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ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Counting & Writing

(with details from "Better: A Surgeon's Notes on Performance" by Atul Gawande [1])

Dear All:

Continuing on making things better (by the way, I would like to take this opportunity to thank one of our esteemed past presidents for the nice email about last letter, where he provides two more examples: 1) providing clean drinking water and proper sanitation to the poor in the world would do more good to preserve lives at a much lower expense than everything we do fighting global warming, and 2) it was found that by teaching some parenting skills to young, pregnant women in Harlem, such as reading to their children, did more to ensure success in the child's educational life than anything else; so, small and simple things really do matter), it is imperative that we measure the "better", that is, the performance must be measured; we need a score. There is no score better than the Apgar score that has saved thousands of newborns since the 1950s. Newborns who would otherwise be left to die as too small or too sick/blue to save [1]. Virginia Apgar was the one of the first women to be admitted to the surgical residency of Columbia University College of Physicians and Surgeons in 1933. A very talented surgeon/person (she wasn't only a talented violinist; she also made her own instruments, and began flying single-engine planes at the age of fifty nine), she was persuaded by her chairman to become an anesthesiologist after her surgical residency, a profession of far less status at that time. However, as skilled as she was, a female surgeon had little chance of attracting patients [1]. She never delivered a baby – not as a doctor nor as a mother. And she decided to save the lives of many newborns. She was not an obstetrician, and she was a female in the male world. So she took a less direct but more powerful approach; she devised a score, known as the "Apgar" score, a revolutionary effect in the 1950s.

The Apgar score rates the condition of babies on a scale of zero to ten after one and five minutes of birth [1]. An infant gets two points if it is pink all over, two for crying, two for taking good, vigorous breaths, two for moving all four limbs, and two if its heart rate was over a hundred. Ten points means a child is born in perfect condition. Four or less means a blue, limp baby. This score, simple but effective, turned an intangible and impressionistic clinical concept – the condition of new babies – into numbers that people could collect, compare, and work on. It drove doctors and nurses to have better scores, and better outcomes, for the newborns they delivered.

Thus, simple things like scoring and counting help to improve things. We could do the same to assess or rate the success/service of our society, our annual conferences, and our joint conferences. For example, if 80% of our members submit an abstract, two points. If 90% of accepted abstracts are presented in the annual ESA conference, two points. If we get 5% to 10% new members in a year, two points. A 10% increase in number of students attended, two points, etc. We can devise a scoring system, like Apgar, and congratulate ourselves when we score 8 or above, or work to improve when our score is 4 or below (these are just sample numbers, we will work collectively and pick acceptable numbers). If we count something interesting, we will learn something very interesting.

(cont'd. on page 3)

ELECTROSTATIC PROCESSES COMMITTEE

Electrostatics Society of America

CALL FOR PAPERS

2009 JOINT CONFERENCE ESA / IEJ / IEEE-EPC / SFE

June 16-19, 2009

Boston University, MA, USA

The Electrostatic Society of America (ESA), Institute of Electrostatic Japan (IEJ), Industry Applications Society (IEEE-IAS) Electrostatic Processes Committee, and La Societé Francaise d'Electrostatic (SFE) will hold their 2009 Joint Conference on the campus of Boston University. Please join us for possibly the largest, most diversified, international gathering on electrostatics in North America including technical papers, a student paper competition, poster sessions, informal discussions, and electrostatic demonstrations.

TECHNICAL PROGRAM: We invite papers in all scientific and technical areas involving electrostatics. Contributions can range from fundamental investigations of electrostatic phenomena to studies of the implications, mitigation, or utilization of electrostatic phenomena in diverse settings. Technical topics include:

• Atmospheric and space applications	• Flows, forces, and fields	• Particle control and charging
• Biological and medical applications	• Materials behavior and processing	• Safety and hazards
• Breakdown and discharge	• Measurement and instrumentation	

ABSTRACT SUBMISSION: Abstracts should be submitted online, at http://www.electrostatics.org

STUDENT PAPER COMPETITION: Undergraduate and graduate student authors and co-authors presenting their work are eligible. The Conference Registration Fee is waived for participants in our Student Paper Competition.

IMPORTANT DATES	February, 2009	Detailed conference information available at http://www.electrostatics.org
	March 2, 2009	Abstract submission deadline
	March 18, 2009	Notification of paper acceptance
	April 17, 2009	Final manuscripts due

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President's Message (cont'd.)

Once we count, we have to document it, write about it. By offering our reflections to an audience, even a small one, we make ourselves part of a larger world. Please put a few thoughts of yours on this newsletter or in an ESA conference, as, a published word is a declaration of membership in that community and also of a willingness to contribute something meaningful to it. So, let us choose our audience, write something [1], as writing lets you step back and think through a problem. By collecting modest contributions from many, we have produced a store of collective know-how with far greater power than any individual could achieve.

Thanks very much. Have a great time.

Yours for the Friendly Society,
Raji Sundararajan,
ESA President

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Calendar

- ISEHD2009. March 25-28, 2009, Universiti Malaysia Sarawak, Sarawak, Malaysia, Contact: ISEHD2009 Secretariat, Tel: 006-082-58-3326, *isehd2009@feng.unimas.my* or *aigit@feng.unimas.my* , website: *http://www.feng.unimas.my/ISEHD2009/* (abstracts due Oct. 31, 2008)
- 11th Int'l. Conf. of Electrostatics. May 27-29, 2009, Valencia, Spain, Contact: Dr. Pedro Segovia, Tel: (+34) 96 136 66 70, *pedro.llovera@ite.es*, website: http://electrostatics.ite.es (abstracts due Feb. 29, 2008)
- ESA-2009, June 16-19, 2009, Boston, MA Contact: Mark Horenstein, Tel: 617-353-5437, *mnh@bu.edu,* website: http://www.electrostatics.org
- ESA-2010, June, 2010, Charlotte, NC Contact: Maciej Noras, Tel: 704-687-3735, *mnoras@uncc.edu,* website: http://www.electrostatics.org

ESA08 Conference Follow-up

ESA08 Presentations - Where are they?

I had hoped to have the ESA08 presentations ready and up on my web site by the Nov/Dec 2008 ESA Newsletter. Unfortunately, other more pressing commitments have taken up my time. Hence, I must apologize and set a new goal to have the presentations ready for announcement in the Jan/Feb 2009 ESA Newsletter.

Al Seaver
Past ESA President

Current Events

Researchers write protein nanoarrays using a fountain pen, electric fields

Small Times
http://www.smalltimes.com/Articles/Article_Display.cfm?Section=ONART&Category=Bio&PUBLICATION_ID=109&ARTICLE_ID=342630&dcmp=STD.Enl

A team of researchers at Northwestern U. has demonstrated the ability to rapidly write nanoscale protein arrays using a tool they call the nanofountain probe (NFP).

"The NFP works much like a fountain pen, only on a much smaller scale, and in this case, the ink is the protein solution," said Horacio Espinosa, head of the research team and professor of mechanical engineering in the McCormick School of Engineering and Applied Science at Northwestern.

The results, which will be published online the week of Oct. 13 in the Proceedings of the National Academy of Sciences (PNAS), include demonstrations of sub-100nm protein dots and sub-200nm line arrays written using the NFP at rates as high as 80µm/second.

Each nanofountain probe chip has a set of ink reservoirs that hold the solution to be patterned. Like a fountain pen, the ink is transported to sharp writing probes through a series of microchannels and deposited on the substrate in liquid form.

"This is important for a number of reasons," said Owen Loh, a graduate student at Northwestern who co-authored the paper with fellow student Andrea Ho. "By maintaining the sensitive proteins in a liquid buffer, their biological function is less likely to be affected. This also means we can write for extended periods over large areas without replenishing the ink."

Earlier demonstrations of the NFP by the Northwestern team included directly writing organic and inorganic materials on a number of different substrates. These included suspensions of gold nanoparticles, thiols, and DNA patterned on metallic- and silicon-based substrates.

In the case of protein deposition, the team found that by applying an electrical field between the nanofountain probe and substrate, they could control the transport of protein to the substrate. Without the use of electric fields, protein deposition was relatively slow and sporadic. However, with proper electrical bias, protein dot and line arrays could be deposited at extremely high rates.

"The use of electric fields allows an additional degree of control," Espinosa said. "We were able to create dot and line arrays with a combination of speed and resolution not possible using other techniques."

Espinosa collaborated closely with Neelesh Patankar, associate professor of mechanical engineering at Northwestern, and Punit Kohli, assistant professor of chemistry and biochemistry at Southern Illinois University, Carbondale.

"We are very excited by these results," said Espinosa. "This technique is very broadly applicable, and we are pursuing it on a number of fronts." These include single-cell biological studies and direct-write fabrication of large-scale arrays of nanoelectrical and nanoelectromechanical devices.

"The fact that we can batch fabricate large arrays of these fountain probes means we can directly write large numbers of features in parallel," added Espinosa. "The demonstration of rapid protein deposition rates further supports our efforts in producing a large-scale nanomanufacturing tool."

Peeling Scotch Tape Powers X-Ray Machine

Barry E. DiGregorio

Peeling a roll of ordinary sticky tape can generate 100 milliwatt pulses of X-rays, enough to capture a human finger on X-ray film, according to a new study by UCLA scientists. They claim to have found the cheapest way to produce X-rays of that scale. "At some point we were a little bit scared," says Juan Escobar, a member of the research team. But he and his co-workers soon realized that the X-rays were only emitted when the kit was used in a vacuum [Nature News].

Their kit consisted of a vacuum-enclosed machine, reminiscent of a video casette player, that peeled a roll of Photo Safe 3M Scotch tape at a rate of 3 cm per second. Rapid pulses of X-rays, each about a billionth of a second long, emerged from very close to where the tape was coming off the roll. That's where electrons jumped from the roll to the sticky underside of the tape that was being pulled away, a journey of about two-thousandths of an inch, Escobar said. When those electrons struck the sticky side they slowed down, and that slowing made them emit X-rays [AP]. This type of energy release is known as triboluminescence — the same principle behind the fun trick of crunching on Wint-O-Green Live Savers to produce blue sparks.

Although the idea of peeling tape to emit X-rays was first suggested by Russian scientists in the 1950s, the new study, which made the cover of Nature [subscription required], comes as a shock to many in the field. "You wouldn't have thought that so much of the mechanical energy would come out as X-rays," says Ken Suslick, an expert in mechanoluminescence…. "The adhesive on the tape is an amorphous liquid, not crystalline. What's causing the transfer of charge, of electrons or protons, what the accepting and donor groups are — these things are much less clear" [Nature News].

The researchers themselves are not exactly clear on the details of the phenomenon, but they say they are confident there is room for improvement; other types of tape may increase the X-ray yield by magnitudes of tens or hundreds. They are already filing a patent for their device, which could be developed into inexpensive hand-operated X-ray machines. Co-author Carlos Camara sums it up: "Just peeling tape is the quickest, cheapest way to provide X-rays… It's X-rays for everyone" [AFP].

http://blogs.discovermagazine.com/80beats/2008/10/22/peeling-scotch-tape-powers-x-ray-machine/

Carbon nanotube speaker makes sound, but no vibrations

R&D Magazine

http://www.rdmag.com/ShowPR~PUBCODE~014~ACCT~1400000101~ISSUE~0811~RELTYPE~MS~PRODCODE~00000000~PRODLETT~D.html

While carbon nanotubes are widely praised for their strength and electrical properties, no one has thoroughly investigated their acoustic properties, until now. A team of Chinese researchers has found that zapping sheets of carbon nanotubes with an electric current causes the nanotubes to emit sound.

The team, which consists of scientists Shoushan Fan and colleagues at Tsinghua Univ. in Beijing, China, and Beijing Normal Univ., hope that the discovery could lead to the development of cheap, flat loudspeakers. To create the nanotube speaker, the researchers sent an audio frequency current through a thin sheet of carbon nanotubes, generating a sound. Unlike standard loudspeakers that generate sound by vibrations in the surrounding air molecules, the nanotube speaker doesn´t emit vibrations. The team used a laser vibrometer to detect vibrations in the sheet, but found nothing. Instead, the nanotube speaker likely works as a thermoacoustic device: when an alternating current passes through the sheet, the sheet experiences rapid temperature oscillations alternating between room temperature and 80°C (176°F). These temperature oscillations cause pressure oscillations in the surrounding air, producing the sound, while the nanotube sheet remains static. One advantage of this method is that, even if part of the nanotube sheet breaks, it should continue to emit sound, unlike conventional speakers.

This thermoacoustic phenomenon was actually discovered in the late nineteenth century, when scientists passed a current through a thin foil to produce sound, leading to the invention of the "thermophone." Although the principle is the same, however, the nanotube sheet acts much more efficiently than foil because it doesn´t require nearly as much applied heat to increase its temperature. Specifically, the nanotube sheet´s heat capacity is 260 times smaller than platinum foil, making nanotubes 260 times more efficient and able to produce a louder sound.

The Chinese researchers envision several interesting applications for the nanotube speakers. Because the nanotube sheets can be stretched to be visually transparent and still produce sound, they might be fitted over the front of an LCD screen to replace conventional speakers. Another possibility is incorporating the nanotube speakers into textiles to create musical clothes.

A video with sound created by the nanotube is available here, http://ie.youtube.com/watch?v=8aoflVUvwlQ . A Quicktime version of the file, http://pubs.acs.org/subscribe/journals/nalefd/suppinfo/nl802750z/nl802750z-File004.qt . The abstract to the study, "Flexible, Stretchable, Transparent Carbon Nanotube Thin Film Loudspeakers," Nano Letters, http://pubs.acs.org/cgi-bin/abstract.cgi/nalefd/asap/abs/nl802750z.html

Build charge with a bend or two

R&D Magazine

http://www.rdmag.com/ShowPR.aspx?PUBCODE=014&ACCT=1400000101&ISSUE=0811&RELTYPE=MS&PRODCODE=00000000&PRODLETT=HI&CommonCount=0

Researchers have developed a new type of small-scale electric power generator able to produce alternating current through the cyclical stretching and releasing of zinc oxide wires encapsulated in a flexible plastic substrate with two ends bonded. The new "flexible charge pump" generator is the fourth generation of devices designed to produce electrical current by using the piezoelectric properties of zinc oxide structures to harvest mechanical energy from the environment. The new generator can produce an oscillating output voltage of up to 45 millivolts, converting nearly seven percent of the mechanical energy applied directly to the zinc oxide wires into electricity. To boost the current produced, arrays of the flexible charge pumps could be constructed and connected in series. Multiple layers of the generators could also be built up, forming modules that could then be embedded into clothing, flags, building decorations, shoes—or even implanted in the body to power blood pressure or other sensors.

When the modules are mechanically stretched and then released, because of the piezoelectric properties, the zinc oxide material generates a piezoelectric potential that alternately builds up and then is released. A Schottky barrier controls the alternating flow of electrons, and the piezoelectric potential is the driving force of the charge pump. Constructed with zinc oxide piezoelectric fine wires with diameters of three to five microns and lengths of 200 to 300 microns, the new generator no longer depends on nanometer-scale structures. The larger size was chosen for easier fabrication, but Wang said the principles could be scaled down to the nanometer scale.

The wires are grown using a physical vapor deposition method at approximately 600°C. Using an optical microscope, the wires are then bonded onto a polyimide film and silver paste applied at both ends to serve as electrodes. The wires and electrodes were then encased in polyimide to protect them from wear and environmental degradation.

To measure the electric energy generated, the researchers subjected the substrate and attached zinc oxide wires to periodic mechanical bending created by a motor-driven mechanical arm. The bending induced tensile strain which created a piezoelectric potential field along the laterally-packaged wires. That, in turn, drove a flow of electrons into an external circuit, creating the alternating charge and discharge cycle—and corresponding current flow.

Zhong Lin Wang's Lab at the Center for Nanostructure Characterization, http://www.nanoscience.gatech.edu/zlwang/wang.html . The abstract to the study "Power generation with laterally packaged piezoelectric fine wires" is available here, http://www.nature.com/nnano/journal/vaop/ncurrent/abs/nnano.2008.314.html

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