16th International Conference

Biodetection Technologies 2010

Technological Responses to Biological Threats

June 17-18, 2010 • Arlington, VA USA

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Technological Responses to Biological Threats

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Nothing can substitute the benefits derived from attending **Biodetection Technologies 2010**. But if your schedule prevents you from attending, this invaluable resource is available to you. Please allow 2-3 weeks after the conference date for delivery. *Note: Documentation is included with conference fee for registered delegates*

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Thursday, June 17, 2010

8:00 *Registration, Exhibit Viewing/Poster Setup, Coffee and Pastries*

8:50 **Organizer's Welcome and Opening Remarks**

9:00 **KEY NOTE ADDRESS**

Building a Better Bug Trap: BioWatch Past, Current, and Future Technologies

Michael V. Walter, BioWatch Program Manager, Office of Health Affairs, U.S. Department of Homeland Security

Early detection of a bioterrorist attack has the potential to save thousands, if not millions, of lives. Since 2003, the BioWatch Program has quietly operated in more than 30 cities nationwide, monitoring the air for select pathogens. During the past seven years, much has been learned, including the importance of reliable, accurate detection technology. Dr. Walter will discuss lessons learned from technological problems, the current status of BioWatch Gen-3 sensor-type technologies, and plans for Gen-4 advanced systems.

9:30 **Microfluidic Sensor Based on Hydrodynamic Flow Focusing with Tunable Sensitivity for Detection of Cells or Microparticles**

Mansoor Nasir, PhD, Center for Bio/Molecular Science and Engineering, Naval Research Laboratory

A conductance-based microfluidic sensor utilizing hydrodynamic focusing of a conducting sample fluid by a non-conducting sheath fluid has been realized. The electric field is generated by the four-electrode system and is confined in the focused conducting stream. Both magnetic microspheres and antibody-captured bacteria cause a detectable change in impedance. The sensitivity is tuned using the sheath-to-sample flow-rate ratio. This technique allows for high detection sensitivity while preventing the clogging common to microfluidic detection systems.

10:00 **Non-PCR Point of Care System for Pathogen Identification and Antibiotics Susceptibility Tests**

Vincent Gau, PhD, Co-Founder, CEO, President and CTO, Genefluidics

A point-of-care detection system that integrates the multiplexed electrochemical sensor technology with a microfluidics cartridge has been developed and tested with clinical samples. The result is a revolution in molecular analysis - complete automated sample preparation and detection in a small, portable package. The system utilizes a modular microfluidics cartridge with configurable functional components. Application-specific components are inserted into the universal cartridge case. A single cartridge configuration can run a variety of assays. By interchanging the modular components, the possible assay configurations are limitless. The universal electrochemical sensor array allows detection of multiple targets from a single sample. The revolutionary sensor technology allows any combination of different RNA, DNA, and protein targets to be detected simultaneous in the same cartridge. Pathogen identification and antibiotics susceptibility tests can be accomplished within 60 minutes instead of overnight.

10:30 *Networking Refreshment Break, Exhibit/Poster Viewing*

11:00 **Rapid Prototyping of Microfluidics**

Leanna M. Levine, PhD, President and CEO, ALine, Inc.

Rapid Prototyping is a necessary component of product development. There are few rapid prototyping technologies that support the use of materials and methods that provide sophisticated functional prototypes suitable for production quantities in the tens of thousands. We describe a novel polymer laminate technology platform, PLT, which uses a no tooling approach to rapidly create complex fluid structures with pumps and valves that have been used for early prototyping through to product launch. In this talk we demonstrate its application for product development of a molecular diagnostic product.

11:30 **Microfluidic PCR Array for Parallel Genetic Analysis of Waterborne Pathogens**

Haiqing Gong, PhD, Associate Professor, Thermal and Fluids Engineering Division, School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore

We have developed a high throughput microfluidic PCR array card, pre-loaded with different primer pairs for simultaneous (parallel) detection of multiple waterborne pathogens. The PCR mixture loading into an array of reactors and subsequent sealing of the reactors were realized by a simple and automated microfluidic scheme. This PCR array greatly reduces the complexity of the microfabrication and fluidic operation process where individual valving or sealing of a PCR reactor is required. The card performance was successfully demonstrated by detecting DNA of a pool of waterborne pathogens.

12:00 **Multiplexed Pathogen Detection Using a Micro Flow Cytometer with Integrated Sample Preparation**

Li (Julie) Zhu, PhD, Bioanalytical Chemist, Chemistry Technology and Material Characterization, GE Global Research, General Electric Company*

NRL and GE have developed a micro flow cytometer with integrated sample preparation for rapid and multi-analyte detection for point-of-care applications. The system consisted of disposable fluidic chips and compact instrument (including optical, fluidic and electronics controlling modules). The flow cytometer chip employed novel design to achieve

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hydrodynamic focusing for optical detection. The sample preparation chip employed multiple on-chip valves, magnetic trap, and pressure driven flow to fully automate the sample preparation protocol. The two microfluidic chips were interconnected for a complete analysis. Multiplexed detection of bacteria and toxins using the flow cytometer system will be presented. *Work supported by NRL under contract #: N00173-08-2-C003.

12:30 *Luncheon Sponsored by the Knowledge Foundation Membership Program*

2:00 Integrated Lab-On-A-Chip: A Combined Sample Preparation and PCR System as Ultrafast Analytical Tool for B-Agents

Claudia Gärtner, PhD, CEO, microfluidic ChipShop GmbH, Germany

The overall aim is the realization of a reliable, ultrafast, and portable tool for the identification of B-agents at the point of interest. PCR is the method to be used for the doubtless identification of e.g. bacteria, and viruses. Miniaturization is the way to include the overall analysis process, from sample preparation to detection, on a microtiterplate-sized consumable device and to allow to carry out the analysis without the need for an equipped biological laboratory. An innovative PCR concept with constant temperature zones allows also for the instrument to become portable, due to much reduced power consumption since no thermocycling is necessary. An overall concept to implement the biological reactions for the analysis on-chip, the methods of sample preparation on-chip, and the results of the ultrafast PCR with Bagents on-chip, as well as the basic instrument will be presented.

2:30 VereThreat™ Detection, Differentiation and Identification of: Anthrax, Plague, Small Pox and Tularemia in One Test

Rosemary Tan, PhD, CEO, Genecet Biotechnologies Pte Ltd.; CEO, Veredus Laboratories Pte Ltd., Singapore

We have developed a novel Lab-on-Chip (VereThreat™) that can rapidly detect and identify catastrophic pathogens. This fast, user-friendly and low cost device combines an ultra-fast miniaturised PCR for amplification of nucleic acids and a high quality microarray for detection in a single chip. Customized spotting on the chip means that the chip can be easily reconfigured to expand its range of detection to detect other pathogenic targets of interest. This device allows users to apply the full benefits of DNA testing in real-world conditions, at a fraction of the time, cost and complexity. Details of VereThreat™ will be presented.

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3:00 Human Karyotyping Using TaqMan Copy Number Assays

Caifu Chen, PhD, Scientific Fellow and Sr Director, Genomic Assays R&D, Molecular Biology Systems Division, Life Technologies Corporation

Chromosomal or sub-chromosomal changes in genomic copy numbers may lead to various genomic disorders and developmental abnormalities including Down Syndrome etc. In addition, these numerical aberrations, also known as aneuploidy, may also occur in embryos, stem cells, and other cell lines during cell culture. Therefore, karyotyping analysis is crucial for clinical research and diagnosis including prenatal diagnostics, IVF (in vitro fertilization), stem cell and cancer research. Most commonly used technologies for karyotyping analysis are microarray-based comparative genomic hybridization (CGH) and fluorescent in-situ hybridization (FISH). Although they are powerful and have many advantages, their detection of chromosomal gain or loss is not quantitative and may not be reliable. Moreover, the lengthy protocols and cost for sample screening are undesirable. To overcome these problems, we have developed a new method for chromosome karyotyping using TaqMan copy number assays. Since extra or missing chromosomes will cause chromosomal copy number changes, we leverage the existing pre-designed TaqMan Copy Number Assays. We select and validate TaqMan copy number assays that target each of the 24 chromosomes. To cover all the 24 chromosomes on a 384 well plate or a TaqMan Array Card, we select 4 assays per chromosome. We also develop a gene-specific pre-amplification protocol for copy number assays to perform karyotyping analysis using a minute amount of DNA sample. Our preliminary feasibility studies suggest that TaqMan karyotyping assays enable researchers to quantitatively detect chromosome copy number changes for limited quantity of gDNA sample and offer a simple workflow with high sample throughput. As a complementary tool to the existing karyotyping technologies, TaqMan karyotyping is valuable for aneuploidy screening and validating karyotyping results from other platforms. *In collaboration with: K.Li, B.Ching, I.Casuga, F.Wang, X.You, A.Broomer, A.Tobler

3:30 Networking Refreshment Break, Exhibit/Poster Viewing

4:00 Challenges of Biological Dosimetry in a Nuclear or Radiological Incident

Marcy Beth Grace, PhD, Project Officer, Biomedical Advanced Research Development Authority (BARDA), Office of the Assistant Secretary for Preparedness and Response, U.S. Department of Health & Human Services

Cutting-edge approaches to biodosimetry focus on finding molecular biomarkers. Promising biomarkers are being explored in proteomics, genomics, metabolomics, glycanomics, and lipidomics. Using a combination of funding mechanisms, HHS, in collaboration with interagency partners, is focused on improving public health emergency response for radiological or nuclear incidents through supporting the

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development. Despite challenges, great progress has been made in the development of minimally invasive, rapid, and high throughput biodosimetry tools.

4:30 **Advanced Biodetection Gadgets and Techniques: A View from the Field**

Kathryn M. Hansen, Bioterrorism Response, Microbial Diseases Laboratory, California Department of Public Health

This presentation will look at the deployment of new technologies by civil response (Hazmat) teams: their needs, requirements, and the difficulties they face. It will look at current field testing recommendations (including CDC/FBI, AOAC, and State LRN Laboratories), current response protocols and how new technology is integrated into them, and the obstacles facing such adoption.

5:00 **MODERATED DISCUSSION:**

The Way Forward: What Hazmat Teams Could Use in the Future. First Responders Perspective on the State-of-the-Art Detection Technologies

Moderator: ***Kathryn M. Hansen, Bioterrorism Response, Microbial Diseases Laboratory, California Department of Public Health***

5:45 *End of Day One*

Friday, June 18, 2010

8:00 *Exhibit/Poster Viewing, Coffee and Pastries*

9:00 **Genomic Barcoding for Pathogen Detection and Surveillance Systems**

Willy A. Valdivia-Granda, PhD, CEO, Orion Integrated Biosciences Inc.

Unless the world community acts decisively, a terrorist attack using biological weapons will occur somewhere in the world by the end of 2013 [1]. The impact of such attack will depend on the use of pathogen genomic information not only as new regulatory strategy to prevent the proliferation and the illegal transfer of deadly biological agents, but to develop a new generation of countermeasures. While pathogen genome sequencing is generating vast amounts of information, the use of this data for the inclusion of an organism within the select agent list remains limited. Here we will present specific strategies to use genomic units that are specific for a genus, species or strain and the development of an international database compiling information about microbial collections. These initiatives can open new directions for verification of international treaties, forensics, attribution and the enhancement of intelligence judgment. [1] World at Risk; The Report of the Commission on the Prevention of WMD Proliferation and Terrorism.

9:30 **Deployment of a Network of SmartBio Sensors for Special Events Bio-Monitoring**

Ken Klein, Product Manager, Smiths Detection

An important component to countering Bio-Terrorist threats is rapid detection of bio-releases. Vulnerable targets are large public gatherings at indoor and outdoor venues. We describe a pilot system currently deployed with a police department equipped with a wireless array of SmartBio Sensors communicating to a command and control vehicle. We will also present a protocol for using complementary Bio-Identifier technologies to confirm an alarm event and provide field presumptive identification of high threat BWAs.

10:00 **ECIS for Synthetic Pathogen Detection**

Douglas B. Chrisey, PhD, Professor, Dept of Materials Science and Engineering, Rensselaer Polytechnic Institute

Synthetic pathogens are believed to be likely future weapons of terrorists. Electric Cell-Impedance Sensing is a real-time system that can be used to detect both existing and synthetic pathogens by measuring the change in impedance of a confluent cell monolayer grown on interdigitated electrodes. Pathogen toxicity causes a change in the cell barrier function, i.e., the resistance to current flow caused by tight junction formation between the individual cells. Pathogen exposure results in an immediate drop in the measured resistance/capacitance.

10:30 *Networking Refreshment Break, Exhibit/Poster Viewing*

11:00 **Characterization and Optimization of Quantum Dot-Antibody Conjugates for Biological Detection, Identification, and Quantification**

Michele D. Kattke and Larry D. Stephenson, PhD, U.S. Army Engineering Research and Development Center Construction Engineering Research Laboratory, U.S. Army Corps of Engineers

FRET-based quantum dot-antibody biosensors are capable of highly sensitive and specific detection. Sensitivity can be compromised by the presence of unconjugated antibodies, which compete for target antigen. Antibody aggregation may be responsible; this possibility was investigated after size exclusion chromatography and dialysis failed to adequately reduce the number of excess antibody fragments. SDS-PAGE was used to visualize the effect of unaggregated versus

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aggregated antibody on antibody fragmentation and purification efficiency.

11:30 **Ultra-Sensitive Quantum Dots-Based DNA Fiber Optic Biosensor and Its Application in Hybridization Kinetics Analysis**

Feng Long, Environmental Simulation and Pollution Control State Key Joint Laboratory, Dept of Environment, Science and Engineering, Tsinghua University, PR China

We have demonstrated a new biosensing platform for ultrasensitive DNA detection by taking advantage of total internal reflection fluorescence (TIRF) and quantum dots (QDs), which provides simple, cheap, fast, and robust solutions for many potential applications. This method features an exceptional detection limit of 2.9 amol of bound target DNA. The quantitative measurement of binding kinetics can be achieved with high accuracy using our proposed theoretical basis.

12:00 **Portable and Rapid Raman Bioagent Identification**

Marie Lesaicherre, PhD, Morpho Detection Inc., SAFRAN Group

Sensitive Raman-based detection of biological pathogens was achieved using antibody-coated SERS tags synthesized from gold nanoparticles. The pathogens of interest were first captured using antibody-coated magnetic capture particles, thus reducing the effect of commonly found interferents. This assay was integrated onto a portable Raman device to allow for rapid & field deployable biological pathogen identification and results from 3rd party validation will be presented.

12:15 *Lunch on Your Own*

2:00 **Magnetic Field Enhanced Immuno-Agglutination Technology for Rapid Detection of Environmental Pathogens: KIM Technology**

Elodie Brient-Litzler, PhD, Chief Project Scientist, Bertin Technologies, France

Bertin Technologies has developed a patented technology dedicated to the detection of Bio Warfare Agents. Based on antibody-grafted magnetic colloids agglutination, this homogeneous assay enables the rapid and sensitive bioanalysis of a range of environmental samples. Within 10 minutes, typical limits of detection of 1 ng/ml for toxins and 1E5 CFU/ml for bacteria are achieved. Specific agents kits have been validated to be used with the KIM analyzer.

2:30 **Label-Free Phage-Based Biosensor for Rapid Pathogen Detection and Identification**

Rosemonde Mandeville, PhD, President and CEO, Biophage Pharma Inc, Canada

Abstract is not available at time of printing. Please visit www.KnowledgeFoundation.com for the latest Program updates.

3:00 **Multiplexing Assays Go Digital**

Winston Ho, PhD, Applied Biocode

A novel Barcoded Magnetic Bead (BMB) technology utilizing digital technology, instead of conventional analog methodology, offers unmatched decoding accuracy; precise fluorescence detection; and an unlimited number of barcodes for use in multiplex tests. The polymer-based BMBs are permanently encoded with paramagnetic material, which not only provides the accurate digital pattern (no classification ambiguity), but also enables easy washing, separation, and automation. The digital pattern is easy scalable, BMBs with 32, 128, and 1,024 (2N, N=5, 7, and 10) codes have been mass produced.

3:30 **Selected Oral Poster Highlights and Open Discussion**

4:00 *Concluding Remarks, End of Conference*

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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 May 17, 2010. When making reservations, please refer to the The Knowledge Foundation. Contact The Knowledge Foundation if you require assistance.

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