



Society for Analytical Chemists OF PITTSBURGH



SEPTEMBER MEETING

Monday, September 8, 2008
8:00 p.m.

Duquesne University
Laura Falk Hall

Dinner: City View Café (6th Floor)



AKOS VERTES, PH.D.

PROFESSOR OF CHEMISTRY, PROFESSOR OF BIOCHEMISTRY
& MOLECULAR BIOLOGY FOUNDER AND CO-DIRECTOR

W.M. KECK INSTITUTE FOR PROTEOMICS TECHNOLOGY AND APPLICATIONS
DEPARTMENT OF CHEMISTRY
GEORGE WASHINGTON UNIVERSITY

**"Atmospheric Pressure Live Tissue Imaging and Single Cell Analysis
by LAESI Mass Spectrometry"**



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| 5:30 PM | Social Hour | Student Union – City View Café (6 th Floor) |
| 6:30 PM | Dinner | Student Union – City View Café (6 th Floor) |
| 7:30 PM | Student Affiliate Meeting | Mellon Hall – Room 410 |
| 7:40 PM | Business Meeting | Mellon Science Building – Laura Falk Hall |
| 8:00 PM | Technical Meeting | Mellon Science Building – Laura Falk Hall |

ABSTRACT:

The ultimate analysis of biomedical systems requires the collection of spatiotemporal chemical information from live organisms. In vivo analysis by mass spectrometry (MS) requires minimally invasive atmospheric pressure sampling, preferably one cell at a time. Atmospheric pressure infrared matrix-assisted laser desorption ionization (AP IR-MALDI) and laser desorption electrospray ionization (LAESI) MS, introduced in our laboratory, rely on the water content of biological tissues as the energy absorbing matrix. AP IR-MALDI is based on the efficient collection of ions from the ablation plume, whereas LAESI enhances the ion yield through electrospray postionization.

Spatial and temporal changes in tissue and body fluid metabolite levels reflect the physiological state of an organism. Lateral variations and depth profiles of numerous metabolites were detected directly from the variegated leaf tissue of the zebra plant (*Aphelandra squarrosa*) by LAESI MS. The images created from the two-dimensional metabolite distributions in some cases indicated tissue specificity and correlation with biological function. We also utilized LAESI MS to follow the distributions of endogenous secondary metabolites in three dimensions in the leaves. Based on the leaf anatomy, tissue-specific metabolite accumulation patterns were identified and correlated with their biochemical roles.

As examples of animal tissue analysis, metabolites and lipids were analyzed directly from mouse brain sections and from the electric organ of the Pacific electric ray (*Torpedo californica*), a model system for the neuromuscular junction. In the brain tissue, major lipid components including cholesterol, phospholipid species (glycerophosphocholines, sphingomyelin and phosphatidylethanolamines) along with metabolites, such as GABA, creatine and choline, were detected. In the Torpedo electric organ most of the identified metabolites (acetylcholine, choline, betaine, carnitine, acetylcarnitine, and creatine) were related to the cholinergic function of the electric synapse. The ability to detect and quantitate these small signaling molecules directly from tissue promises new insight into the muscle-nerve 'dialogue'.

In order to understand metabolite trafficking on a cellular scale, we explored the LAESI analysis of single cells within a tissue. To achieve sufficient focusing of the mid-IR laser light, one end of an optical fiber was etched to ~50 μm diameter. Coupling the laser energy through this tip into the admittedly large epidermal cells of onion (*Allium cepa*) storage leaf resulted in the ablation of individual cells. LAESI mass spectra from a single cell indicated the presence of various

oligosaccharides and other metabolites. Based on this technique, cellular diversity and differentiation can be explored and, in future imaging experiments, single cells can be used as the natural voxels.

BIOGRAPHY:

Akos Vertes earned his advanced degrees at the Eotvos Lorand University in Budapest, Hungary. Since 2000 he has been a Professor of Chemistry at the George Washington University in Washington, DC. He is a co-founder and co-director of the W. M. Keck Institute for Proteomics Technology and Applications, a center of strategic excellence at the university. His research interests span from fundamental studies in analytical and physical chemistry to the development of new technologies for biomedical analysis. He made significant contributions to the field of laser desorption and ablation of organic and biological materials. The foundations of our current understanding of matrix-assisted laser desorption ionization have been laid by his plume dynamics and energy transfer investigations. His fundamental studies of the electrospray process uncovered the relationship between the electrohydrodynamics of liquid ejection and the production of ions in a variety of spraying modes. Recent exploits include the introduction of photonic ion sources based on nanostructures (e.g., laser-induced silicon microcolumn arrays or LISMA), the atmospheric pressure analysis of biological tissue, the introduction of a new ambient ion source called laser ablation electrospray ionization (LAESI), metabolic imaging of live plant organs and the mass spectrometric analysis of single live cells. His research has been presented in over 100 peer-reviewed publications, in two books, the first on laser ionization and the second on the medical applications of mass spectrometry, which he co-edited and co-authored, and in numerous conference presentations. He is an internationally recognized expert in bioanalytical methods. The research in his laboratory has been funded by the National Science Foundation, the Department of Energy, the National Institutes of Health and the W.M. Keck Foundation. His honors and awards include the Oscar and Shoshana Trachtenberg Prize for Scholarship, Fellow of the Royal Flemish Academy for Science and the Arts in Brussels, Belgium, Doctor of the Hungarian Academy of Sciences in Budapest, Hungary, Visiting Professor of the Swiss Federal Institute of Technology in Zurich, Switzerland, the Elsevier/Spectrochimica Acta Award, and Member of the Science Advisory Board of Protea Biosciences, Inc., Morgantown, WV.

DINNER RESERVATIONS:

Please email Larry Senor, Arrangements Co-Chair at senor@pittcon.org, by Thursday, September 4, 2008 to make dinner reservations. Should you not have email, please call Larry at 724-327-4428. If you want to be placed on the permanent dinner list, let Larry know when you RSVP. The entrée for September is Chicken stuffed with apple and brandy sauce. Dinner will cost \$8 (\$4 for students) and checks can be made out to the SACP. If you have any dietary restrictions, please let Larry know when you leave your message.

PARKING:

Duquesne University Parking Garage entrance is on Forbes Avenue. Upon entering the garage, you will need to get a parking ticket and drive to upper floors. Bring your parking ticket to the dinner or meeting for a validation sticker. Contact Dr. Mitch Johnson at Duquesne University, if any difficulties arise.