabricate than the nanotubes. "The grain boundaries in the diamond film provide the same kind of opportunity for electron emission and ion generation as a carbon nanotube," Garimella said.

ESA 32nd Annual Meeting: Final Program

Tuesday, June 22

3:30-6 PM **Registration: Golisano (Bldg. 70), Rm. 1435, Rochester Institute of Technology Campus**
6-9 PM **Reception Golisano (Bldg. 70), Rm. 1445, Rochester Institute of Technology Campus**

All Conference Sessions: Auditorium, Golisano College of Computing & Info Sciences

Wednesday, June 23

8:00 AM **Registration**
8:30-8:50 AM **Welcome and Announcements**

Session A: Tribocharging & Particle Charging

8:50-9:15 AM A1. **Charging Characteristic of Nylon 66 by Contact With Metals**, A. R. Akande, J. S. Nomad, University of Botswana

9:15-9:40 AM **A2. Application of Electrographic Rotating Magnetic Brush Technology to Powder Coating,** Eric Stelter, Heidelberg

9:40-10:00 AM *Refreshment Break:* **Golisano Atrium**

10:00-10:25 AM **A3. Effect of Rubbing Materials on the Tribo-Electrification of Textiles,** (1) Jie Zhao, (2) Jose A. Gonzalez, (1) Department of National Defense, Ottawa, ON Canada, (2) Univ. Alberta

10:25-10:50 AM **A4. Two-Phase Equilibrium Model of Insulator-Insulator Contact Charging With Electrostatic Potential**, (1) M. D. Hogue, (1) C. R. Buhler, (1) C. I. Calle, (2) E. R. Mucceciolo, (1) Kennedy Space Center, (2) Univ. Central Florida

10:50-11:10 AM *Refreshment Break:* **Golisano Atrium**

11:10-11:35 AM **A5. Particle Size Analysis in the Study of Induction Charging of Granular Materials,** Y. Wu, G.S.P. Castle, I. I. Inculet, University of Western Ontario

Session B: Property Characterization & Modeling

11:35-12:00 AM **B1. Distributed Parameter Model For Computing Energy Dissipation in Brush-Type Electrostatic Discharges,** J.C. Crager, M.N. Horenstein, Boston University

12:00-1:00 PM *LUNCH:* **Crossroads Café & Market**

1:00-1:25 PM **B2. Surface Resistivity and the Vapor Adsorption Effect – Part I: Theory,** Albert E. Seaver, Electrostatics Consultant

1:25-1:50 PM **B3. Surface Resistivity and the Vapor Adsorption Effect – Part II: Applications ,** Albert E. Seaver, Electrostatics Consultant

1:50-2:15PM **B4. Characteristics of Secondary EHD Flow in Pin-Grid System Generated by Electric Corona Discharge in Air,** Lin Zhao, K. Adamiak, University of Western Ontario

2:15-2:35 PM *Refreshment Break:* **Golisano Atrium**

2:35-3:00 PM **B5. Negative Corona Discharge in Oxygen Under Different Pressures,** Jiacheng Zhang, Kazimierz Adamiak, G.S.Peter Castle, University of Western Ontario

3:00-3:25 PM **B6 Surface Voltage/Charge Measurement Using a 100 um (Micrometers) Spatial Resolution Electrostatic Voltmeter,** Maciej A. Noras, William A. Maryniak, Christopher J. Lemke, Trek, Inc.

3:25-3:50 PM **B7. Discharge Times and Voltage Offsets For Charge Plates of Different Sizes and Capacitances,** Maciej A. Noras, Trek, Inc.

3:50-4:10 PM *Refreshment Break:* **Golisano Atrium**

4:10-4:35 PM **B8. Characterization of Conductive Field Dependent Composite Materials**, (1, 2) F. P. Espino-Cortes, (2) Shesha H. Jayaram, (2) Edward A. Cherney, (1) National Polytechnic Institute, Mexico, (2) University of Waterloo

4:35-5:00 PM **B9. Degradation of Stator Winding Insulation Under Steep-Fronted Voltage Pulses,** Saeed U. Haq, Shesha H. Jayaram,, E. A. Cherney, University of Waterloo

5:00-6:00 PM **ESA Council/General Business Meeting: Golisano Building, Rm. 2500**
6:00-7:00 PM ***DINNER:*** *RIT Campus, choice of 3 locations using Conference meal plan.*

Thursday, June 24

Session C: Electrostatic Phenomena & Processes

8:30-8:55 AM **C1. Electrodynamic Dust Shield for Solar Panels on Mars Rovers**, (1) C.I. Calle, (2) M. K. Mazumder, (1) C.R. Buhler, (3) J. G. Mantovani, (2) A. S. Biris, (4) S. Clements, (5) A. Chen, (1)

A.W. Nowicki, (1) NASA Kennedy Space Center, (2) Univ. Arkansas at Little Rock, (3) Florida Institute of Technology, (4) Appalachian State University, (5) Oklahoma Baptist Univ.

8:55-9:20 AM **C2. EHD-Enhanced Drying Using a Multiple-Needle Electrode,** F. C. Lai, R. K. Sharma, University of Oklahoma

9:20-9:50 AM *Refreshment Break:* **Golisano Atrium**

9:50-10:15 AM **C3. Using Static Charge on Pyroelectric Crystals to Produce Self-Focusing Electron and Ion Beams and Transport through Tubes,** James D. Brownridge, Steve M. Shafroth, Binghamton University

10:15-10:40 AM **C4. Design and FEA of a Linear Electrostatic Motor,** Yousef Hojjat, Mehdi Modabberifar, Terabit Moderns University

10:40-11:10 AM Refreshment Break: ***Golisano Atrium***

11:10-11:35 AM **C5. Experiments on Electricity With Benjamin Franklin As Lab Partner,** Robert A. Morse, St. Albans School

11:35-12:00 PM **C6. High Speed Color Electro Photographic Printing Using Image-On-Image Technology,** Rick Lux, Bill Wayman, Xerox Corp

12:00-1:00 PM *LUNCH:* **Cross Roads Café & Market**

1:00-1:25 PM **C7. The Effect of Space Charge on the Performance of An Electrostatic Induction Charging Spray Nozzle,** S. Zhao, G.S.P. Castle, K. Adamiak, University of Western Ontario

1:25-1:50 AM **C8. Use of Resistive Coating to Suppress Electric Stress Concentration on Polymeric Housing Materials,** Rocket Wei, Edward A. Cherney Shesha H. Jayaram, Univ. of Waterloo

Session D: Biological Applications, part 1

1:50-2:15 PM **D1. A Simulation Study of Electrical Model of Biological Cells,** Premkumar Ellappan, Raji Sundararajan, Arizona State University East

2:15-2:40 PM ***Refreshment Break:*** Golisano Atrium

Session E: Safety & Hazards

2:40-3:05 PM **E1. A Measurement Method of the Electrostatic Charge at Garment Removal Off of a Human Operator,** (1) Mihai Antoniu,(1, 2) Angela Antoniu, (1) University of Isai, (2) University of Alberta

3:05-3:30 PM **E2. Experiences at the Measurements of Packaging Material For Electronic Devices According to the New Standards IEC- 61340-5-1,** Hartmut Berndt, B.E.STAT Elektronik Elektrostatik GmbH

3:30-3:55 PM ***Refreshment Break:*** Golisano Atrium

3:55-4:20 PM **E3. Studies on ESD - Flooring Material, Especially the Comparison of the Measurement Methods - Walking Test and System Test With Normal Resistance Methods, Microscopically Explorations,** Hartmut Berndt, B.E.STAT Elektronik Elektrostatik GmbH

4:20-4:45 PM **E4. Spark-Protection Circuit For Measuring Current in High-Voltage Circuits,** Kelly Robinson, John J. Coleman, Eastman Kodak Company

7:00 – 9:00PM ***BANQUET:*** *Student Alumni Union Cafeteria, RIT Campus*

Friday, June 25

Session F: Biological Applications, part 2

8:30-8:55 AM **F1. Cancer Growth Acceleration by External Electrostatic Fields,** (1) James R. Gray, (2) Charles H. Frith, (2) J. David Parker, (1) Conundrum Project, (2) Toxicology Pathology Assoc.

8:55-9:20 AM **F2. Static Fields: Possible Therapeutic Benefit --- Possible Danger,** (1) James R. Gray, (2) Charles H. Frith, (2) J. David Parker, (1) Conundrum Project, (2) Toxicology Pathology Assoc.

9:20-9:50 AM *Refreshment Break:* **Golisano Atrium**

9:50-10:15 AM **F3. Electrostatic Force Generation in Chromosome Motions During Mitosis,** L. John Gagliardi, Rutgers University

10:15-10:40 AM **F4. Effect of Electrostatic Atomization on Electrical Sterilization,** Hee Kyu Lee, Jong-Geum Lee, Bucheon College

10:40-11:10 AM *Refreshment Break:* **Golisano Atrium**

11:10-11:35 AM **F5. Electric Field Distribution of Biological Cells-a Simulation Study,** Jason Graves, Raji Sundararajan, Arizona State University East

11:35-12:00 PM **F6. Electrostatic Adhesion on Food Products: Is It Important?,** F Halim, S Barringer, The Ohio State University

12:00-3:00 PM **TRIP:** Rochester Institute of Technology Center for Integrated Manufacturing

Electrostatics Society of America

30 Shalimar Drive
Rochester, NY 14618

Current Events Calendar

- ESA 2004, June 23-25, 2004, Rochester, NY, Contact: Kelly Robinson, email: *kelly.robinson@kodak.com* , website: *http://www.electrostatics.org/Announcements/2004%20Call-For-Papers.htm*
- 5th international Electro-Hydro-Dynamics Workshop, August 30-31, 2004, Poitiers, France, Contact: Hubert Romat, email: *hubert.romat@lea.univ-poitiers.fr* , website: *http://labo.univ-poitiers.fr/informations-lea/EHD/p1.html* **(NOTE: abstracts due April 30, 2004)**
- 4th French Electrostatics Society (SFE) Congress, September 2-3, 2004, Poitiers, France, Contact: Gerard Touchard, email: *gerard.touchard@lea.univ-poitiers.fr* **(NOTE: abstracts due April 30, 2004)**
- EOS/ESD Association 26th Annual Symposium, September 19-23, 2004, Grapevine Texas, email: *info@esda.org* , website: *http://www.esda.org* **(NOTE: abstracts due April 30, 2004)**
- Electrostatics 2005, June 15-17, 2005, Helsinki, Finland, Contact: *electrostatics2005@congreszon.fi* , website: *http://electrostatics2005.vtt.fi/* **(NOTE: second call for papers - abstracts due May 28, 2004)**

ESA Information

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

Bill Vosteen
President
Monroe Electronics, Inc.
PO Box 535
Lyndonville, NY 14098-0535
585-765-2254
billv@monroe-electronics.com

Steve Cooper
Secretary/Treasurer
540 Morton Rd.
Athens, GA 30605
706-769-0025
steve@steve-cooper.com

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