July/August 2006 • No. 180

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

Being active in the Electrostatics Society of America increases your professional skills. Progress towards mastery is the reward for completing an anonymous review, working "behind the scenes" as a conference organizer, or in serving as a society officer. In an excellent article, Ross [1] presents strong evidence that study and training rather than native ability or intelligence are the keys to mastering physics, mathematics, music, chess, golf, or any given field. Ross argues that "effortful study" or "tackling challenges just beyond one's competence" must be sustained for a long time, something like 10 years, to master a field. When effort is not sustained, performance plateaus. Example of performance plateaus are learning to drive a car just well enough to pass a drivers license test or learning to play golf just well enough to play competitively with one's friends. When we become complacent "effortful study" stops and progress ceases.

How can we avoid complacency and strive to master our field? For educators, this is an important question. How can we lead students down a path so that they achieve a level of competence by graduation and are able to strive independently towards mastery in their chosen field? In business, leaders encourage employees to commit to "continuous improvement." When business is poor, it is a "no-brainer" that things must change. However, when things are going well, striving for mastery is all the more valuable. When a product sells well, a production process work efficiently, or a business strategy is successful, we must strive to make it even better. Measuring performance, recognizing weaknesses or waste, and driving improvement are now fundamental "business" strategies.

In fields of knowledge like physics, mathematics and electrostatics, your progress and mine are synergistic. If we collaborate, we will achieve more when either of us gains skill. This is different from competitive fields such as sports or chess where progress by one threatens another with defeat. Coaches and trainers jealously guard training methods and advances that give their team a competitive edge. In contrast, knowledge professionals freely share advances as part of the scientific process. Within the Electrostatics Society of America, helping each other strive for mastery is fundamental.

Professional activity is a great opportunity for "effortful study." When you review manuscript that has been submitted for publication, you must "tackle challenges just beyond your competence" to provide positive and specific information to the author about how to make the most of this publication opportunity. Serving as a society officer is an "out of the comfort zone" experience that stretches communication and leadership skills. Helping to organize and run a technical conference develops organizational ability and teamwork. In each case, while we all benefit, the personal "effortful study" is uniquely valuable.

Give some thought to your career and your pursuit of mastery in your chosen field. Consider how you would benefit from greater professional involvement as a reviewer, a society officer, conference organizer, or committee chair. Please feel free to contact me if you would like to learn more about how you can become more involved and gain more from the Electrostatics Society of America.

Kelly Robinson,
ESA President

[1] Ross, Philip E., "The Exert Mind," Scientific American, Vol. 295, No. 2, August 2006, pg. 64-71.

Scientists reveal how a novel ceramic achieves directional conduction

Working with researchers from the Swiss Federal Institute of Technology (ETH), Zurich, the University of Tokyo and Lucent Technologies, USA, they reveal in a Letter to Nature that the complex material, which is an oxide of manganese, functions as a self-assembled or 'natural' layered integrated circuit. By conducting electricity only in certain directions, it opens up the possibility of constructing thin metal layers, or racetracks, insulated from other layers only a few atoms away.

Currently, the race for increasingly small and more powerful devices has relied on two-dimensional integrated circuits, where functional elements such as transistors are engineered via planar patterning of the electrical properties of a semiconductor. Packing more functionalities into tiny electronic devices has until now been achieved by reducing the lateral size of each component, but a new realm of opportunity opens with the ability of building three-dimensional structures.

Using one of the classic tools of nanotechnology, the scanning tunnelling microscope, Dr Henrik Rønnow (ETH) and Dr Christoph Renner (LCN and UCL) swept a tiny metallic tip with sub-atomic accuracy over the surface of the ceramic to sense its topographic and electronic properties at spatial resolution of less than the diameter of a single atom. The data showed that this ceramic behaves like a perfect metal along the planes parallel to the surface and like an insulator along the direction perpendicular to the surface.

The results also revealed the first snap-shot of a possible culprit for this unusual electronic behaviour. In conventional solids, charge is carried by simple electrons, but in such ceramics, it is shuttled around by more complex objects, known as polarons, which consist of electrons bound to a magnetic disturbance as well as local displacements of atoms away from their ordinary positions.

(Excerpted from http://www.physorg.com/news64673463.html)

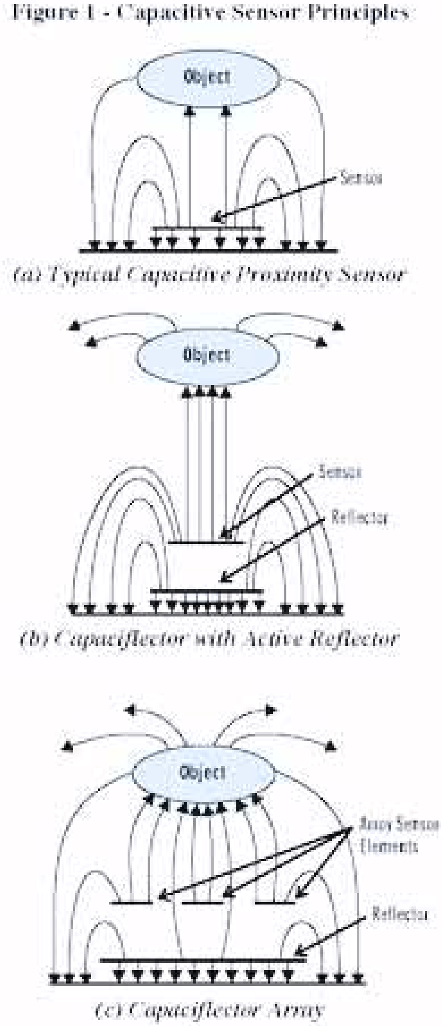
Capaciflectors - Advanced Capacitive Sensing

As illustrated in Figure 1, the Capaciflector is a capacitive sensing element backed by an active reflector element that acts as a shield to reflect field lines. The capacitive coupling between the senor and the object is used to control an oscillator. As an object moves closer, the capacitance increases and the oscillator frequency decreases, which allows varying detection ranges for objects. The active shield reflector is electrically isolated from the sensor and follows the oscillator, keeping it in phase with the electric field of the sensor without affecting the oscillator frequency. The reflector therefore reflects the electric field of the sensor without being affected by the coupling between the sensor and the approaching object.

The Capaciflector can be used as a single unit (see Figure 1b), or as a closely packed array (see Figure 1c). Even though the sensors are separated only by a few thousandths of an inch in the array, there is virtually zero cross-talk. In the array configuration, each sensor performs independently as a Capaciflector, operating off a common driven shield and locked to a single oscillator in frequency, amplitude, and phase. Flexible printed circuit boards have been constructed of Capaciflector arrays that can image in 3-D and act as a "Capaciflector camera." The Capaciflector array concept has also been extended to embedding the sensors into structures so that they become load-bearing parts of the structure. Applications for this aspect include self-diagnostic systems and end-effectors for robots.

(Excerpted from http://techtransfer.gsfc.nasa.gov/ft-tech-capaciflector-guided-mechs.html)

Figure 1 - Capacitive Sensor Principles



Current Events (cont'd.)

Rice develops novel method to sort nanotubes by diameter

Rice University scientists have developed a novel method for sorting semiconducting carbon nanotubes based on their diameter, a long-awaited development that could form the basis of a nanotube purification system capable of producing the necessary feedstocks for nano-circuits, therapeutic agents, next-generation power cables and more.

To sort nanotubes, the CNL team built a system that capitalizes on the fact that each type of nanotube has a unique dielectric constant - a term that refers to a material's ability to store electrostatic energy. CNL scientists created an electrified chamber and pumped a solution of dissolved nanotubes through it. The chamber traps metallic nanotubes and causes semiconducting varieties to float at different levels in the chamber. The smaller the diameter of the nanotube, the larger the dielectric constant and the lower in the system the tubes float. By varying the speed of flow through the system - with upper-level currents traveling faster than lower-level currents - the scientists were able to collect samples that had three times more small tubes than large and vice versa.

(Excerpted from *http://media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=8617&SnID=437190581*)

Zap

Extreme voltage could be a surprisingly delicate tool in the fight against cancer

Karl H. Schoenbach, Richard Nuccitelli, and Stephen J. Beebe

40 Thousand volts, four thousand amperes, and over one hundred million watts squeezed into a cubic centimeter. You'd think that would be enough to vaporize just about anything, and it certainly doesn't seem like the kind of electricity you'd want to apply to your body. But if our research continues to succeed as it has, years from now we'll be asking some cancer patients to do just that. And it might just save their lives.

The trick is to apply that gargantuan jolt for only a few billionths of a second. That's so brief a time that the energy delivered is a mere 1.6 joules per cubic centimeter—barely enough to warm a thimbleful of water by a third of a degree Celsius. But these powerful, ultrashort voltage pulses do something nothing else can—harmlessly slip past a cell's exterior to shock the vital structures within.

The effects of such pulses of power on living tissue are profound and varied. Malignant tumors—in mice, at least—can be completely wiped out, even by significantly lower power levels; new genes can be efficiently inserted into living cells in the hope of correcting genetic defects; and

ESA OFFICERS

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

CALENDAR

- SFE 2006, Aug. 30-31, 2006, Grenoble, France, Contact: Prof. Pierre Atten, Tel: 33 476 88 11 71 (or 73), *pierre.atten@grenoble.cnrs.fr*
- 28th Annual Int'l. EOS/ESD Symposium & Exhibits, Sep. 10-15, 2006, Tucson, Arizona, website: *http://www.esda.org/symposia.html*
- IEEE Conf. on Elec. Insul. & Diel. Phen., CEIDP, Oct. 15-18, 2006, Kansas City, Missouri, website: *http://www.ewh.ieee.org/soc/dei/ceidp/*
- 2006 ISEHD, 2006 Int'l. Symp. on Electrohydrodynamics, Dec. 4-6, 2006, Buenos Aires, Argentina, website: *http://www.fi.uba.ar/isehd2006/2006*
- Electrostatics 2007, 12th Int'l. Conf. on Electrostatics, 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* (abstracts due by Sept. 15, 2006) website: *http://conferences.iop.org/ELE/*
- ESA 2007, June, 2007, Purdue University, West Lafayette, Indiana (more info. forthcoming)

Current Events (cont'd.)

immune-system cells can be marshaled to fight off invading microbes.

A new field of research, bioelectrics, is emerging to study these effects, as well as the naturally occurring electric fields in biological systems. Bioelectrics relies on a curious pairing of disciplines that until now have had almost nothing to do with each other: high-voltage engineering and cell biology. In particular, the new field depends on advanced pulsed power technology. That's the ability to switch on and off thousands of amperes of current and just as many volts in mere nanoseconds (the kind of parameters needed to detonate nuclear bombs, it so happens).

(Excerpted from *http://www.spectrum.ieee.org/aug06/4257*)

Electrostatics
Society of America

30 Shalimar Drive
Rochester, NY 14618

ESA Information

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

Kelly Robinson
President
Eastman Kodak
66 Eastman Avenue
Rochester, NY 14650-1718
585-477-4951
Kelly.Robinson@SigmaXi.net

Steve Cooper
Secretary/Treasurer
540 Morton Rd.
Athens, GA 30605
706-255-5518
steve@steve-cooper.com

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

2007 ESA Annual Meeting
June 2007
Purdue University
West Lafayette, Indiana
(details forthcoming)