

CPS Plasma Page

Published by the Coalition for Plasma Science, Vol.10., No.1 March 2007

Hopwood Details Plasma's Role in Computer Chip Manufacturing

On January 30, 2007, Prof. Jeffrey Hopwood of Tufts University presented a talk on Capitol Hill entitled, "How Plasma is Changing the World: The Micro-electronic Revolution." This marked the tenth in a series of Capitol Hill educational luncheons sponsored by CPS, designed to introduce congressional representatives and their staffs to the marvels, challenges and benefits of plasmas.

CPS Vice Chair Gerald Rogoff introduced the packed room of over eighty attendees to the Coalition and its goals. Observing that a plasma TV is now often simply called "a plasma," he noted that this would be like going to the grocery store to buy bread and milk, and asking for a "solid" and a "liquid." Solids and liquids come in many different types, sizes and shapes, and so do plasmas.

Hopwood immediately addressed the economic impact of plasma processes used in microchip manufacturing, a \$227 billion industry, revealing that half of the processes used to create a chip involve plasma. He proceeded to detail those processes.

He explained that "computer chips are made like a layered cake, but with the

unwanted parts of each layer removed." To create a chip's complex three-dimensional structure requires that multiple layers be added, then parts of them etched away. Both adding layers and etching them away require plasma. Hopwood's clear graphics detailed each step in creating a chip, each layer laid down, patterned, etched or removed using plasma.

Hopwood examined the benefits of plasma etching over wet chemical processes used in the past. For example, when etching with acid, all the chemical reactions occur on every surface at the same rate. This makes it impossible to etch very small circuit patterns. However, the directional ion energy of plasma provides much greater control of the etching, allowing the creation of much finer features. Plasma-etched microstructures can be 500 times smaller than the diameter of a human hair. These finer structures make it possible for circuits to become more



Luncheon speaker Prof. Jeffrey Hopwood (left) addresses a question from Representative Dana Rohrabacher of California (foreground). CPS Vice Chair Gerald Rogoff (right) introduced the session. Photo by Paul Rivenberg

complex and faster.

Prof. Hopwood recently finished a two-page essay on "Computer Chips and Plasma" for the CPS *About Plasma* series. This essay provides a careful explanation of plasma's roles in the chip manufacturing process. It is available on the CPS publications page: <http://www.plasmacoalition.org/publications.htm>.

Plasma Lamps Distributed to Teachers at APS-DPP Meeting



What single piece of equipment would best help a teacher

Former US Secretary of Energy Spencer Abraham (left) helps demonstrate a half-coated plasma tube with CPS Steering Committee member John DeLooper at the Princeton Plasma Physics Laboratory. The tube suddenly glows when placed near the black box, under which is hidden a plasma globe. The apparent "magic" is uncovered with an explanation of the physical properties of plasma. Photo by Elle Starkman

explain plasma to a classroom?

This is the question CPS members discussed in advance of the October 2006 American Physical Society - Division of Plasma Physics (APS-DPP) Meeting in Philadelphia.

The Coalition has continued to be actively involved with education events scheduled during this annual meeting, typically supplying posters, brochures and spectrographic eyewear for students and teachers. But this year the Coalition wanted to have a greater impact, particularly to assist the teachers attending Teachers Day.

continued on next page

Continued from page 1

On this day teachers first receive training in plasma physics and related sciences from scientists and staff who work at national laboratories and institutions, then receive a bag full of educational tools for their classrooms.

CPS felt that teachers would prize a half-coated plasma tube. Steering Committee member John DeLooper, from the Princeton Plasma Physics Laboratory, uses such a tube to explain plasma to the teachers who attend his "Plasma 101" session on Teachers Day. The familiarity of the fluorescent lamp helps make this demonstration easier to teach and to understand. Students and teachers are fascinated to see the thin, purplish plasma exposed from behind the fluorescent coating that actually makes the lamp bright enough to light a room.

The tubes were made specifically for CPS by OSRAM Sylvania, using a

process that required some hand crafting. Over 80 tubes were distributed to the teachers attending Teachers Day. The remaining tubes will be distributed to teachers upon request, or used for other educational outreach events.

Besides overseeing distribution of the plasma tubes, CPS members contributed in other ways to the APS-DPP outreach events. Many members staffed a special education table, positioned in the middle of the poster sessions, to inspire other researchers to get involved in outreach. CPS Chair, Lee Berry, also gave a talk



Darlene Markevich (left) of DOE and CPS Chair Lee Berry help staff an education table at the 2006 APS-DPP meeting, hoping to attract researchers at the poster session to become involved with educational activities. Photo by Paul Rivenberg

about CPS involvement with the 2006 Intel Science and Engineering Fair, which was reported in the May 2006 Plasma Page.

"Stormy Night" Outlines CPS Goals and Activities for IEEE

"It was a dark and stormy night."

So begins an article in an IEEE newsletter, for those of you wanting a summary overview of CPS. The article outlines CPS's goals, activities, publications, and how it works with technical conferences – such as the APS-DPP annual meeting and the IEEE's International Conference on Plasma Science (ICOPS).

CPS has a tradition of working with the APS-DPP meeting (see article above).

The Coalition has also arranged special events at the IEEE ICOPS conference, both within the technical program and as social events to inform attendees about the Coalition.

After the "dark and stormy night" opener, the IEEE article moves to an imaginary conversation between a congressman and one of his young staffers during a thunder storm in Washington DC. Referencing the storm's lightning, which is a plasma, the staffer tells the

congressman about plasma: what it is, its importance to industry and the economy, and how CPS is helping to educate non-technical people about the fourth state of matter through its website and two-page write-ups. The staffer attributes his extensive knowledge to his attending CPS Capitol Hill luncheon presentations.

This conversation leads to a discussion of CPS, including an explanation of its audience, its current activities and events, and past events, including those organized at various technical conferences.

The IEEE article appeared in the September 2006 IEEE Nuclear and Plasma Sciences Society (NPSS) newsletter, and was written by Gerald Rogoff, CPS Vice-Chair and the IEEE NPSS Liaison Representative to the Coalition. The IEEE Nuclear and Plasma Sciences Society was one of the early members of CPS. It has been and continues to be one of its strongly supportive members.

A copy of the article can be obtained via <http://ewh.ieee.org/soc/nps/newsletter.htm>, either in HTML format (under Liaison Report) or as a PDF (where the article appears on page 20).



The imaginary staffer in Rogoff's essay got his information from educational luncheons like the one pictured, where Prof. Vladimir Rakov discussed lightning. Photo by Paul Rivenberg