Mar/Apr 2005 • No. 174

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

I feel I need to put some closure on the standards discussion after all of the impassioned input in the last two newsletters. This type of discussion could have taken place regarding any institution. It seems that there are two camps in these situations. You have the innovators who feel burdened by structure and the past. These are the people breaking new ground and have the burden of overcoming the inertia of the established norms. Then you have those managing the institution itself. They have the job of finding consensus in most democratic situations and may be a bit behind the innovation curve. The innovators feel frustrated that their ideas aren't greeted with more enthusiasm. But speaking for the institution, the slowness in accepting change can help prevent the possibility of endorsing ideas that haven't been thoroughly tested in a broad array of real world applications, helping to surface any shortcomings.

It's time to start making your plans for the ESA Conference in Edmonton. John Pelesko has brought together an interesting group of speakers, including a number of invited speakers from various backgrounds. Electrostatics in biological systems is an area from which we have seen more activity in recent years and is well represented at this year's conference. We are looking forward to sharing the ESA experience with our guests, learning of their work, thus broadening our scope and enriching our understanding of the field of electrostatics. We hope they enjoy the less formal structure in our format which has become our trademark over the years. We will be offering our proceedings on CD for the first time thanks to Joe and Barb Crowley. The CD will be in addition to the printed copy.

If you are interested seeing the Canadian Rockies, it is possible to drive to Jasper and back in one long day. It takes about 4 hours each way, leaving a few hours for sight seeing and relaxing. You need minimally 2 or 3 days to see Banff and Jasper and do the area justice. There are not any regularly scheduled tours and our numbers are not high enough to be economical to arrange a bus tour, so we feel that the best way is to rent cars and make your own tour. I'm planning on renting a car and going to Jasper on Saturday, June 25th. If anyone wishes to join me, please let me know. If the numbers get large enough we may rent a van or multiple cars. I've also become aware of the West Edmonton Mall, which claim's to be the world's largest shopping mall. For general information on Edmonton, such as airline info, maps, etc. visit: *http://www.discoveredmonton.com*

The travel costs to Edmonton will be more than usual for an ESA conference. Edmonton is getting to the far northern reaches of our continent and we just happen to have our conference at the beginning of their peak summer tourist season. I hope this doesn't keep many of you from attending. Those who are in the habit of driving to the conference will also find this location a bit more of a challenge than our traditional day's drive or so in the northeast. Not to mention the rising cost of gasoline.

Hope all are well and I hope to see you in Edmonton!!

Bill Vosteen
ESA President

Current Events

Low cost, electrostatically actuated mesopump with high pumping rate

Honeywell

The novel mesopump consists of a series of cells. Each cell includes a shaped chamber, diaphragm, and interconnecting conduits as shown in Figure 1. The interconnecting cells work together to efficiently and effectively transfer fluid from one side of the pump to the other. The

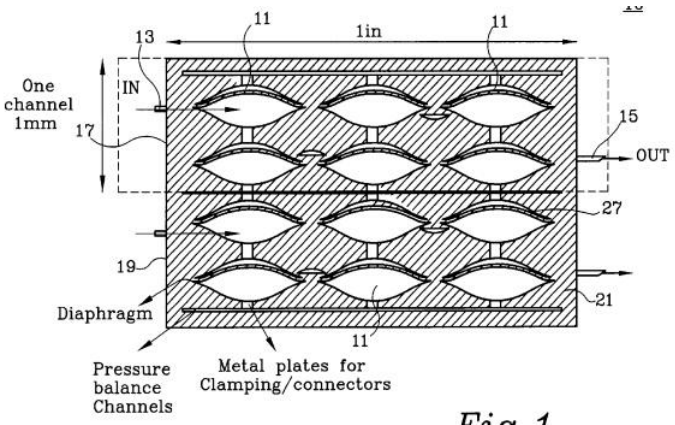


Fig. 1

body of the pump (21) may be made of a high temperature plastic.

As seen in Figure 2, each channel of the mesopump has a molded body with an upper actuation electrode (23) and a lower actuation electrode (25). An electrically grounded diaphragm (27) moves inside the chamber (29) between the upper electrode (31) and the lower electrode (25). The electrodes may be formed by metal plating, printing, or electron beam deposition. The diaphragm may be constructed from metal-coated polymers or a conductive elastomer; however, the material must conform to the curved surfaces of the chamber. This tech-

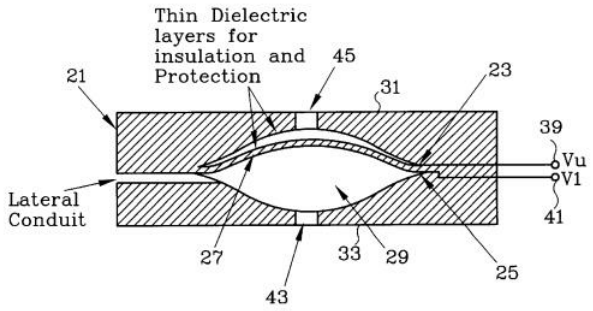


Fig. 2

nology is used for high volume electronic keyboards and flexible circuits. The preferred material is either Kapton™ or Mylar™ .

Electrostatic actuation is the most efficient way to operate the diaphragm. The distance between the diaphragm and the electrodes is suited for efficient operation. For example, a 100-volt input with a one micron thick film (a dielectric constant of six) will provide an electrostatic pressure of 5.2 atmospheres at the rolling contact point. As voltage is applied, the point of high electrostatic pressure advances from the edge toward the center, producing a rolling motion of the contact point. This motion produces minimum dead volume. In other words, all the fluid in the cavity is displaced. Chamber-to-chamber compression ratios of up to 75 or more can be achieved. The high electrostatic pressure evacuates the fluid and provides a sealing mechanism (with the access channels), which is useful in compressor and vacuum applications. The dielectric material is key to the rolling contact method. It must supply electrical isolation, be chemically inert, and prevent sticking. Silicon dioxide and silicon nitride are suitable candidates. When voltages are applied to the electrodes, the diaphragm is subjected to a snapping action.

Test analyses for a 10mm diameter (by 25-micron thick) diaphragm with 75-micron deep chambers indicates a snapping action between 48-50 volts. This results from the nonlinear, position dependent force as well as the bistable nature of the diaphragm.Pumping is accomplished by a series connection of at least 3 chambers working together.

for more info go to
http://www.yet2.com/app/list/techpak?id=24880&sid=90&abc=0&page=details

Stealing Celestial Fire

Prachi Patel Predd
Photos: Kay Rethmeyer/TU BERLIN/TERAMOBILE

A laser has sparked artificial lightning in a laboratory, a first step toward controlling real thunderbolts

There has to be a better way of tapping a lightning bolt than flying a kite in a storm, and a group of French and German scientists just may have found one. They have demonstrated in a laboratory that shining powerful laser pulses between two electrodes elicits a controllable form of lightning. They hope that their invention will eventually help to fend off lightning strikes on airports and power stations.

They employed their Teramobile laser, whose pulse lasts for a mere 100 femtoseconds and packs a peak power of 5 terawatts. The pulse rips the electrons from air molecules, creating a plasma; it also changes the refractive index of the air, a phenomenon called the Kerr effect. The

effect focuses the light just enough to balance plasma-induced diffraction, creating a straight and highly conductive channel, called a filament, which can stretch up to 3.8 meters between the charged electrodes.

In the experiment, a 1- to 2-megavolt electrode simulates a thundercloud and an electrically grounded plate simulates the earth. The laser-induced filaments short-circuit the electrodes, triggering an electric discharge much like a lightning bolt. To complete the simulation, the researchers sprayed water between the electrodes. "We expected that the 'rainwater' would scatter light and perturb the filaments, but the filaments survived the interaction," says Jérôme Kasparian, a lead investigator and a member of the group from the University of Lyon, in France. Another team hails from the École Polytechnique, in Palaiseau, France; two others come from the Free University of Berlin and the Friedrich Schiller University, in Jena, Germany.

0405nlas01.jpg The main problem is the plasma's milliseconds-long life, which limits the distance between the two electrodes to 10 meters. Kasparian says that the research groups hope to keep the plasma going longer by heating it with a second laser. Still, they are far from getting filaments that could span the 5 to 6 kilometers separating a thundercloud from the earth.

FILAMENT OF FIRE: The Teramobile laser [below right] shoots pulses from a shed to the space between an electrode charged by a generating tower and a grounded electrode [not shown]. The pulse ionizes the air, creating a conductive filament. Artificial lightning follows the filament's straight path [below left].

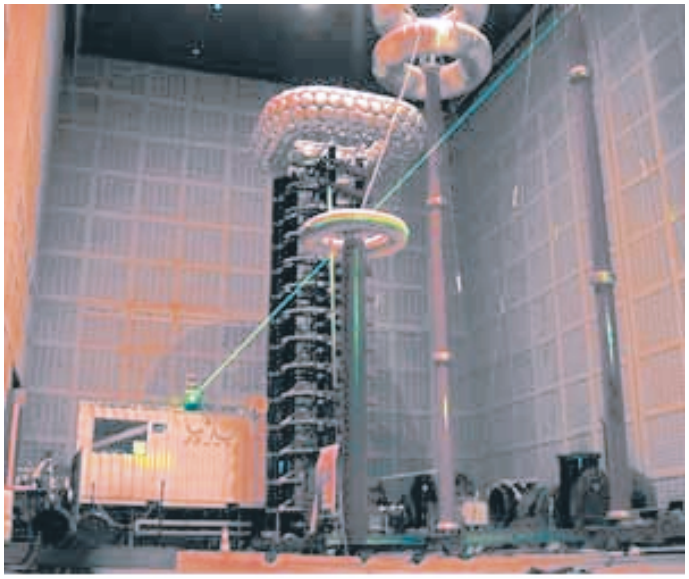
Scientists have tried and failed to manipulate lightning with lasers for 20 years. One reason, Kasparian says, is that all experiments so far have employed lasers with relatively long pulses of high energy, which create plasmas so dense that they scatter the laser light, preventing the formation of a filament. The Franco-German team solved this problem with the Teramobile, the first mobile laser ever to emit ultrashort pulses of moderate energy. The titanium-sapphire laser was designed to track air pollution by analyzing light that bounces off atmospheric gases, but the researchers realized that it could also provide lightning "on demand."

Matters don't seem that simple to Martin Uman, director of the Lightning Research Laboratory at the University of Florida, in Gainesville. Every summer for 11 years, he and his group have launched about 70 rockets trailing grounded wire into thunderclouds, drawing lightning half the time. "The cloud charges itself back up in about 10 seconds. You don't know if you're going to put the rocket [or the laser beam] in the right place," he says. "Firing lasers or rockets is not going to make any difference to what's going on up there. You probably have to go a step further back and understand the physics behind it."

To understand lightning, however, you need to be able to produce it reliably and frequently, and here lasers might have advantages over rockets. Typical rocket racks allow only up to 10 launches, Kasparian points out, while the laser technique could provide a "virtually unlimited number of shots" at triggering lightning.

If lasers ever write glowing lines high in the sky, it should be possible to control the course of lightning bolts. Then people will not merely talk about the weather, but do something about it.

from
http://www.spectrum.ieee.org/WEBONLY/resource/apr05/0405nlas.html



Nanoactuators Based on Electrostatic Forces on Dielectrics

Large force-to-mass ratios could be achieved at the nanoscale.

NASA's Jet Propulsion Laboratory, Pasadena, California

Nanoactuators of a proposed type would exploit the forces exerted by electric fields on dielectric materials. As used here, "nanoactuators" includes motors, manipulators, and other active mechanisms that have dimensions of the order of nanometers and/or are designed to manipulate objects that have dimensions of the order of nanometers. The underlying physical principle can be described most simply in terms of the example of a square parallel-plate capacitor in which a square dielectric plate is inserted part way into the gap between the electrode plates (see Figure 1 below). Using the conventional approximate equations for the properties of a parallel-plate capacitor, it can readily be shown that the electrostatic field pulls the dielectric slab toward a central position in the gap with a force, F, given by $F = V\ 2(\varepsilon_1-\varepsilon_2)a/2d$, where V is the potential applied between the electrode plates, ε_1 is the permittivity of the dielectric slab, ε_2 is the permittivity of air, a is the length of an electrode plate, and d is the thickness of the gap between the plates. Typically, the force is small from our macroscopic human perspective. The above equation shows that the force depends on the ratio between the capacitor dimensions but does not depend on the size. In other words, the force remains the same if the capacitor and the dielectric slab are shrunk to nanometer dimensions. At the same time, the masses of all components are proportional to third power of their linear dimensions. Therefore the force-to-mass ratio (and, consequently, the acceleration that can be imparted to the dielectric slab) is much larger at the nanoscale than at the macroscopic scale. The proposed actuators would exploit this effect. The upper part of Figure 2 (facing page) depicts a simple linear actuator based on a parallel-plate capacitor similar to Figure 1. In this case, the upper electrode plate would be split into two parts (A and B) and the dielectric slab would be slightly longer than plate A or B. The actuator would be operated in a cycle. During the first half cycle, plate B would be grounded to the lower plate and plate A would be charged to a potential, V, with respect to the lower plate, causing the dielectric slab to be pulled under plate A. During the second half cycle, plate A would be grounded and plate B would be charged to potential V, causing the dielectric slab to be pulled under plate B. The back-and-forth motion caused by alternation of the voltages on plates A and B could be used to drive a nanopump, for example. A rotary motor, shown in the middle part of Figure 2, could include a dielectric rotor sandwiched between a top and a bottom plate containing multiple electrodes arranged symmetrically in a circle. Voltages would be applied sequentially to electrode pairs 1 and 1a, then 2 and 2a, then 3 and 3a in order to attract the dielectric rotor to sequential positions between the electrode pairs. A micro- or nanomanipulator, shown at the bottom of Figure 2, could include lower and upper plates covered by rectangular grids of electrodes — in effect, a rectangular array of nanocapacitors. A dielectric or quasi-dielectric micro- or nanoparticle (a bacterium, virus, or molecule for example) could be moved from an initial position on the grid to a final position on the grid by applying a potential sequentially to the pairs of electrodes along a path between the initial and final positions.

This work was done by Yu Wang of Caltech for NASA's Jet Propulsion Laboratory. For further information, go to http://www.techbriefs.com/tsp under the Machinery/Automation category. NPO-30747. NASA Tech Briefs, April 2005

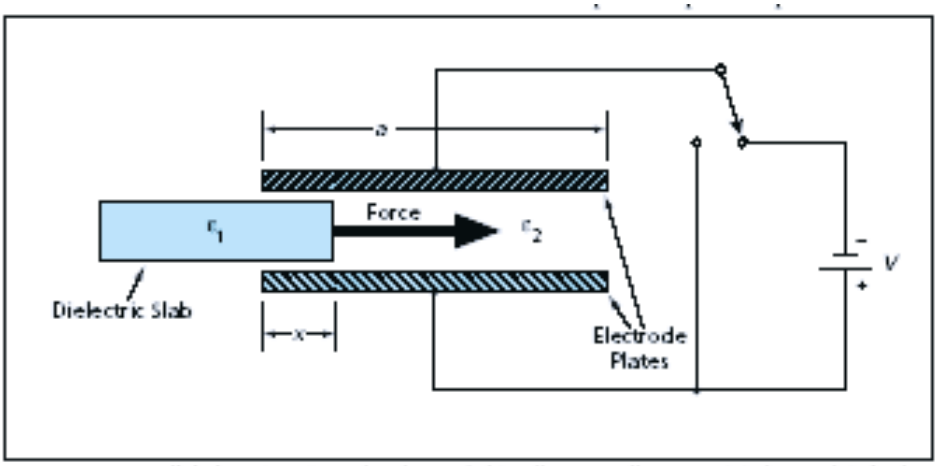


Figure 1. In a Parallel-Plate Capacitor, the electric field pulls a partially inserted dielectric slab further into the gap.

ESA 2005 Conference

The annual meeting of the Electrostatics Society of America will be held this year on the campus of the University of Alberta in Alberta, Canada. Running from the 21st to the 24th of June, the meeting will feature technical presentations on classical electrostatics topics such as atmospheric electricity and triboelectrification as well as technical presentations on emerging electrostatics topics such as electrostatically driven granular media and electrostatic nanodevices. Of special note are the presentations by our invited speakers, all of whom bring new expertise to the ESA. These include Robert Blick of the University of Wisconsin, Charvaka Duvvury of Texas Instruments, Stein Kuiper of Phillips, Joerg Lahann of the University of Michigan, Igor Aronson of Argonne National Laboratory, Ronald Phillips of UC Davis, and Osman Basaran of Purdue University. The rapidly becoming traditional student paper competition will once again be held. Undergraduate and graduate students are encouraged to attend, to present their work, and participate in the competition. Details, including accommodations and reservations, may be found at: *http://www.electrostatics.org*. Please follow the links in the Registration Form.

We look forward to seeing you in Alberta!

Angela Antoniu (General Chair) and John Pelesko (Technical Chair)

Current Events (cont'd.)

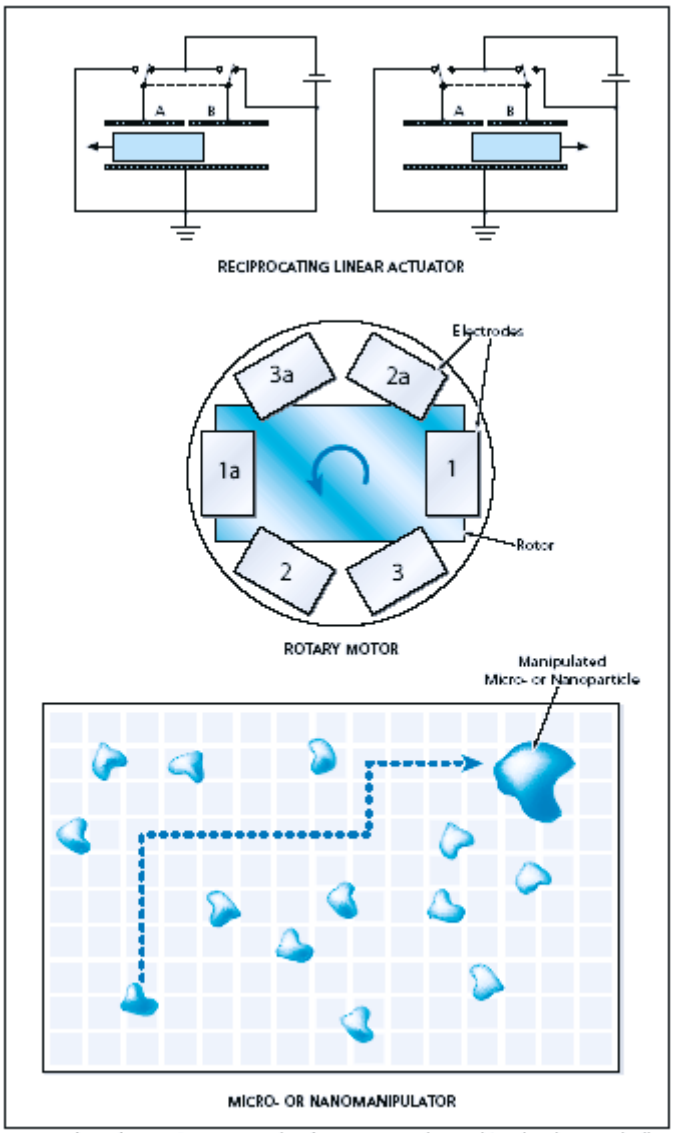


Figure 2. These Three Devices are examples of nanoactuators that would exploit the principle illustrated in Figure 1.

Sources and Sinks

Bob Gundlach Inducted Into National Inventors Hall of Fame

This past March 17, one of the original found members of the ESA, Bob Gundlach, was inducted into the National Inventors Hall of Fame. Here is a copy of the synopsis as found at the Hall of Fame website:
http://www.invent.org/hall_of_fame/1_3_0_induction_gundlach.asp

Robert Gundlach made photocopying technology more practical, flexible and affordable. As one of the first research scientists hired by the Haloid Company, now known as the Xerox Corporation, Gundlach was responsible for finding ways to refine and improve xerography. The first commercial copy machines were the size of a desk, operated slowly, and produced copies of marginal quality.

Gundlach devoted over three decades to the task of transforming the machines into the small, robust products that revolutionized xerography. He created three patentable inventions during his first year at Xerox, including an idea that allowed photocopiers to reproduce solid shapes, making copies more universally acceptable. As xerography advanced, Gundlach invented ways to produce color copies and use digital technology. His most lucrative patent at Xerox enabled photocopiers to print two-colored images.

Born in Buffalo, NY, Gundlach graduated from the University of Buffalo in 1949. He has earned more than 150 patents and was the first Research Fellow at Xerox. Although most of his inventions related to xerography, he has also received patents for a snow-making machine, a comfortable backpack, and a new water-based heat pump system.

Bakken Library News
Ellen Kuhfeld

The Bakken Library and Museum of Electricity in Life seeks a Curator of Instruments to succeed Dr. Ellen Kuhfeld, who is retiring after 25 years of service to The Bakken. The Bakken holds an outstanding collection on the general history of electricity and magnetism, with a particular focus on their uses in medicine and the life sciences. The collection includes about 2,000 scientific and medical instruments and other miscellaneous artifacts, as well as 12,000 book and journal volumes. Please see *http://www.thebakken.org* for further information on The Bakken's collections and programs.

The Curator of Instruments facilitates and promotes use of the artifact collection, both internally and externally, in addition to fulfilling the core responsibilities of security, preservation, acquisition, and cataloguing of artifacts. The ideal candidate will have a Ph.D. in history of science, technology, or medicine, have in-depth experience in working with artifacts, and be able to serve as an enthusiastic ambassador and interpreter to a wide range of audiences. The start date is midsummer 2005; applications will be accepted until the position is filled.

Please send cover letter, c.v., and list of references to: The Bakken, attn: Human Resources, 3537 Zenith Avenue S, Minneapolis, MN 55416-4623, or fax to 612-927-7265, or email to *jobs@thebakken.org)*

Call for Papers

2nd International Panel Symposium ESD 2005, 7th International ESD - Workshop DRESDEN 2005

The Highlight of the year, the approved meeting of all European and international interested persons in ESD will take place in Dresden in time of 27. – 29. September 2005.

Abstracts due by May 27, 2005, send to *hberndt@bestat-cc.com*

For more information go to *http://www.bestat-cc.com*

Sources Needed

Looking for a few good articles

I need help in providing content for the newsletter. It has been suggested that more information and focus should be given to electrostatics education, electrostatics as a hobby, and artistic uses of electrostatics. Please send your thoughts/input to me (*mark.zaretsky@kodak.com*).

Society News

ESA Officers

President:	William Vosteen, Monroe Electronics
Vice President:	Kelly Robinson, Eastman Kodak
Executive Council:	Sheryl Barringer, Ohio State Univ.
	John Gagliardi, Rutgers Univ.
	Mark Zaretsky, Eastman Kodak

Election of ESA Council Members

ESA Elections Upcoming - New Council Slates Are Sought.

Based on Article 4 of the ESA Constitution, the two-year term of the present ESA Council ends on June 30, 2005 and the new Council term of office begins on July 1, 2005. It is now time for the Secretary (address found on back page of this ESA Newsletter) to receive slates of nominees for the upcoming (7/1/05 - 6/30/07) term. Article 4c states, "The Council shall be nominated as a full slate, naming the officers and members." Article 4d states, "Slates may be self-nominated, each being presented by a member of the slate. Also, the Council may nominate a slate." Article 4e states, "The several slates shall be presented to the Secretary three months before the end of the Council's term. After validation of the nominated slates, the Council shall cause the Secretary to present the slates to the membership two months before term end, with the mail vote deadline to be one month before term end. The slate receiving the largest number of votes shall be declared elected. If two slates are tied in receiving more votes than any other slate, the Council shall act to break the tie."

Since the Council shall be nominated as a full slate, the presenter of that slate is responsible for checking with all the members of that slate to insure each nominee is willing to serve. A slate consists of five members: the President, the Vice-President and three Council Members.

If more than one slate is presented to the Secretary, a ballot will be mailed out about April 15 with the deadline for receipt of the ballots by the Secretary being May 31, 2005. If only one slate is presented (then as tradition has held) no ballots will be mailed, and the Membership present at the ESA Annual Meeting will be asked to vote on the slate. If no slates are presented, then, as Article 4b states, "If extraordinary circumstances prevent the election of a new Council, the existing Council shall continue in office, year by year, until an election can be held."

Calendar

- Electrostatics 2005, June 15-17, 2005, Helsinki, Finland, Contact: *electrostatics2005@congreszon.fi* , website: *http://electrostatics2005.vtt.fi/*
- ESA 2005, June 21-24, 2005, University of Edmonton, Alberta, Canada. Contact: Angela Antoniu, *antoniu@ece.ualberta.ca*
- 2nd International Panel Symposium ESD 2005, 7th International ESD - Workshop DRESDEN 2005, Sept. 27-29, 2005, Dresden, Germany. Contact *hberndt@bestat-cc.com*, website: *http://www.bestat-cc.com* (abstracts due by May 27, 2005
- IEEE Electrostatic Processes Committee 2005 Annual Meeting, Oct. 3-7, 2005, Hong Kong China, Contact: Prof. Malay Mazumder, Tel: 501-569-8007; Fax: 501-569-8020, website: *http://dynamic.appsci.ualr.edu/labs/mkml/Index.html*
- Electrical Insulation Conference (EIC), Oct. 24-26, 2005, Indianapolis, Indiana, USA, info: *http://www.deis.nrc.ca/eic2005/eic2005.htm*
- IEEE Conf. on Elect. Insul. & Diel. Phen., Oct. 16-19, 2005, Nashville, Tennessee Contact: *ceidp@ieee.org* , website: *http://www.ewh.ieee.org/soc/dei/ceidp/5*

Awards Nominations

Do you feel that someone's contributions to the field of electrostatics needs to be recognized.? If so, please use the forms found on the ESA website (*http://www.electrostatics.org/awards/index.htm*) and submit your nomination today. Or contact our awards chairperson, Lance Jerale, at (920) 684-5660, email: *staticawards@hotmail.com*

Electrostatic Profiles

LOOKING FOR A FEW MORE BRAVE SOULS: Please take advantage of this opportunity to introduce yourself to the rest of the ESA members and help keep the friendliness growing. Please send your profile to me at *mark.zaretsky@kodak.com* .

Help Wanted

Electrostatic Arts Generator Needs Repair

If you can be of assistance, please contact this newsletter by email (*mark.zaretsky@kodak.com*) or phone (585-588-6351). I will connect you with the person making this request.

Electrostatics
Society of America

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ESA Information

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

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ESA Council Member Elections
Awards Nominations

2005 ESA Annual Meeting - June 21-24, 2005

University of Alberta
Edmonton, Alberta, Canada
(Registration Information insert)