

Special One Day Symposium

Utilizing Nanotechnology for Detection of Viruses, Toxins and Pathogens

**November 4, 2009
Washington, DC USA**

Conveniently timed with

Detection Technologies 2009
*New Developments in Identification of
Microorganisms & Chemicals*

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Industry and academic scientists are encouraged to submit poster titles for this event. One-page abstracts (8 1/2" x 11" with 1-inch margins) must be submitted by email to submit@knowledgefoundation.com no later than **October 8, 2009** for inclusion in conference documentation. Additional poster submissions will be accepted until **October 25, 2009** but may not be included in conference documentation. *Note: If you are submitting a poster, you MUST be registered and paid in advance to ensure that a posterboard is reserved for you.*

COMPREHENSIVE DOCUMENTATION AVAILABLE

Nothing can substitute the benefits derived from attending **nanoKAP 2009**. But if your schedule prevents you from attending, this invaluable resource is available to you. Please allow 3-4 weeks after the conference date for delivery. *Note: Documentation is included with conference fee for registered delegates.*



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Symposium Agenda

Wednesday, November 4, 2009

9:15 *Registration, Exhibit Viewing/Poster Setup, Coffee and Pastries*

10:10 **Organizer's Welcome and Opening Remarks**

10:15 **Cowpea Mosaic Virus Nano-Scaffold as Signal Enhancement for DNA Microarrays**

**Carissa M. Soto, PhD,
Center for Bio/Molecular
Science and Engineering,
U.S. Naval Research Laboratory**

Previous studies have shown that a functionalized viral nanoparticle can be used as a fluorescent signal generating element and enhance detection sensitivity for immunoassays and low density microarrays. In this study, we further tested this ability in commercial DNA microarrays, including Affymetrix high density resequencing microarray. Optimum conditions for NeutrAvidin and dye coupling to a double-cysteine mutant of cowpea mosaic virus (CPMV) were found to be comparable to the commonly used streptavidin-phycoerythrin (SAPE) for high density resequencing microarray. A 3-fold signal enhancement in comparison to Cy5-dCTP controls was obtained when using nanoparticles on control scorecard expression microarrays. Hybridization results from commercially available 8000 rat expression arrays indicate an increment of 14% on the detected features when the virus complex was used as the staining reagent in comparison to Cy5-dCTP controls. The current work shows the utility of the CPMV-dye nanoparticles as a detection reagent in well-established detection platforms.

10:45 **An Integrated System for Diagnostics Using Nano-Particles for DNA Purification and Nano-Scale Metal-DNA Wires for Detection**

**Michael Connolly, President and CEO,
Integrated Nano-Technologies, LLC;
and**

**Janet Betters and Robert Dorsey,
BioSensors Branch, ECBC, RDECOM,
Aberdeen Proving Ground, U.S. Army***

INT is developing an automated portable field system for identification of pathogens. Recent work has allowed for automation of an electronic DNA based sensor. A universal sample preparation process has also been made compatible with the electronic sensor allowing for a completely integrated solution from sample introduction to result. Current performance levels will be reported. INT's sensor system is a novel sensor which electronically detects nucleic acid sequences in a sample. No amplification is required. INT's approach

utilizes nano-scale metallized DNA wires to allow for detection of even a single molecule target on the sensor. Metal nanoparticles interact with the target molecule and catalyze metal deposition to form a conductive wire. A microfluidic system has been developed to deliver all reagents to the sensor in a small manufacturable disposable cartridge. The system also incorporates a universal sample preparation approach to prepare DNA or RNA from a sample. Ultrasonic disruption is used to lyse the sample and shear the target molecules. Super para-magnetic nano-particles capture and concentrate the target molecules. The nano-particles can capture and concentrate DNA, RNA, or protein. The captured target molecules can be washed to remove inhibitors. All steps of sample collection, processing and analysis can be carried out automatically in a single disposable cartridge. The sample preparation method can be used with targets such as viruses, bacteria, and fungi and with a variety of matrices, including soil, water, tissue, blood, and air filters. *In collaboration with: V.Tannous, R.Murante, C.Deboer, INT; and K.Mangaya, Science Applications International Corp.

11:15 *Networking Refreshment Break, Exhibit/Poster Viewing*

11:45 **Nanocavity Biochemical Sensor**

**Michael J. Naughton, PhD, Professor of
Physics, Boston College**

A nanoscale biochemical sensor based on a coaxial "nanocavity" is described. The sensor is capable of detecting small changes in complex impedance resulting from the presence of target molecules in and near the device. Its nanoscale dimensions can be tuned for size-specificity, and its constituent components functionalized for biochemical specificity. Target molecules entering the coax annuli in the sensor array (one million sensors per square millimeter) are shown to result in a significant change in impedance as a function of time, frequency and concentration, with a detection sensitivity of ~ 1 molecule per nanocavity.

12:15 **Rapid Discovery of Synthetic Antibodies for Nanoengineering of Reagentless Assays**

**Alexander N. Asanov, PhD, President,
TIRF Technologies, Inc.**

Antibodies are the gold standard of Molecular Recognition Elements (MRE) for detection of proteins. Bioassays based on antibodies exhibit high specificity and affinity. However, natural antibodies are not reproducible and do not withstand temperature and other environmental factors. Synthetic MRE made of non-natural sequence-specific heteropolymers is a valuable alternative to antibodies. Peptoid oligomers are of particular interest for creating synthetic MRE because of ease of synthesis and their chemical and biological stability. Several laboratories have shown a wide variety of potent biological activities of peptoids, including antibody-like molecular recognition functions. In this presentation, we report on the development of novel method for the rapid discovery of synthetic MRE from one-bead-one-compound (OBOC) combinatorial libraries of peptoids and peptides. The approach employs Total Internal Reflection Fluorescence (TIRF) combined with electrochemistry and electric field control (TIRF-EC). TIRF-

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EC allows for instantaneous detection of MRE-target interactions and real-time monitoring of their association and dissociation. TIRF-EC also provides new insights into the mechanisms of biomolecular interactions. We present data that explain why the idea of aptamers made of nucleic acids was not successful and why the probability of discovery synthetic antibodies from combinatorial libraries of peptides and peptoids is much larger than that for nucleic acids. We also describe novel application of TIRF-EC for nanoengineering of molecular switches - reagentless assays equipped with embedded fluorescent reporters that perform detection and quantification of protein biomarkers without labeling and with no or minimum sample preparation stages.

12:45 *Lunch*

2:15 **Nanostructured Porous Material Preconcentrators**

Jun Xu, PhD, Surface Chemistry Group, Oak Ridge National Laboratory

Nanostructured mesoporous materials, such as ordered mesoporous carbons and metal-organic frameworks, have been studied as adsorbents for capturing dimethyl methylphosphonate (DMMP) and chlorinated hydrocarbons. The purpose of this work is to increase detection sensitivities for chemical agent detectors, including differential mobility spectrometry (DMS) and ion mobility spectrometry (IMS). We have found that mesoporous carbons are much more effective adsorbents for DMMP than conventional adsorbents.

2:45 **Magnetic Glyco-Nanoparticles, a Unique Tool For *In Vitro* and *In Vivo* Detection**

Xuefei Huang, PhD, Associate Professor, Dept of Chemistry, Michigan State University

Carbohydrates are ubiquitous in nature. Many pathogens use mammalian cell surface carbohydrates as anchors for attachments, which subsequently results in infection. In this talk, we will discuss our work in combining the diverse carbohydrate bioactivities with the unique properties of magnetic nanoparticles for pathogen sensing.

3:15 *Networking Refreshment Break, Exhibit/Poster Viewing*

3:45 **Bacteriophage and Qdot Nanocrystals Combo for Pathogen Detection**

C.D. Atreya, PhD, Associate Director for Research, Office of Blood Research and Review, Center for Biologics Research and Review, US Food and Drug Administration

Previous reports of site-directed deletion analysis on gamma (γ)-

phage lysin protein (PlyG) have demonstrated that removal of a short amino acid sequence in the C-terminal region encompassing a 10-amino acid putative bacterial cell wall binding motif abrogates its binding activity specific to the cell wall of *Bacillus anthracis*. Whether short synthetic peptides representing the-amino acid PlyG putative binding motif flanked by surrounding N- and C-terminal residues also selectively bind to the bacterial cell wall has not been evaluated. By using *B. anthracis* (Sterne, 34F2), an animal vaccine and *B. cereus*-4342, a γ -phage susceptible rare strain as surrogates of *B. anthracis*, we developed a proof-of-concept for *B. anthracis* detection by using six synthetic peptides representing the motif for the bacterial cell wall binding capacity. The bound peptides with biotin were detected by streptavidin conjugated Qdot nanocrystals. Our analysis identified three peptides to have binding capability to both *B. anthracis* (Sterne, 34F2) and *B. cereus*-4342. Overall, these studies illustrate that in principle, synthetic peptides representing the binding motif coupled with Qdot-nanocrystals are useful as high-sensitivity bio-probes in developing detection technologies for *B. anthracis*.

4:15 **Rapid Detection of *Botulinum Neurotoxins* Using Magnetic Nanoparticles-Based Magnetic Separation Coupled With Optical Immunoassay**

Ganapathy Rajaseger, Population Genetics Laboratory, DMERI, DSO National Laboratories, Singapore*

Botulinum neurotoxins (BoNTs) produced by *Clostridium botulinum* are among the most dreadful toxins that pose a major threat to humans and has the potential for use as bioweapons. Rapid and sensitive diagnosis of natural or deliberate food contamination is critical in deterrence of an event as well as in the aid of appropriate treatment. We have previously developed an optical immunoassay (OIA) for the detection of BoNTs. In the course of this work we have developed a simple toxin extraction protocol for BoNTs A, B, E and F from food matrices using magnetic nanoparticles (MNPs) based approach. The technique include concentration of target analytes using specific antibody coated MNPs followed by affinity displacement of the toxin-antibody complex. The experiment results demonstrated that the combined extraction strategy with OIA have importance in the field detection of bio-toxins in different matrices. Membrane filtration prior to the magnetic isolation could increase enrichment factor and eliminate potential matrix interference. The total analytical time was around 2h. *In collaboration with: Z. Zhengjie Lewis, E.P.Yap, S.Moochhala, P.Gopalakrishnakone, DSO National Laboratories; and P.Saravanan, National University of Singapore

4:45 **Concluding Discussion**

5:00 *End of Symposium*

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Discount Accommodations and Travel: A block of rooms has been allocated at a special reduced rate. Please make your reservations by **October 1, 2009**. When making reservations, please refer to The Knowledge Foundation. Contact The Knowledge Foundation if you require assistance.

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