Abstracts of Awards for Fiscal Year 2010 NIST SBIR Program

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**FY 2010 Phase I Award Winner**

**Topic: ADVANCED BIOLOGICAL AND CHEMICAL SENSING**

**Subtopic:** 9.01.01.3-TT Microfluidic Palette for Cellular Response to Chemical Stimuli

**Title:** Development of MicroFluidic Palette for Cellular Responses to Chemical Stimuli

**OU:** Material Measurement Laboratory Office

**FIRM:** BellBrook Labs LLC
5500 Nobel Drive, Suite 250
Madison, WI   53711-4951

**Principal Investigator:** Elizabeth Vu
**Phone:** 608-227-4521
**Email:** Elizabeth.vu@bellbrooklabs.com

**Award Amount:** $90,000.00

**Abstract:** Current research tools to understand tumor cell migration and metastases are limited to linear gradients or constant flow across cells skewing results. Researchers at the National Institute of Standards and Technology developed a tool called the microfluidic palette which exposes cells to chemical stimuli in a static environment overcoming the limitations above. Several improvements are necessary before this technology can be put to use in research. 1) Simplify the current complex assembly and connections, 2) decrease the excessively large footprint, 3) integrate temperature control to enable mammalian cell culture. We will demonstrate a device design engineered to simplify use and utilize space efficiently. The device will occupy and 1”x3” slide footprint containing reservoirs for reagents and waste, demonstrate robust control of temperature, dissolved gas concentration, generation of a non-linear gradient and, multi-day study of tumor cell chemotaxis. While this phase I project will focus on a specific application, the system will be designed in a modular fashion that supports a variety of palette designs with up to four different stimuli.

**Commercial Applications:** The microfluidic palette has potential applications in life science research, including basic research, drug discovery, as well as diagnostics. The proposed research will yield technology that provides temporal and spatial control of cell stimulation with dissolved test compounds. This technology can help elucidate cell functions, disease processes, and the therapeutic potential of drug candidates; it may also be employed in stem cell biology, where time-dependent stimulation is utilized to achieve lineage specific differentiation. Microfluidic palette system would solve problems for academic and industry researchers working with in various areas, including cancer, immunobiology, neurobiology, and infectious diseases.

**FY 2010 Phase I Award Winner**

**Topic:** INFORMATION TECHNOLOGY

**Subtopic:** 9.05.02.4-R Analysis of New WWVB Modulation Schemes for Future Broadcast

**Title:** A novel enhanced-performance low-cost receiver and modified modulation scheme for WWVB

**FIRM:** XW, LLC dba Xtendwave
7920 Belt Line Road, Suite 1000
Dallas, TX   75254

**Principal Investigator:** Oren Eliezer
**Phone:** 972-290-0967 x111

**Award Amount:** $90,000.00

**Abstract:** The development of a greatly enhanced receiver for the WWVB signal is targeted, as well as possible modifications in the transmitted signal, which would both offer significant improvements in its effective coverage. This is to be achieved while allowing the replacement of the bulky, expensive, ferrite-based antenna, commonly used in the receiver, with a novel lower-cost antenna. Furthermore, the proposed receiver architecture, leveraging on today’s technologies for integrated receivers and on newly proposed schemes, would allow for the elimination of the commonly used high-cost crystal filter, while improving selectivity and robustness to interference. The proposed modification to the transmitted signal is designed to maintain backwards-compatibility and therefore would not affect its reception by the existing devices, while offering a significant advantage in its reception by the newly proposed receivers.

**Commercial Applications:** The proposed receiver architecture targets commercial applications, as it is of low cost and low form-factor, allowing the smallest of devices to incorporate self-adjusting time-keeping features. It is envisioned that this would accelerate the already-high demand for atomic clocks/watches, which have become popular in watches and other time-keeping devices in the consumer market. Commercialization would be pursued by fabricating the proposed programmable receiver and offering it not only for time-keeping devices, such as clocks and watches, but also as an added feature for more complex systems, where it may be integrated as an IP (intellectual property) within a larger system-on-chip (SoC).

**FY 2010 I Phase I Award Winner**

**Topic:** INFORMATION TECHNOLOGY

**Subtopic: 9**.05.04.9-TT Technology Transfer of Multimodal Biometric Application Resource Kit (MBARK)

**Title:** Distributed MBARK Based Mobile Face Recognition

**OU:** Information Technology Laboratory Office

**FIRM:** Ad Harmony
15 Ross Ave.
Staten Island, NY   10306-2215

**Principal Investigator:** Bob Gupta
**Phone:** 609-230-4262
**Email:** bobg1966@gmail.com

**Award Amount:** $90,000.00

**Abstract:** Perform a feasibility study on developing a face recognition application in a cloud computing environment utilizing MBARK as the middleware. The application will have a client piece that will run on a mobile device and a server piece that will run on a higher-performance computing cluster. The specific objectives of the feasibility can be enumerated as follows: 1. Split/distribute the MBARK middleware to allow local functions – such as sensor data capture and filtering – to pass data and control streams with server functions such as compute-intensive analysis and database matching. 2. Create a face recognition workflow in the XML format as required by MBARK. DSCI’s STARFace SDK will be used to perform the face recognition functions on both the client and server sides. 3. Define additional UI component(s) that would be added to the MBARK UI to show image snapshots and matching results.

**Commercial Applications:** A Commercial Mobile Face Identification and FACE Matching System may potentially result from this research. Mobile, cloud and video capture enablement of MBARK will allow for proper interface to a commercially available Face Recognition SDK.

**FY 2010 Phase I Award Winner**

**Topic:** MANUFACTURING SYSTEM INTEGRATION

**Subtopic:** 9.07.01.2-R Decision Support Tools for Sustainable Manufacturing

**Title:** Decision Support Tools for Sustainable Manufacturing

**OU:** Engineering Laboratory Office

**FIRM:** BIMCON Inc.
2957 Brentwood Road
W. Bloomfield, MI   48323

**Principal Investigator:** Krishna Murthy
**Phone:** 248-875-6591
**Email:** kmurthy@bimcon.com

**Award Amount:** $89,700.00

**Abstract:** The objective of this proposal is to establish the feasibility of developing an integrated decision support tool that transforms the current time-consuming and reactive (post-design) sustainability assessment into a real-time, proactive approach available in the early phases of product design. This tool, called Sustainability Integrated into Early Design (SIED), will define and capture lifecycle-wide information relevant to sustainability and its assessment, and make it available in the product design phase. The availability of this information in a timely and accurate manner, in turn, will enable the development of value-added, vertically specialized tools for activities such as material usage monitoring, energy monitoring and recyclability analysis. In this phase I project, we shall focus on: 1. Requirement analysis to determine the constituents of information that need to be managed 2. Formalization of integrated data models to describe how data should be stored, linked and accessed 3. Proof of concept prototype to demonstrate feasibility and use in decision-making.

**Commercial Applications:** By integrating sustainability target and status information with the existing product creation and business process information using open standards, the SIED tool will deliver a one-stop access to structured, real-time information. This project aims to rectify all of the technical and data standard hurdles currently experienced by the automotive OEMs and their supply chain. The biggest beneficiaries are the Tier 1, 2, and 3 suppliers, who will have a good understanding of what data to provide the OEMs and in what format. This project will be an efficiency gain to the suppliers, since all the OEMs can use a standard data model, which eliminates translation/re-transmission of their data to each OEM independently. Once the data has a place to be stored and managed, we are also developing tools to deliver the data via existing commercial applications to decision makers in a transparent and seamless interface. This will ensure that sustainability and other metrics are given their due importance in product development, which will make compliance to regulations more robust and eliminate costly re-design.

**FY 2010 Phase I Award Winner**

**Topic:** MICROELECTRONICS MANUFACTURING

**Subtopic**: 9.10.02.1-R Massively Parallel High Temperature Probe System for Wafer-level Reliability Testing

**Title:** 300 mm High Density Temperature Probe Card for Wafer- Level Reliability Testing

**FIRM:** Celadon Systems, Inc.
14763 Energy Way
Apple Valley, MN   55124-5762

**Principal Investigator:** Bryan J. Root
**Phone:** 952-232-1678
**Email:** Bryan.root@celadonsystems.com

**Award Amount:** $90,000.00

**Abstract:** Historical methods of reliability assessment are less and less effective as device sizes shrink. Already researchers are unable to package the many advanced devices because the act of cutting the wafer and the packaging operation pre-stresses or destroys the devices resulting in unreliable test results. Additionally the increasing cost of fabricating a wafer with advanced integrated circuit technology requires the designer to maximize the utilization of the wafer real estate. Additionally smaller devices require electrical characteristics and the short term and long term reliability to be know with even higher precision and accuracy. This is a proposal to design a probe card for massively parallel reliability testing to address this need. The objective of the project is to design a 300mm probe card with 5000 probes at sustained operating temperatures up to 400?C. The probes need to contact 50µm pad sizes that are typical in the industry. Additionally, the probes need to align to the pads throughout an operating envelope of 25?C to 400?C, contacting the pads after the system achieves thermal equilibrium.

 **Commercial Applications:** Understanding the reliability of advanced semiconductor devices is at the forefront of the industry. The need for a cost effective method to test thousands of devices increases every day. The new technologies being developed require massively parallel reliability tests to fully understand the fundamental physics, develop new models, and determine the reliability with much higher accuracy and precision. Operating in this industry, we can see this need to increase sample sizes and significantly reduce the cost and time to obtain the data every day. The successful introduction to the industry of this type of testing capability is needed to continue the fast pace of innovation.

**FY 2010 Phase I Award Winner**

**Topic:** OPTICS AND OPTICAL TECHNOLOGY

**Subtopic:** 9.12.08.5-R High Speed and High Sensitivity Quadrant Photodetector

**Title:** High Speed and High Sensitivity Quadrant Photo Detector

**OU:** Material Measurement Laboratory Office

**FIRM:** Radiation Monitoring Devices, Inc.
44 Hunt Street
Watertown, MA   02472-4699

**Principal Investigator:** Richard A. Myers, Ph.D.
**Phone:** 617-668-6800
**Email:** Rmyyers@RMDInc.com

**Award Amount:** $89,999.00

**Abstract:** To further advance the characterization and utility of microcantilevers, next generation optical detectors with higher frequency response, improved displacement resolution and lower noise for weak signal detection are needed. Consequently, Radiation Monitoring Devices, Inc. (RMD) will develop a turnkey optical detector module for use in characterizing the displacement and resonant frequencies of microcantilevers used in atomic force microscopes and sensing applications. This module will meet desirable detector specifications, including a bandwidth of at least 50 MHz, displacement resolution of 0.1 µm and high responsivity to wavelengths in the visible and near-infrared. At the end of the Phase effort, a working prototype will be delivered to NIST for test and validation. The Phase II effort will highlight further performance enhancement and refining the module design for commercial production.

**Commercial Applications:** Microcantilevers are currently being utilized to help characterize and map the structure of nanomaterials as well as used as chemical, biological and environmental sensors. The quadrant array module proposed here will resolve the microcantilever movement with greater precision, produce richer spectral information about nanomaterials, improve molecular recognition and allow studies of interaction chemistry that have, to date, been inaccessible. Significant markets for this technology include homeland security concerns, environmental monitoring, material manufacturing and health screening. Beyond monitoring the movement of micorcantilevers, the advanced quadrant array module would also be useful for position sensing, tracking and LADAR-related applications.

**FY 2010 Phase I Award Winner**

**Topic:** TECHNOLOGIES TO ENHANCE FIRE SAFETY

**Subtopic:** 9.13.01.6-R Barrier Fabrics for Fire Safe Furniture and Mattresses

**Title:** High Char Yield Multifunctional Textile Finishes

**OU:** Engineering Laboratory Office

**FIRM:** Luna Innovations Incorporated
1 Riverside Circle, Suite 400
Roanoke, VA   24016

**Principal Investigator:** Aaron Small
**Phone:** 540-769-8400
**Email:** submission302@lunainnovations.com

**Award Amount:** $89,991.00

**Abstract:** A need exists for advances in non toxic treatments for cover and barrier fabrics. Since polybrominated materials have been banned in many European countries and the production of a number of brominated additives terminated in the U.S. as well, future technologies must focus on non-halogenated treatments. In general, non-halogenated treatments (phosphates and borates) are not durable to aqueous solutions. Barrier fabrics are useful in reducing the risk of fires, however many of the synthetic polymers used in them do not form cohesive char layers or they experience significant shrinkage during initial exposure. This allows holes to form, allowing for off gassing and continued burning of underlying foam. During this program, Luna will develop a durable non-halogenated flame retardant treatment applicable to both barrier fabrics and cover fabrics. This treatment will significantly improve char yields of the barrier fabric. Cover fabric samples will exhibit improved fire performance and stain resistance.

**Commercial Applications:** Potential markets for advanced barrier fabric treatments include: barrier fabrics for upholstery and mattresses, cover fabrics for furniture upholster, drapery, automotive upholstery, marine upholstery, and aircraft upholstery, military fatigues, fire fighter/first responder uniforms, tents, and soft wall shelters. Since Luna’s treatment is intended to be non-halogen based, overseas markets (Europe and Japan) will be viable as well as U.S. By developing a durable and stain resistant, non-halogenated fire retardant treatment applicable to numerous fabric compositions, Luna’s fabric treatment will become the standard for next generation fire resistant textile articles.

**FY 2010 Phase II Award Winner**

**Topic:** ENERGY: ALTERNATIVE AND EFFICIENCY

**Subtopic:** 9.04.03-6.R Sensor Systems for Complete Residential Energy Monitoring

**Title:** Comprehensive Residential Energy Monitoring System

**OU:** Engineering Laboratory Office

**FIRM:** Physical Optics Corp.
20600 Grammercy Pl., Bldg. 100
Torrance, CA   90501-1821

**Principal Investigator:** Ninad Patnekar
**Phone:** 310-320-3088
**Email:** ATProposals@poc.com

**Award Amount:** $299,950.00

**Abstract:** NIST needs a complete residential energy monitoring system to convey real-time comprehensive energy consumption data by particular end-use to occupants. POC developed a new Comprehensive Wireless Residential Energy Monitoring (CORE) system that integrates multiple wireless sensor modes with a unique radio board into an innovative wireless network architecture. Key Phase I developments were a first-of-a-kind noninvasive clamp-on mass flow sensor for water consumption monitoring and a GUI that presents understandable energy usage data to promote energy-efficient behavior. POC met all Phase I objectives through system design, sensor research and simulation, sensor/system development, assembly, and demonstrating a proof-of-concept prototype to NIST. In Phase II, POC plans to enhance CORE technology be developing a pre-production prototype with high commercial value. The Phase II work will be a straightforward implementation of Phase I findings and will incorporate major improvements determined during Phase I.

**Commercial Applications:** CORE’s main application will be residential energy monitoring, where it will provide the user with complete details of energy usage. In the commercial and industrial sectors, it can monitor energy usage in small- and large-scale offices or big processors and plants. In transportation, it can measure various parameters in a vehicle, ship, or airplane, and in military, it can monitor energy usage in bunkers, camps, or vehicles. Additionally, it can be applicable in the Smart Grid sector where it can map energy consumption trends to optimize power consumption, generate real-time pricing during peak and nonpeak hours, and facilitate personal energy and resource management.

**FY 2010 Phase II Award Winner**

**Topic:** ENERGY: ALTERNATIVE AND EFFICIENCY

**Subtopic: 9**.04.03-6.R Sensor Systems for Complete Residential Energy Monitoring

**Title:** Sensor Systems for Complete Residential Energy Monitoring - Phase II

**OU:** Engineering Laboratory Office

**FIRM:** TIAX LLC
35 Hartwell Ave.
Lexington, MA   02421

**Principal Investigator:** Dr. Matthew C. Wiggins
**Phone:** 617-498-5162
**Email:** Wiggins.Matt@TIAXLLC.com

**Award Amount:** $299,986.00

**Abstract:** In Phase I, TIAX developed and demonstrated a residential energy monitoring system (R-EMS) with potential national energy savings of $20 billion annually. Based on user requirements and well-established systems engineering methodology, TIAX’s R-EMS solution is inexpensive, easy to install and operate, and is supportive of intuitive decision making about energy usage. In Phase II, TIAX will extend these accomplishments by further refining our Phase I system to enable internet access to a homeowner’s energy usage data through a simple, yet powerful user interface. Working with industry partners, our goal is to have a product in the marketplace within 24 months of the initiation of Phase II. This is achievable given the rapidity of technology development and the US consumers’ interest in saving money and adopting technologies. To address cost, TIAX will use cost as an independent variable to develop a sensor suite and communication system at a price point that will permit a less than three year payback for the average consumer. Furthermore, TIAX will use a human-centric design methodology to develop a system that is easy to install and operate.

**Commercial Applications:** Current residential energy monitoring systems (R-EMS), with or without breakdowns of energy consumption by specific end uses, have negligible penetration. The proposed TIAX R-EMS with its low installed cost, ease of installation, and user-friendly interface will enable significant market penetration. It is estimated that with a three-year payback period the proposed R-EMS will achieve a market share of just over 20 percent in new construction and around 70 percent in existing homes. These penetration levels suggest that, within a decade of commercial launch, a cost-effective R-EMS could be installed in at least 10 percent of the approximately 115 million US households. If it realizes an average energy savings of 10 percent, after ten years the R-EMS would achieve annual energy and energy cost savings of approximately 0.2 quad and $20 billion in the US, alone.

**FY 2010 Phase II Award Winner**

**Topic:** HOMELAND SECURITY

**Subtopic:** 9.06.06-9.R Automated Interaction with Fingerprint Sensors

**Title:** Programmable Fingerprint Emulator

**OU:** Information Technology Laboratory Office

**FIRM:** PHT Aerospace
230 West Parkway, Unit 2
Pompton Plains, NJ   07444

**Principal Investigator:** Patrick R. Antaki
**Phone:** 972-896-4937
**Email:** pat@PHTaerospace.com

**Award Amount:** $300,000.00

**Abstract:** This proposal is for the development of a technology apparatus which can dynamically synthesize a mechanical fingerprint pattern, from an electronic image or from a computer-generated artificial pattern, onto a 2-dimensional pliable surface whose surface height is modulated by protrusions in the z-axis direction. When mechanically applied to a fingerprint sensor-under-test, the synthesized modulated surface appears to be a human fingerprint. Thus, the instrument can be utilized to apply all sorts of pre-programmed, standardized, controlled and/or experimental fingerprint patterns to a variety of sensors-under-test. Some of the key parametric attributes of this technology are: greater-than-500dpi resolution, large contiguous active area (3.2”x2.0”), up to 80um of z-axis displacement, 8-bit resolution for height displacement, fast response time, fully computer-controlled, and compatible with all know fingerprint sensing technologies.

**Commercial Applications:** This research will lead to the development, manufacturing and marketing of test equipment for use in the testing, characterization and calibration of fingerprint sensors, sensor systems, and of matching algorithms. Such equipment does not currently exist in the marketplace. The significant advance of this tester is in its ability to generate high resolution (over 500dpi) mechanical fingerprint patterns over a large area (compatible with the 4-finger slap requirement) in a computer-controlled programmable and dynamic manner. Potential customers include manufacturers of fingerprint sensors, test/calibration/certification service providers, biometric researchers, and governmental agencies internationally.

**FY 2010 Phase II Award Winner**

**Topic:** MANUFACTURING SYSTEM INTEGRATION

**Subtopic:** 9.08.02-2.R Virtual Measurement Metrology for Economic Optimiza**tion**

**Title:** A Method for Specification of Efficeint and Effective Strategies for Measurement of a Measurement Article on a Coordinate Measuring Machine by Use of Measurement Simulation Techniques

**OU:** Engineering Laboratory Office

**FIRM:** MetroSage, LLC
26896 Shake Ridge Road
Volcano, CA   95689-9610

**Principal Investigator:** Daniel A. Campbell
**Phone:** 415-738-7366
**Email:** dcampbell@metrosage.com

**Award Amount:** $279,111.80

**Abstract:** We propose the definition, design, and prototype development of a software tool for use by the U.S. manufacturing community to enable the automated production of design-based measurement strategies of know reliability and high economic efficiency for coordinate measuring machines (CMMs). The measurement strategies so generated will meet the objective of reducing overall costs to near-minimal values, based on consideration of costs associated with both the direct use of the suggested measurement strategy and with its attendant risks of Type I and Type II accept/reject decision errors. The measurement programs will be created in a CMM-independent format (DMIS) to be applicable to any selected CMM software system. Design of the system will fully leverage existing, related software technologies. The resulting software, when fully developed and commercialized, will enhance the competitive position of manufactured products by reducing waste, both in manpower and raw materials, by improving the utilization of energy-intensive raw materials and will enhance the perceived quality of items so measured and certified.

**Commercial Applications:** The availability of an easily accessible cost-of-measurement software toolset suitable for mechanical measurement and for CMM metrology in particular will constitute a valuable addition to the arsenal of tools for advancing U.S. manufacturing profitability. While the size of the customer organization may span the entire range from the one-person company to the very large multinational corporation, it is expected that the need for and value of our product will be recognized earliest among organizations at the high end of the size range, and in their first-and second-tier suppliers. It is chiefly in this arena that economies of scale and the complexity of the interaction between measurement practice and profit margin will be most evident. We anticipate three sales modes for our product: a) as a stand-alone system, primarily to end-user organizations, b) as a licensed “kernel”, primarily to other software writers and system integrators and c) as a service, with web-based distribution and specialized consultation, primarily to end users who cannot justify the cost of system ownership.

**FY 2010 Phase II Award Winner**

**Topic:** OPTICS AND OPTICAL TECHNOLOGY

**Subtopic:** 9.12.07-4.TT Automated, temperature-controlled high-power LED measurement system

**Title:** Development of Pulse/DC Characterization System for LEDs

**FIRM:** Arroyo Instruments, LLC
373 Front St., Suite B
Grover Beach, CA   93433-1553

**Principal Investigator:** Paul Corr
**Phone:** 805-481-6684
**Email:** pcorr@arroyoinstruments.com

**Award Amount:** $270,738.00

**Abstract:** Development of LEDs for various applications, such a vehicle lighting, signage, and commercial and residential solid state lighting is progressing at a rapid pace. Various methods exist for measuring the performance of LEDs, but variations in test configurations, thermal management, T&M equipment, and operator experience lead to significant variation in measured performance. The project will design a commercially viable instrument for precisely controlling LED junction temperatures for consistent and repeatable performance during LED test processes. The method, as defined by the Zong/Ohno, eliminates the variations and repeatability errors in thermal interfaces and ensures the junction temperature, a key metric in LED testing, is both known and controllable. Both DC and AC testing modes will be supported.

**Commercial Applications:** This process will create a common, comparable standard for device characterization. However, the market does not presently offer an integrated solution, instead forcing customers to piece together a system with individual pieces, and then develop the process to control them. This presents a huge cost to the user and creates a significant barrier for entry, which will hinder the acceptance of the process as a standard. The commercial potential of the application is significant, as it could ultimately reach into every LED R&D, test, and manufacturing facility. Because it eliminates variations in LED temperature, which is a critical metric in LED performance, this method has the potential to significantly change the way LED specifications are developed. A peer-reviewed, integrated system will significantly speed the adoption of this test method.

**FY 2010 Phase II Award Winner**

**Topic:** OPTICS AND OPTICAL TECHNOLOG**Y**

**Subtopic:** 9.12.03-3.R Gigahertz Frequency Comb for Coherent Fourier Transform Spectroscopy

**Title:** Phase-Stabilized 1-GHz Fiber-Laser Frequency Combs at 2~5um for Coherent Fourier Transform Spectroscopy

**OU:** Material Measurement Laboratory Office

**FIRM:** AdValue Photonics, Inc.
4585 S Rita Rd., Suite 405
Tucson, AZ   85714-1962

**Principal Investigator:** Jihong Geng
**Phone:** 520-790-5468
**Email:** jgeng@advaluephotonics.com

**Award Amount:** $299,125.00

**Abstract:** The GHz-rate phase-stabilized fiber-laser frequency comb system is proposed to be used as a light source for coherent Fourier transform spectroscopy. The system will be developed based on our proprietary glass/fiber technology, which features a low-cost, robust, highly stable, mid-infrared light source that enables the development of a robust portable c-FTIR spectrometer for absorption measurements of many important chemical/biological species. Both the pulse repetition rate and carrier-to-envelop offset frequency of the comb system are stabilized. Important key concepts in the proposed system have been demonstrated in the Phase I effort. This Phase II program will focus on the development of a prototype device, which will be delivered to NIST at the end of the Phase II program for use in proof of principle experiments demonstrating the utility of the device for high-resolution, coherent spectroscopy.

**Commercial Applications:** This proposed technology could offer a turnkey fiber comb system, which will be an ideal light source for c-FTIR spectroscopic applications. The successful accomplishment of the proposed system will enable a low-cost robust portable c-FTIR spectrometer for a variety of applications, such as remote sensing, real-time environmental monitoring, and chemical and bio-molecular screening. Also, a phase-locked frequency comb will be a very useful light source for other high-precision metrology R&D applications, such as high-precision molecular spectroscopy, gas remote sensing and analysis for environmental monitoring, pollution control, agriculture and life sciences, and non-invasive disease diagnosis through breath analysis.

**FY 2010 Phase II Award Winner**

**Topic:** OPTICS AND OPTICAL TECHNOLOGY

**Subtopic:** 9.12.02-1.R High Efficiency Matched Pair Photodiodes at 1550nm

**Title:** High Efficiency, Large-Area, 1550 nm InGaAs Photodiodes

**FIRM:** Voxtel, Inc.
15985 NW Schendel Avenue, Suite 200
Beaverton, OR  97006-6703

**Principal Investigator:** Andrew S. Huntington, Ph.D.
**Phone:** 971-223-5646
**Email:** andrewh@voxtel-inc.com

**Award Amount:** $300,000.00

**Abstract:** A back-illuminated planar InGaAs photodiode tested to have 95% quantum effiiency (QE) at 1550 nm, area greater than 1 mm2, low capacitance (<23 pF), and high bandwidth (>125 MHz) will be improved. Although the existing Phase I device exhibited bulk material dark current generation better than commercially available devices, the sidewall-generated dark current was found to dominate the noise equivalent power (NEP) performance. With all other aspects of the device shown to meet the requirements of optical quantum state tomography, in Phase II, standard planar processing will be used to fabricate the innovation, so that the bulk-InGaAs dominated performance limit of less than 500 pA of dark current can be achieved. Pairs of detectors matched for rise and decay time with less than 0.1% subtraction mismatch under optical excitation by femtosecond laser source will be packaged for use by NIST in homodyne measurements.

**Commercial Applications:** Large-area InGaAs p I n photodiodes are commercially available, but none yet with 95% quantum efficiency (QE) at 1550 nm. Voxtel’s design uses a double optical pass through a thick absorber. This relies on a back-illuminated architecture, and is the only practical method of achieving >95% QE. Typical QE in large-area commercial offerings is ~76%, corresponding to an absorption path length less than ¼ that implemented by Voxtel. The best commercially available high-speed photodiodes achieve about 90% QE, corresponding to an optical path length a bit more than 1/3 of Voxtel’s design. The device has significant advantages in lager diagnostics, optical power meters, laser range finding, near-IR spectroscopy and optical instrumentation. When the Phase II program is complete, Voxtel will have a diode whose unique back-illuminated structure will provide a market barrier to other entrants. Target markets include government and academic labs, and defense applications, where absolute performance rather than unit cost drive demand. Specific applications include near infrared spectroscopy and laser spot tracking. Large-area InGaAs p I n photodiodes are commercially available, but none yet with 95% quantum efficiency (QE) at 1550 nm. Voxtel’s design uses a double optical pass through a thick absorber. This relies on a back-illuminated architecture, and is the only practical method of achieving >95% QE. Typical QE in large-area commercial offerings is ~76%, corresponding to an absorption path length less than ¼ that implemented by Voxtel. The best commercially available high-speed photodiodes achieve about 90% QE, corresponding to an optical path length a bit more than 1/3 of Voxtel’s design. The device has significant advantages in lager diagnostics, optical power meters, laser range finding, near-IR spectroscopy and optical instrumentation. When the Phase II program is complete, Voxtel will have a diode whose unique back-illuminated structure will provide a market barrier to other entrants. Target markets include government and academic labs, and defense applications, where absolute performance rather than unit cost drive demand. Specific applications include near infrared spectroscopy and laser spot tracking.

**FY 2010 Phase II Award Winner**

**Topic:** OPTICS AND OPTICAL TECHNOLOGY

**Subtopic:** 9.12.11-5.TT Integrated Laser Source for Broadband CARS Microscopy

**Title:** Compact fs Fiber Laser Source for Broadband CARS Microscopy

**OU:** Material Measurement Laboratory Office

**FIRM:** PolarOnyx, Inc.
470 Lakeside Dr., Suite F
Sunnyvale, CA   94085-4720

**Principal Investigator:** Lihmei Yang
**Phone:** 408-245-2181
**Email:** lihmeiyang@polaronyx.com

**Award Amount:** $299,557.20

**Abstract:** Based on our success in developing the world’s first commercial 10 W femtosecond fiber laser system and our leading technology development in ultrashort pulsed fiber laser, PolarOnyx proposes, for the first time, a compact high power dual band integrated fiber laser source. The integrated system will be the first extremely compact comprehensive system to address NIST’s current and future needs for accessing molecular fingerprints via chemical imaging of materials and biological systems. The key for the commercialization of BBCARS is the development of advanced performance laser system. In the current proposal a new approach is suggested for generation of compressible Supercontinuum covering from 800-1300 nm and a probe beam at 850 nm. In this approach a photonic crystal fiber PCF with flat dispersion wavelength is pumped by 100 fs fiber laser at 1030 nm wavelength and 850 nm probe beam is through an OPA system. In Phase I, these key functions have been demonstrated. A prototype with turnkey operation will be developed and delivered to NIST in Phase II.

 **Commercial Applications:** The technology proposed by PolarOnyx will provide a vital tool for medical equipment, biomedical instrumentation, imaging microscopy, and precision spectroscopy.