



# SCCAVS Newsletter

Sept 2011

The Science & Technology of Materials, Interfaces, & Processing

## Special points of interest:

- "Fuels From Sunlight" Speaker Dinner Event Announced for September 26, 2011. REGISTER EARLY-WILL SELL OUT
- Elmer Carvey Scholarship winner announced
- Report on Dr. Brucker's June talk on Advances in Vacuum Quality Measurement
- Applications now accepted for SEW held in Nashville, TN at AVS

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## "Fuels From Sunlight" Talk by JCAP's Dr. Nathan Lewis

Jim Garner

The SCCAVS is pleased to announce a special event scheduled for Monday, September 26, 2011. Dr. Nathan Lewis of the California Institute of Technology will present his talk, "Fuels from Sunlight: A Technical and Operational Perspective on the Joint Center for Artificial Photosynthesis (JCAP), a DOE Energy Innovation Hub". The event will be held at Il Fornaio Restaurant's Sorrento Room at 24 West Union Street in Pasadena at 6:30pm. The cost is \$40 per person (\$25 for students) and includes the dinner and presentation. Advance payment is required and early registration suggested, as space is limited and we expect a high level of interest in the topic.



**President Obama announced this project in his 2011 State of the Union Address**

New science for converting sunlight directly into fuel (instead of electricity) has

the potential to revolutionize our way of life. The potential for artificial photosynthesis is so great that, in his 2011 State of the Union Address, President Obama announced a \$122 million DOE project to pursue this technology. Dr. Nathan Lewis (Caltech) is the project's Director and one of its Principal Investigators. He will discuss the science, technology, and project objectives.

Enormous advances have been made in our understanding of the subtle and complex photochemistry behind the natural photosynthetic system and in the use of inorganic photo-catalytic methods to split water or reduce carbon dioxide. The project focus is on developing an artificial photosynthetic system that will utilize sunlight and water as inputs and produce hydrogen and oxygen as outputs. Special challenges for creating anode, cathode, and membrane surfaces with the necessary materials and structures will be discussed. This work is an excellent example of how AVS disciplines in thin films, nano-structures, and surface interfaces remain on the cutting edge of modern technology.

Dr. Nathan Lewis, George L. Argyros Professor and Professor of Chemistry, has



**Dr. Nathan Lewis is Director & Principle Investigator for JCAP**

been on the faculty at the California Institute of Technology since 1988 and has served as Professor since 1991. He is the Director and one of the Principal Investigators of the Joint Center for Artificial Photosynthesis (JCAP), the DOE's \$122M Energy Innovation Hub in Fuels from Sunlight. Dr. Lewis has also served as the Principal Investigator of the Beckman Institute Molecular Materials Resource Center at Caltech since 1992. Dr. Lewis has published over 300 papers and is currently the Editor-in-Chief of Energy & Environmental Science. He has supervised approximately 60 graduate students and post-doctoral associates.

Please contact:  
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### Science Educator's Workshop (SEW) Applications Now Being Accepted

AVS has conducted a two-day in-service workshop on low pressure experiments and modeling for middle and high school teachers since 1990. The workshop is accredited for CEU's and is aligned with national science and mathematics standards. The Southern California Chapter once again wishes to sponsor one local teacher to attend this year's workshop to be held in Nashville, TN from October 31 to November 1, 2011. For more information visit: <http://www.avs.org/education.workshop.aspx>

To apply please download application at [www.sccavs.org](http://www.sccavs.org) or email [corinne@sccavs.org](mailto:corinne@sccavs.org)

**SOUTHERN CALIFORNIA  
CHAPTER OF THE AVS :  
THE SCIENCE &  
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**We're on the web!**  
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**Upcoming Events**

AVS 58th International  
Symposium &  
Exhibition

Nashville, Tennessee

Oct. 30—Nov. 4, 2011

[WWW.AVS.ORG](http://WWW.AVS.ORG)



**Local Chapter Activities**

**“Advances in Vacuum Quality Measurement”**

Synopsis of talk given by Dr. Gerardo Brucker, June 14, 2011  
Corinne D'Ambrosio

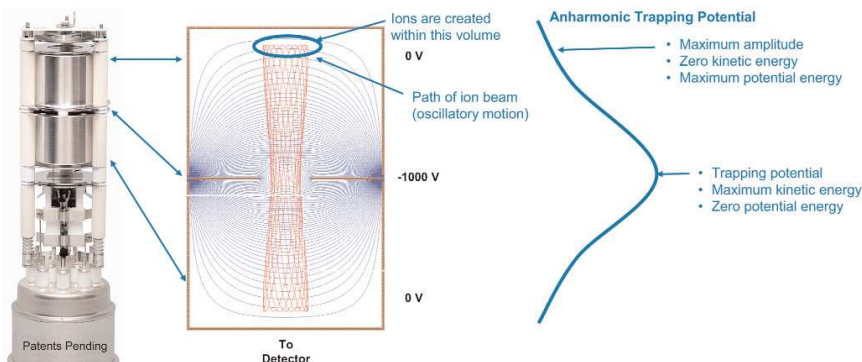
On June 14, 2011 the SCCAVS sponsored a dinner with guest speaker, Dr. Gerardo Brucker, Chief Scientist of the Granville-Phillips Instrumentation Division at Brooks Automation. His speech titled, “Advances in Vacuum Quality Measurement” was well attended by local vacuum community members whose interests ranged from optical coating to thin film photovoltaics to tribology.

Dr. Brucker emphasized that mass spectrometry is important in vacuum quality measurement, rather than relying on total pressure measurement alone. The talk focused on improvements made in electrostatic ion traps and autoresonant mass detection. These improvements have enabled the development of the autoresonant ion trap mass spectrometer (ITMS), which in many cases offers smaller size, lower power, and faster response times with increased accuracy and resolution at low mass ranges compared to typical quadrupole filtering (QMS). Dr. Brucker believes that ITMS could replace QMS as the industry workhorse for residual gas analysis, leak detection, and contamination monitoring.

The ITMS design uses anharmonic resonant electrostatic trapping potentials (see Figure):

**Electrostatic Ion Trap**

Electrostatic Ion Trap: Ions confined by purely electrostatic fields oscillate at a resonant frequency proportional to  $\sqrt{m/z}$



Mass selective ejection is achieved through a novel autoresonant pumping process.

The ITMS design is a simple electrostatic mirror structure of cylindrical symmetry with a center plate biased at a negative 1000 Vdc and located between two opposite grounded cup structures creating an electrostatic field. Ions stored inside the trap oscillate at a resonant frequency that is inversely proportional to the square root of their m/z (mass to charge ratio). The ions are accelerated by the electrostatic field toward the center plate aperture, and can now be used for mass spectrometry since their energy is 100% kinetic energy (KE). A novel methodology was developed to selectively increase the ion energy using low power RF signals until their oscillation amplitude exceeds the length of the trap where the ions can be detected.

The ITMS design has many benefits, including:

- \*Speed—20x (or more) faster than a QMS
- \*Low power—a purely electrostatic device
- \*Smaller size—reduced surface area for less outgassing
- \*Excellent performance at low masses—No zero blast
- \*Single point mass calibration

*Continued on Page 5...*



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### **Elmer Carvey Scholarship Winner**

Jeff Lince

The winner of the 2011 Elmer Carvey Scholarship is Vinh Diep, an undergraduate student at University of California, San Diego, majoring in Nanoengineering. He is performing undergraduate research with Professor Michael Sailor.



**2011 Elmer Carvey Scholarship Recipient Vinh Diep**



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Mr. Diep proposed the use of porous silicon-based optical films in drug delivery systems. For example, these nanomaterials might deliver drugs such as insulin in a more controlled fashion, resulting in better efficacy and reduced side effects. He is using a number of chemical and nanostructural techniques to follow the loading and release of insulin and other molecules from chemically modified porous silicon. His results have been submitted for publication. In addition to his productive research at UCSD, in a highly competitive process, Mr. Diep obtained a summer internship at the National Nanotechnology Infrastructure Network at UC Santa Barbara.

The Elmer Carvey Memorial Scholarship was established in honor of Elmer Carvey, an active member of the SCCAVS from 1964 until 1982. The Scholarship is awarded to undergraduate students attending public, four-year colleges in California who are planning careers in areas of interest to the society, which include vacuum science and vacuum-related technologies that include surface and thin film science, nanotechnology, the understanding of materials properties, and the development of new materials. The stipend is \$1,500.00 for one year.



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### **CHAPTER ANNOUNCEMENTS**

- AVS Short Courses offered by request through your local Chapter, taught by AVS National instructors. Please contact corinne@sccavs.org for details.

- Your local Chapter is seeking corporate sponsors for our area events like speaker dinners, field trips, and student sponsorships. Please contact jeff@sccavs.org to inquire about opportunities.

The following table was provided to allow easy comparison of the low mass range systems based upon ITMS transducers with QMS transducers:

Feature	Ion Trap MS	Quadrupole MS
Mass Range (AMU, low mass range devices)	300	300
Minimum Detectable Partial Pressure (Torr)	$10^{-12}$	$10^{-13}$
Spectral Resolution (M/ΔM50%)	100 to 300	100 to 300
Scan Speed (1-100 AMU scan range)	<0.1sec	1-2 sec
Maximum Operating Pressure (Torr)	$10^{-3}$ to $10^{-4}$	$10^{-3}$ to $10^{-4}$
Surface Area (1-300 AMU capable)	Smaller	Larger
Low Mass Range Limit (zero blast)	No	Yes
Calibration	Single Point/self	Multipoint
Remote Mounting (via cable)	Yes	No

The SCCAVS would like to thank Dr. Gerardo Brucker for sharing his expertise in this essential evolving field.



**From Left to Right:** John Freeman (Mbar Technology), Corinne D'Ambrosio (SCCAVS Treasurer, Mbar Technology), Fred VanDerLinde (DF Technology), Bob Willis (Brooks), Jim Garner (SCCAVS Secretary, MacroVantage), Dr. Gerardo Brucker (Brooks), Jeff Lince (SCCAVS Chair, Aerospace Corporation), Richard Stamberg (Coursen Coating), Greg Mills (AXR Technology)

## September 2011

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16 <i>Reg. Deadline</i>	17
18	19	20	21	22	23	24
25	26 <i>JCAP Talk</i>	27	28	29	30	