November/December 2006 • No. 182

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

I enjoy hearing stories that challenge my understanding of electrostatics and show me something new. One of my colleagues shared with me that he grew up in a rural area in a house heated by several fireplaces. When he was perhaps 10 years old, his family purchased a wood-burning stove. Their home was heated much more efficiently by their new stove. And, my friend paused, looked me in the eye and said, "Of course, you know why we kept a kettle of water on the stove. Well, before we did that, I got some nasty shocks from the stove. The boiling water raised the humidity so as to dissipate the charge on the stove."

This stirs my curiosity. What is it about combustion that charges particles? Do smoke particles carry a significant amount of charge? If so, why don't they deposit on the inner surfaces of the chimney? Well, perhaps they do. Can the combustion process be optimized to maximize particle charge? Perhaps there are implications for enhancing air quality by improving the capture of small particles such as diesel exhaust. I know that combustion has been studied for many years. Are you familiar with any work on charge separation during the combustion process?

Now, what do you think about the idea that charge is dissipated by increasing the humidity? Certainly, the boiling water will increase the humidity. And, perhaps the air exchange in the room is sufficiently low so that the humidity will increase significantly. Another mechanism is that the kettle of water sprays charged particles into the room. The interior of the kettle would be a field-free region. So, I think that the boiling process should not form any charged particles. However, if there are any sharp edges on the kettle, there would be corona discharge before a "nasty spark" would occur. And, there is often a film of water around the lip of a kettle. If the voltage is sufficient, the water film would become unstable and form a spray of charged droplets.

What do you think? How does a kettle of water on a wood-burning stove prevent nasty static shocks? Is there a simple, order-of-magnitude calculation to guide our thinking?

Have you heard an interest story with an electrostatics connection? If so, I invite you to share them by writing a short article for our Newsletter. Our membership is diverse with a broad range of interests. Sharing information with others is a great way for you to contribute to the ESA and enrich our Society.

Kelly Robinson,
ESA President

CALL FOR PAPERS

2007 Electrostatics Society of America Annual Meeting

June 12 - 14, 2007
Purdue University, West Lafayette, Indiana USA

The 2007 Electrostatics Society of America (ESA) Annual Conference will be held on the campus of Purdue University in West Lafayette, Indiana starting 1pm on Tuesday, June 12 and ending after the banquet on Thursday, June 14, 2007. Join us for our technical sessions including comprehensive technical papers, a Student Paper Competition, informal discussions, poster sessions, and electrostatics demonstrations.

TOPICS OF INTEREST INCLUDE:

- Atmospheric Electricity
- Biological Applications
- BioMEMS and BioFluidics
- Breakdown and Discharges
- Charge Neutralization
- Computational Methods
- Display Devices
- Electrets
- Electrohydrodynamics
- Electrophotography
- Electrostatic effects in drug delivery
- Electrostatic Painting
- Electrostatic Powder Coating
- Electrostatic microencapsulation
- Electrophoresis
- Electroviscous effects
- Electrostatic Printing
- Electrostatic Propulsion
- Electrostatics Demonstrations
- Electrostatics Education
- ESD Prevention and Detection
- MEMS Devices
- Nonthermal Plasmas
- Nanoelectrospray applications
- Particle Control & Transport
- Precipitators and Cleaners
- Safety and Hazards
- Sprays and Droplets
- Triboelectrification

DEADLINES:

Mid - February	Registration and detailed conference information will be available at www.electrostatics.org.
March 1, 2007	Titles, abstracts and name of 1 - 2 relevant subject area from the list above are due to www.electrostatics.org.
March 16 , 2007	Notification of Paper Acceptance
April 13, 2007	Final Manuscripts due. Send final manuscripts to: electro@electrostatic.com Instructions for authors are available at www.electrostatics.org, along with templates for MS Word and Latex.

♦ Authors may request that their manuscript be considered for publication in the Journal of Electrostatics.

STUDENT PAPER COMPETITION:

To encourage participation by student researchers, all presentations that have a student as the presenter and first author are eligible for the student paper competition. Note the student must attend and present at the meeting. Undergraduate and graduate students are eligible. Papers will be judged on their technical merit and the cogency of their presentation. Please indicate at submission that the abstract is to be considered for the student paper competition, and list all student authors.

Contact the General Chair for information regarding transportation and accommodations, or the Technical Chair for information regarding the technical sessions:

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NOTE: Change of Conference Schedule

This year's annual meeting will take place at Purdue, IN, with slightly different dates. The conference will be begin at 1 pm on Tuesday, June 12 and end with the banquet on Thursday night, June 14. This will allow people to travel on Monday night or Tuesday morning, and return home on Friday morning. As usual, the banquet will be the highlight of the conference, with a stimulating speaker and awards ceremony.

Sources and Sinks

A Crossroad in Technical Publishing - Part I: The Cost Problem

You get funding, you work hard, you discover new things, you arrive at conclusions, and then you write it all up and submit it for review and publication. But, does anyone read your publications? I would like to take a few paragraphs to discuss what is changing in the world of technical publications. It may surprise you.

Publishing a scientific article is not what it used to be just a few short decades ago. The world changed when digital delivery of scientific papers became available. Thanks to this digital revolution private publishers – and professional organizations who also publish – are finding increased profit in their publishing businesses. However, if you publish in a journal, an important question must be asked: "Who is reading your work?" Are you being ignored by the bulk of engineers and scientists who reside in the "typical" organization because the "cost" associated with obtaining a technical publication is just too high? You do great work and publish great papers, but is it really worth $35 to $40 just get one of your papers? Is your work of significant value if a reasonable portion of the scientific community is not reading your published papers? To make it less personal the following question should be asked: If we are all part of the greater scientific community, why are we paying so much to read each other's scientific works?

It is time to re-examine why we publish and to bring the discussion to the electrostatics community. Scientific publishing is primarily done by those working in academia, government and industry; and it is worth looking at the basic reason behind publishing.

Colleges and universities throughout the world continually generate new and useful information, which is published for the benefit of the scientific community at large. A "publish or perish" mentality at these institutions has required these publications to be in refereed scientific journals. One benefit of a refereed article is that the reader knows others with knowledge of the subject matter have accepted the information; so, the reader is usually not wasting time reading a paper of questionable content.

Some military science is classified and some industrial science is kept as trade secrets. Such knowledge hoarding has long been accepted as an honorable means of protecting a country or a business. However, scientific information that does not fall into these two categories is typically published in open reports or in refereed scientific journals. The general scientific community uses much of this published information to further both fundamental science and to develop and advance technologies. Furthermore, a fair amount of this published information ends up being used by government and industry to advance their classified or proprietary objectives. As a result, the cycle of scientific advancement is heavily dependent on published information. Implied in this last statement is the assumption that others have access to and read these published works.

So why bring this up to the ESA membership. One reason is electrostatics was not the only thing being discussed on the Berkeley campus of the University of California during this past ESA Joint Meeting in Electrostatics. On June 7, 2006 the local newspaper – the East Bay Daily News (Vol. 1, No. 278, p1) – had a front page headline titled "Read all about it in a journal, for a price." In the article, UC Berkeley's head librarian, Thomas Leonard was quoted as saying "We think the model of scholarly publishing is broken and needs to be changed." He was further quoted as saying "Once you think about material delivered digitally, you start to think whether a journal is needed at all." WOW! That sounds like either publisher blasphemy or at least a strong attention-grabbing statement.

The problem is the high cost of refereed journals. Publishers offer large institutions special package deals to keep overall costs down for these institutions. However, smaller institutions with fewer employees can't afford these packages and have to "pay per paper", usually in the range of $35 to $40 for a single article. This can quickly consume an annual library budget in the matter of a few weeks to a few months. The newspaper article noted that on June 7, UC Berkeley's head librarian and others from the academic and corporate worlds would meet with Elsevier, one of the world's largest publishers. Elsevier also publishes the Journal of Electrostatics, a journal in which many ESA members have published papers.

From all that was written above, we now have a general understanding of the cost problem a reader will encounter when trying to access a paper you published in a traditional journal. But what are the alternatives? In the next ESA Newsletter I will take a look at "open access", which attempts to bypass a lot of the problems associated with present-day traditional publishing. Furthermore, some of what has transpired in open access should fit the often frugal nature of the ESA membership.

For the Friendly Society
Al Seaver, 1995-1999 Past President of ESA

Current Events

Electrically Conductive Anodized Aluminum Surfaces

Anodized aluminum components can be treated to make them sufficiently electrically conductive to suppress discharges of static electricity. The treatment was conceived as a means of preventing static electric discharges on exterior satin-anodized aluminum (SAA) surfaces of spacecraft without adversely affecting the thermal-control/optical properties of the SAA and without need to apply electrically conductive paints, which eventually peel off in the harsh environment of outer space. The treatment can also be used to impart electrical conductivity to anodized housings of computers, medical electronic instruments, telephone-exchange equipment, and other terrestrial electronic equipment vulnerable to electrostatic discharge.

The electrical resistivity of a typical anodized aluminum surface layer lies between 10^{11} and 10^{13} Ω-cm. To suppress electrostatic discharge, it is necessary to reduce the electrical resistivity significantly - preferably to 10^{9} Ω-cm. The present treatment does this. The treatment is a direct electrodeposition process in which the outer anodized surface becomes covered and the pores in the surface filled with a transparent, electrically conductive metal oxide nanocomposite. Filling the pores with the nanocomposite reduces the transverse electrical resistivity and, in the original intended outer-space application, the exterior covering portion of the nanocomposite would afford the requisite electrical contact with the outer-space plasma. The electrical resistivity of the nanocomposite can be tailored to a value between 10^{7} and 10^{12} Ω-cm. Unlike electrically conductive paint, the nanocomposite becomes an integral part of the anodized aluminum substrate, without need for adhesive bonding material and without risk of subsequent peeling. The electrodeposition process is compatible with commercial anodizing production lines. At present, the electronics industry uses expensive, exotic, electrostatic-discharge-suppressing finishes: examples include silver impregnated anodized, black electroless nickel, black chrome, and black copper. In comparison with these competing finishes, the present nanocomposite finishes are expected to cost 50 to 20 percent less and to last longer.

This work was done by Trung Hung Nguyen of EIC Laboratories for Marshall Space Flight Center. For further information, access the Technical Support Package (TSP) free on-line at http://www.techbriefs.com/tsp under the Materials category. MFS-32092-1

The Electric Solar Wind Sail

Pekka Janhunen

http://www.space.fmi.fi/~pjanhune/Esail/index.html

The electric solar wind sail, or electric sail for short, is a propulsion invention made in 2006 at the Kumpula Space Centre.

The electric sail is a new space propulsion concept which uses the solar wind momentum for producing thrust (Janhunen, P., Electric sail for spacecraft propulsion, AIAA Journal of Propulsion and Power, 20, 4, 763-764, 2004). The electric sail is somewhat similar to the more well-known solar radiation pressure sail which is often called simply the solar sail.

A full-scale electric sail consists of a number (50-100) of long (e.g., 20 km), thin (e.g., 20 microns) conducting tethers (wires). The spacecraft contains a solar-powered electron gun (typical power a few hundred watts) which is used to keep the spacecraft and the wires in a high (up to 20 kV) positive potential. The electric field of the wires extends a few tens of metres into the surrounding solar wind plasma. Therefore the solar wind ions "see" the wires as rather thick, about 50 m wide obstacles. A technical concept exists for deploying (opening) the wires in a relatively simple way and guiding or "flying" the resulting spacecraft electrically. The implementation details are presently under study.

The solar wind dynamic pressure varies but is on average about 2 nPa at Earth distance from the Sun. This is about 5000 times weaker than the solar radiation pressure. Due to the very large effective area and very low weight per unit length of a thin metal wire, the electric sail is still efficient, however. A 20-km long electric sail wire weighs only a few hundred grams and fits in a small reel, but when opened in space and connected to the spacecraft's electron gun, it can produce a one square kilometre effective solar wind sail area which is capable of extracting 1-2 millinewton force from the solar wind. For example, by equipping a small, 200 kg, spacecraft with 100 such wires, one may produce acceleration of about 1 mm/s^2. After acting for one year, this acceleration would produce a significant final speed of 30 km/s. Small payloads could be moved quite fast in space using the electric sail, a Pluto flyby could occur in less than five years, for example. Alternatively, one might choose to move medium size payloads at ordinary 5-10 km/s speed, but with lowered propulsion costs because the mass that has to launched from Earth is small in the electric sail.

One limitation of the electric sail is that since it uses the solar wind, it cannot produce much thrust inside a magnetosphere where there is no solar wind. Although the

Journal of Electrostatics

Reminder: ESA is again offering a reduced price subscription to the Journal of Electrostatics. Our rate is over 85% off of the regular subscription price.

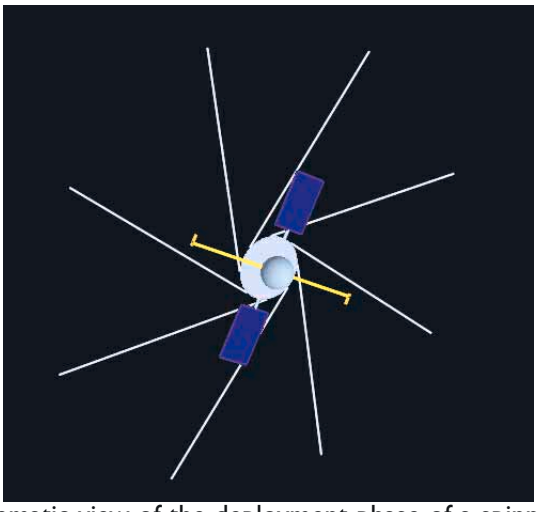
The Journal of Electrostatics started publication in 1975 and is published in three volumes per year (4 issues per volume). The journal's objective is the dissemination of knowledge relating to static electricity and is aimed at a wide audience that includes physicists, electrical, mechanical, chemical, and aeronautical engineers, chemists, biologists, and individuals working in medicine and meteorology. The topics covered in the journal include fundamentals, theory, modeling, applications, biotechnology, microengineering, computational methods, and electrostatic hazards. More detailed information about the readership, authors, aims, and scope of the journal can be found at http://www.bu.edu/eng/jestat

If you are interested in receiving the Journal in 2007 please let Steve Cooper know via e-mail at *steve@stevecooper.com* or return the subscription form from the ESA website (http://www.electrostatics.org) by regular mail. The cost is $124 US. (Note that the normal subscription rate for non ESA members is over $1,000). You can pay for your subscription by check or through PayPal from the ESA website. If you received the Journal last year and wish to receive it again in 2007 please notify Steve to renew and avoid a disruption in your subscription.

Current Events (cont'd.)

direction of the thrust is basically away from the Sun, the direction can be varied within some limits by inclining the sail. Tacking towards the Sun is therefore also possible.

(from M. Murtomaa)



A schematic view of the deployment phase of a spinning electric sail. Only eight wires have been drawn for simplicity. The violet-blue surfaces are solar panels and the yellow lines are propulsive arms (with small rockets attached to the tips) which create the initial spacecraft spin.

ESA OFFICERS

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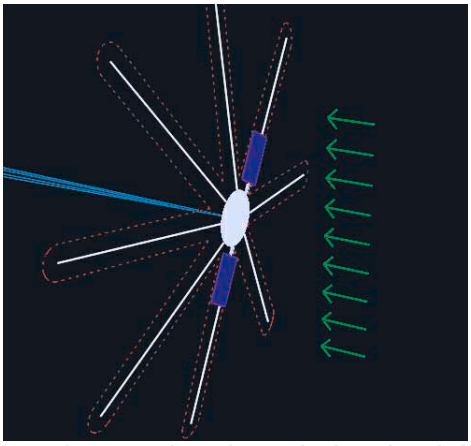
Vice President	Sheryl Barringer, Ohio State Univ
Executive Council	John Gagliardi, Rutgers Univ.
	Steve Cooper, Mystic Tan
	Nathaniel Green, U. of Bloomsburg

CALENDAR

- Electrostatics 2007, 12th Int'l. Conf. on Electrostat., IoP, Mar. 25-29, 2007, St. Catherine's College, Oxford, UK, Contact: Jasmina Bolfek-Radovani, Tel: +44 (0)20 7470 4800, *jasmina.bolfek-radovani@iop.org* website: http://conferences.iop.org/ELE/
- 1st Int'l. Electrostatic Discharge Workshop, May 14-17, 2007, Stanford Sierra Conference Center, Lake Tahoe, California, Contact: ESD Assoc., Tel: 315-339-6937, *info@esda.org* , info at http://www.esda.org
- ESA 2007, June 12-15, 2007, Purdue University, West Lafayette, Indiana, Contact: Prof. Rajeswari Sundararajan, Tel: 765 494-6912, *raji@purdue.edu*
- 5th Asian Aerosol Conf., Aug. 26-29, 2007, in Kaohsiung, Taiwan, info at http://www.aac2007.org (abstracts due by Dec. 31, 2006)
- 29th Annual EOS/ESD Symp., Sept. 16-21, 2007, in Anaheim, California, Contact: ESD Assoc., Tel: 315-339-6937, *info@esda.org* or http://www.esda.org , (abstracts due by Jan. 12, 2007)
- Elect. Insul. Conf., Sept. 24-26, 2007, in Nashville, Tennessee, Contact: Mr. Art Lemm, Tel: 262-835-3368, Fax: 262-835-1515, *alemm@cooperpower.com* , info at http://www.deis.nrc.ca/eic2007/eic2007.htm (abstracts due by Jan. 31, 2007)



In this phase the wires have been deployed and the electron gun has been started. The blue lines symbolize the electron beam of the gun. The spinup propulsion arms and associated fuel tank have been jettisoned to save mass. The solar wind acts on the wires, bending them slightly. The electric field around the wires is depicted by dashed red line.

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