CPS Plasma Page

Published by the Coalition for Plasma Science, Vol.13., No.1, July 2010

Laroussi Explores Plasma's Importance to Modern Medicine

On November 10, 2009, the Coalition for Plasma Science sponsored a presentation to a roomful of Congressional staff on Capitol Hill, describing a new avenue of research that may benefit the healthcare industry: plasma medicine.

CPS Chair Lee Berry introduced speaker Prof. Mounir Laroussi, Director of the Laser and Plasma Institute at Old Dominion University. Laroussi has been involved in CPS's "About Plasmas" series, authoring a two-page overview of how plasmas are being used to protect against biological hazards. This talk was titled, "Gas Plasma – A New Technology for Modern Medicine."

After reviewing states of matter and discussing where the audience may have observed plasmas, both man-made and naturally occurring, Laroussi described the difference between thermal plasmas, such as those used for welding, and low-temperature ("cold") plasmas, which do not destroy the materials they contact.

Laroussi discussed the effects of low-temperature plasma on prokaryotic cells (bacteria), noting aspects of plasmas that make them effective at changing or destroying cells: heat, UV radiation, charged particles and reactive species. He explained that plasmas can be used to destroy bacteria and proteins found on medical instruments without exposing the tools to the possibly destructive high temperatures of an autoclave or to the toxicity of ethylene oxide.

Prof. Mounir Laroussi explains how the properties of cold plasmas make them practical for several medical applications. Photo/Paul Rivenberg

There has been less research with regard to the effect of cold plasmas on eukaryotic (or mammalian) cells – until recently. Preliminary investigations indicate that short exposures of cold plasma to mammalian cells can lead to cell detachment without killing the cells, or "apoptosis," (programmed cell death). These studies suggest that cold plasmas could play a role in killing cancer cells, healing wounds and coagulating blood. Laroussi also noted that there are dental applications to anticipate: cold plasmas could be used to treat periodontal diseases and tooth decay.

Laroussi's talk generated a lot of interest and questions. He is working with CPS on a future publication about the medical applications of plasmas.

INTEL 2010: Turkish Student Examines Effect of Plasma on Biological Systems

San Jose - In May 2010, over 1600 precollege students travelled to San Jose, CA, to compete in the Intel International Science and Engineering Fair. The Coalition for Plasma Science was there, and ready to award its sixth "Excellence in Plasma Science Award," a $1500 prize. Although there were over ten plasma-related projects, CPS judges, Lee Berry and Steve Allen, were most impressed with the work of Ms. Bilge Zeren Aksu, from Ankara Science High School in Ankara, Turkey. Aksu explored the effects of plasma on cells and enzymes in a project entitled "Effects of Oxygen Plasma on Biological Systems."

For her project Aksu first wanted to study the effect of plasma on cells. She applied oxygen plasma to bacteria, yeasts and molds under various conditions, and discovered that she was able to reduce the number of cells by over 99%.

Having determined the effectiveness of plasma at the cellular level, she was determined to see how plasma performed at the molecular level, focusing on the enzyme catalase, a common enzyme that typically helps decompose hydrogen peroxide into water and oxygen. She discovered that proper application of plasmas decreased enzymatic activity significantly.

Her results led her to theorize that plasmas could be used to attack cancer cells. She states in her abstract, "We theorized that if catalase activity can be decreased by plasma action, peroxide would accumulate in the cytoplasm and this would damage the cells with high oxidative species content, namely the cancer cells. Thus, our results imply that oxygen plasma might be used as a tool for therapy for cancer tissues, especially superficial tissues such as skin."

CPS judges Lee Berry and Steve Allen were impressed with Aksu's scientific process. Berry noted, "Her intensity and enthusiasm for her project was impressive. She was as much interested in future

Continued from page 1

plans as in what she had accomplished. This project reflects the growing interest in the medical use of plasma that we saw in Prof. Laroussi's CPS seminar last fall in Washington, DC." (See lead article, page 1)

Besides receiving CPS's award, Aksu also received a special award from the European Organization of Nuclear Research - CERN, which will provide her with an all expense paid trip to CERN.

Berry reported that the number of plasma-related projects - over ten - continued at a high level, and covered a wide range of topics. Six of these were singled out for other awards at the event.:

H-alpha [O III] Photometry of Galactic Plane Candidate Planetary Nebulae: Stephen J. Morrison, Laree Gardner, Genevieve Wang; Grosse Pointe North High School, Grosse Point, MI. Intel Team Projects Second Award ($1500).

Research of Atmospheric Influence on Propagation of Electromagnetic Waves: Lilia Nikolaevna Khrapunova, Antonina Toropkins, Anastasia Shaykina; School #2 of Dzerzhinsk, Dzerzhinsk, Russia. Intel Team Projects Fourth Award ($500), Society of Exploration Geophysicists (Honorable Mention).

Nanoparticle Optimization of Specific Impulse of a Novel Ionic Engine: A Link to nonFET NEMS/MEMS Thrusters: Alexis Emily Block, Nicolet High School, Glendale, WI. Society of Experimental Test Pilots (Honorable Mention).

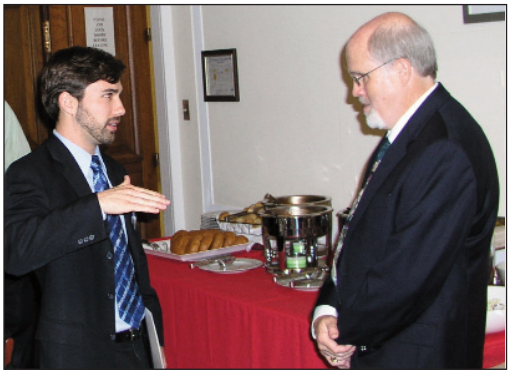
Novel Method: Detecting High Energies in Sonoluminescence: Lyric Elizabeth Gillett, Cornerstone High Homeschool, Houston, TX. Intel Energy and Transportation Fourth Award ($500); Google Future of Energy Award ($1000); Drexel University Tuition Scholarship (worth $150,000).

A Simulation using C++ to Evaluate the Performance of the Columbia University Non-Neutral Torus Stellarator Based on a Pedersen Model for Optimization: Soo Kyoung Kim, Bronx High School of Science, Bronx, NY. Intel Energy and Transportation Third Award ($100).

CPS Chair and Science Fair Judge Lee Berry presents Bilge Zeren Aksu with the CPS Excellence in Plasma Physics Award at the Intel International Science and Engineering Fair. Photo courtesy of Intel.

Next Generation Propulsion: the ALFA markVI: Jesse Kane Ellison, Bayfield High School, Bayfield, CO. Intel Engineering and Electrical Second Award ($1500), Society of Experimental Test Pilots Second Award ($500), European Organization for Nuclear Research-CERN Award (All expense paid trip to CERN).

Dusenbery Provides Space Weather Forecast to Capitol Hill



Dr. Paul Dusenbery (right) speaks with a Congressional staffer after the Capitol Hill talk. Photo/Paul Rivenberg

Dr. Paul Dusenbery, Executive Director of Space Science Institute in Boulder, CO, spent an hour on June 23 guiding Congressional staffers through the plasma and magnetic fields that make up much of space weather. In a talk entitled, "Sunny with a Chance of Blackouts - How Space Weather Affects You," Dusenbery focussed on how processes on the sun lead to phenomena on earth, some beautiful and mesmerizing, like the auroras, others annoying or disruptive, like the interruption of satellite signals.

After introducing plasma, the fourth state of matter, Dusenbery focussed on the sun, dissecting it into its core, radiation zone, convection zone, photosphere and sun spots. He explained how scientists study the sun, "fingerprinting" it by examining its wavelengths of light. He described the highly energetic activity in the upper atmosphere of the sun that leads to solar flares, noting that the energy emitted during a single solar flare event (about two hours) would be enough to power the US for 10,000 years.

Such interesting facts and statistics powered Dusenbery's presentation and kept the staffers engaged, learning about the solar cycle, the recent very low solar minimum, the upcoming solar maximum, and the little ice age between the years 1650 - 1720, which caused the canals in Holland to freeze over. His discussion of Explorer One's "first major discovery of the Space Age"– the radiation belts that protect earth and many other planets from the solar wind – was accompanied by one of many compelling animations scattered throughout the presentation.

The talk concluded with a discussion of the problems space plasmas such as the solar wind can cause, from blackouts, to metal pipeline corrosion and satellite signal disruption. Pilots and astronauts also need to be aware of significant solar activity in order to avoid possible exposure to radiation. He left his audience with the current space weather conditions, mentioning two sunspots, an indication that the next solar maximum, due in 2013 - 14, is right on schedule.