| Title | POC | Time Period | Description | Phase 1 | Phase 2 | Commercialized |
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| A Compact, Low-Cost, Near-UV Sensor for Chlorine Dioxide (EPA 2006 SBIR Phase I) | David S. Bomse, (505) 984-1322, dbomse@swsciences.com Southwest Sciences, Inc., Santa Fe, NM | March 2006- through August 2006 | Southwest Sciences proposes the development of an optical, near-ultraviolet chlorine dioxide (ClO2) sensor having a measurement range of about 0.01 to 2000 ppm with a response time of less than 10 seconds. The sensor will be compact--about the size of a 1-quart milk carton including electronic and optics, operate at low power, and be outfitted with a wireless communications interface to permit remote, unattended operation. Intrinsically safe design is possible. The proposed measurement method is linear, free of hysteresis, and free of interference from common atmospheric gases, as well as urban and industrial pollutants. The sensors will operate well at high humidity and will be able to tolerate moisture condensation. Analyzers will retain calibration for extended periods (many months). Commercial applications include real-time sensors for monitoring and controlling ClO2 decontamination of buildings and other enclosed spaces and for monitoring ClO2 water purification processes and facilities. In Phase II, Southwest Sciences will try to extend the diode-laser method to chlorine detection, which will provide extra utility for characterization and for monitoring combined ClO2/Cl2 decontamination and purifications processes. Southwest Sciences also plans to participate in the U.S. EPA Environmental Technology Verification Program to establish performance specifications for the prototype analyzer. | ✓ | | |
| A Low-Cost Chemosensor for Measuring Phosphate in Water and Soil (EPA 2007 SBIR Phase I) | Thomas E. Coleman, 509-454-5094, tecoleman@dtecsystems.us dTEC Systems LLC, Seattle, WA | March 2007-August 2007 | The proposed Phase I SBIR project is expected to lead to the development of a low-cost portable instrument capable of making real-time measurements of phosphate in water and soil samples. The sensor system for this instrument will be based on the highly selective phosphate binding properties of a co-polymer to be synthesized in this research. When phosphorus is released into water bodies with adequate nitrogen available, eutrophication is likely to result. Eutrophication has been identified as the main cause of impaired surface water quality in the United States. Concentrations of phosphate in solution are usually small, and time is often a critical factor in taking measurements because the inorganic phosphate in a water sample is changing as a result of biological processes. Because of these factors, there is a need for sensitive, inexpensive, and portable instruments to monitor the eutrophication process effectively. Currently available instruments for making phosphate measurements in the field do not adequately address these needs. The sensor to be developed in Phase I will be based on a commercially available microfabricated fringing electric field (FEF) substrate coated with a phosphate-binding polymer. The substrate electrode periodicity will be in the low microns range. By incorporating nanofabrication techniques in the Phase II portion of this research, it will be possible to design and fabricate smaller electrode structures, allowing enhancement of the sensitivity of the sensor system by tuning the electric field pattern generated by the FEF sensor to the dimensions of the proposed phosphate-binding polymer coatings. The key result needed to support the development of a prototype instrument will be the demonstration of binding selectivity for phosphate. A chemosensor developed on the basis of this selectivity would be relatively inexpensive, would require no chemical reagents, and could easily be installed in the field for continuous and/or remote monitoring applications. Additional commercial opportunities are | ✓ | | Initial results unsuccessful. Not commercialized. Working on alternative plan. |

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| | | | possible for wastewater treatment process control and other environmental monitoring applications. | | | |
| A Low-Cost UV Raman Instrument Measuring Nitrate and Nitrite for Improved Operation and Control of Nitrification/Denitrification Treatment Processes (EPA 2005 SBIR Phase I) | William F. Hug (PI), 626-967-6431, w.hug@photonsystems.com Photon Systems, Inc., Covina, CA | March, 2005 - August 2005 | Photon Systems, Inc., demonstrated the proof of concept of a miniature, low-cost UV Raman instrument capable of measuring nitrites in municipal wastewater treatment facilities. Compared to prior technology, the new instrument developed by Photon Systems has about 800-1,000 times less power consumption, 30-40 times lower cost, 10-15 times reduction in size and weight, and is 10 times faster. Further research and commercialization efforts will include development of other special purpose low-cost UVRR instruments for detection of compounds of interest in water supplies, such as algal biotoxins, disinfection byproducts, and other toxic materials that could be accidentally or deliberately introduced. | ✓ | | Project still in progress, but planning to commercialize. |
| A Membrane Preconcentrator for Portable Trace VOC Detectors (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | Haiqing Lin, (650) 328-2228, hlin@che.utexas.edu Membrane Technology and Research Inc., Menlo Park, CA | Phase I: March 2006-August 2006 Phase II: May 2007-April 2009 | A volatile organic compound (VOC) detection system that is portable, sensitive to the low-ppb level, and able to provide reliable measurements in real time is needed for environmental compliance monitoring and process control in chemical plants. Recently, hand-held and battery-powered ppb-level VOC photoionization detectors (PID) have become commercially available, but the presence of water in the sample air interferes with the detection accuracy in PIDs. This project describes the development of a membrane device to remove water vapor from the gas being sent to portable PID-based VOC detectors. The membrane uses a water-permeable, VOC-rejecting perfluoro polymer. The membrane device is compact, lightweight, and energy efficient, which makes it convenient to integrate into a portable detection system. To reduce relative humidity in the air from 100% to 10% while sending 200 mL/min gas to the detector, a membrane with an area of 0.1 sq m is required. In the Phase I project, membranes with the required permeability and selectivity were prepared and made into bench-scale modules with various configurations and the required membrane area of 0.1 sq m. These modules were evaluated for nitrogen/toluene separation, and the configuration was optimized to achieve better separation performance. In addition to removing water from the air, these modules have been demonstrated to enrich VOC content by 10- to 100-fold in the gas sent to the detector. In Phase II, module configurations will be optimized using more innovative designs for improved water removal performance, and a prototype membrane device will be constructed for delivery to business partner RAE Systems, Inc., for testing and evaluation. Integrating such a membrane device with a hand-held, ppb-level VOC detector, such as the ppbRAE Plus detector made by RAE Systems, adds only 30-40% by volume and 100% by weight, which would provide an easily portable system with much improved performance. | ✓ | ✓ | |
| A Nanocrystal Biosensor Array for Simultaneous Detection of Multiple Waterborne Pathogens (EPA | Yongcheng Liu Nanomaterials & Nanofabrication Laboratories PO Box 2168, Fayetteville, AR | March 2005 - August 2005 | NN-Labs successfully developed universal, reliable, simple, and inexpensive protocols for modifying orange-colored nanocrystals with dendron ligands to become water-soluble/biocompatible, for conjugating nanocrystals onto various antibodies, and for immobilizing various antibodies onto the membrane surface. The nanocrystal biosensor technology, in combination with an antibody-immobilized membrane, has been demonstrated as a sensitive, rapid, portable, robust, and inexpensive biosensor for the detection of waterborne pathogens. A manuscript will be submitted to a peer-reviewed journal, such as Nature | ✓ | | No. |

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| 2005 SBIR Phase I) | 72702-2168; 479-575-3055 | | Biotechnology or Analytical Chemistry. A patent is being considered. | | | |
| A New Biosensor for Rapid Identification of Bacterial Pathogens (EPA 2001 SBIR Phase I, EPA 2002 SBIR Phase II) | Mary Beth Tabacco, PI, (703) 658-7692 Echo Technologies Inc., 5250 Cherokee Ave., Alexandria, VA 22312 | Phase I: April 2001-Sept. 2001, Phase II: June 2002 – June 2004 | Echo Technologies, Inc., completed a Phase I project that demonstrated a new approach for the identification of bacteria in aqueous systems. The approach uses bacteriophage as the molecular recognition element. In Phase II, a prototype rapid bacteria identification system will be designed, fabricated, and evaluated in the laboratory and at an independent test facility. The heart of the instrument will be an array of encoded FLVPs integrated with a charge coupled device (CCD)-based imaging/detection system. The results of the project lay the foundation for a continued development effort. The approach also offers an ideal complementary sensor technology that could be incorporated into existing optical sensor platforms and prototype instrumentation. Further development would focus on optimization of the FLVP reaction, design and test of a microfluidic handling system, and prototyping of the RBIS. | ✓ | ✓ | Out of business. |
| A New Compact Portable Field Instrument for Continuous Real-Time Measurement of Trace Organic Air Pollution Emissions Using Jet-REMPI Mass Spectrometry (EPA 2002 SBIR Phase I) | Eli Margalith, PI, (760) 929-0770 OPOTEK, Inc., 2233 Faraday Avenue, Suite E, Carlsbad, CA 92008 | April 2002 – Sept. 1, 2002 | This project will combine tunable ultraviolet laser system with a jet-resonance-enhanced multi-photon ionization (REMPI) time-of-flight mass spectrometer to provide a field-able system for real-time concentration measurements of aromatic hazardous air pollutants (HAPs) in urban air environments. Benchmarks established at this stage are very promising for further development and miniaturization of the system in Phase II. OPOTEK, Inc., has initiated discussion with industrial end users to assess the viability of this technology for specific process contaminant issues. | ✓ | | Yes. |
| A Noncryogenic Tunable Diode Laser Monitor for On-Road Vehicle Emissions (EPA 1999 SBIR Phase I, EPA 2000 SBIR Phase II) | David D. Nelson (978) 663-9500 Aerodyne Research Inc. 45 Manning Road Billerica, MA 01821 | Phase I: Sept 1999-March 2000, Phase II: Sept 2000-Sept 2002 | Remote sensing of on-road vehicle pollutant emissions is a powerful technique for evaluating real-world automotive and truck emissions. Thousands of vehicles are inspected by a single instrument during 1 day. Aerodyne Research, Inc., has previously demonstrated a laser spectrometer that remotely senses vehicle emissions with exquisite sensitivity and selectivity. This instrument used continuous wave lead sail diode lasers operated at cryogenic temperatures using a liquid nitrogen dewar. This use of cryogenic lasers increases the construction cost of the instrument, as well as its operating cost. The goal of this proposal is to build a noncryogenic instrument with similar capabilities that is more compact and less expensive.<br><br>During Phase I, Aerodyne proved that this can be done using quantum cascade QC lasers. The accomplishments included: (1) acquisition of a single mode QC laser operating near 965 cm-1; (2) demonstration of pulsed operation of this laser with pulse widths between 10 and 100 ns and repetition rates up to 200 kHz; (3) integration of this pulsed laser with Aerodyne's proprietary tunable diode laser data acquisition system; (4) acquisition of laboratory spectra of ethylene and ammonia using this system; (5) discovery of operating conditions producing light with a narrow spectral line width (0.012 cm-1); (6) integration of the QC laser with an open path optical system capable of making remote sensing measurements; and (7) remote sensing measurements of ammonia emissions from several automobiles driven through the sensor. | ✓ | ✓ | Yes. Licensed technology to another company; but they are not directly marketing. |

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| | | | During Phase II, Aerodyne will design a dual QC laser system capable of detecting ammonia and carbon dioxide and, therefore, capable of making quantitative ammonia emissions measurements. This system will be compact, cryogen-free, and easily deployed. Aerodyne also will optimize the detection sensitivity and develop a scheme for measuring hydrocarbon emissions - a required element of all automotive inspection programs. The resulting instrument should retain the sensitivity of the existing instrument at a fraction of the cost, and without liquid nitrogen. | | | |
| A Portable Biosensor for the Monitoring of Pentachlorophenol in Pump and Treat Water (EPA 2000 SBIR Phase I) | Dr. John Bowen, (307) 761-3815 Critical Angle, L.L.C., P.O. Box 472, Laramie, WY 82073-0472 | Sept. 2000 - March 2001 | The Phase I objective is to investigate the proof of concept of a biosensor capable of rapid, onsite identification and quantification of an example chlorinated aromatic, pentachlorophenol (PCP), without the use of prior separation or preconcentration. Designed for pump and treat monitoring, this biosensor will be capable of accepting a small (approximately 150 L) sample of water. The sample will be automatically buffered, and the identity and amount of the specific compound will be determined by the instrument platform. This proposed biosensor has the interest of the international environmental consulting firm CH2M Hill and the Hach Company, another international company that produces water quality instrumentation. These companies have agreed to follow the development of this instrument with respect to possible future alliances with Critical Angle for its production. | ✓ | | No. Company is out of business. |
| A Portable Spectrometer for the Accurate Determination of Arsenic in Waters (EPA 2002 SBIR Phase I) | Hakan Gurleyuk, PI, (206) 622-6960 Frontier Geosciences, Inc., 414 Pontius Avenue, North, Seattle, WA 98109 | April 2002 – Sept. 2002 | Originally, it was proposed to develop a micro-plasma source for atomization and atomic fluorescence for detection. Therefore, an He plasma on a quartz chip with a channel of a 1.0 mm x 1.0 mm square cross section was sustained. The length of the plasma was approximately 3-4 mm extending out of the chip. The plasma was operated at 10 W, which can be provided easily by portable power generators. The gas consumption was minimal due to its miniature size. Even though the vessel design has not been coupled with this plasma, mercury vapor has been used, and emission spectra for mercury have been obtained. Even though satisfactory results from a commercial flame AFS instrument have been obtained, Frontier Geosciences, Inc., will continue development of this miniature plasma source for AFS analysis. | ✓ | | No. |
| A Sensitive and Affordable Compact Ammonia Monitor (EPA 2008 SBIR Phase 1) | Joanne H. Shorter (PI), 978-663-9500x208, shorter@aerodyne.com Aerodyne Research Inc., Billerica, MA | March 1, 2008 to August 31, 2008 | The goal of the proposed Phase I project is to develop an affordable, highly sensitive, rapid response, robust, and portable instrument for autonomous real-time monitoring of ammonia. The instrument will use mid-infrared quantum cascade laser (QCL) absorption to accurately quantify ammonia with a precision of 0.3 parts per billion by volume (ppbv) in a 1-second measurement without cryogens or calibration gases. The proposed compact ammonia monitor will be possible with the development of a novel astigmatic multipass absorption cell based on an in-line construction. The novel cell will allow the design of an instrument that is reduced to its optical essentials--little more than a laser, an absorption volume, and a detector. The objective of the Phase I research and development effort is to determine the feasibility of an extremely compact, low-cost noncryogenic QCL spectrometer to measure ammonia. Aerodyne Research will investigate the design of a novel in-line multipass absorption cell and explore | ✓ | | |

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| | | | approaches to simplify the cooling and temperature control of the QCL and infrared detector. These approaches will be studied to determine how they reduce the instrument complexity and, thus, the component and overall cost of a high sensitivity ammonia monitor. The anticipated result of our approach is a robust, portable, sensitive real-time monitor that will be characterized as user friendly and affordable. This instrument will meet the needs and demands of the environmental and atmospheric science communities. The development of a sensitive, affordable instrument for ammonia detection has wide benefits for atmospheric and environmental research. This novel compact QCL instrument will have extensive commercial applications in areas such as air pollution and air toxics monitoring, breath analysis for medical diagnostics, combustion exhaust research, and plasma diagnostics for semiconductor fabrication. | | | |
| A TEF-Based Dioxin Kit Utilizing Fluorescent Aptamers (EPA 2006 SBIR Phase I) | Bharat Chandramouli, (919) 281-4040 Eno River Labs, LLC, Durham, NC | March 2006-August 2006 | Eno River Labs, LLC, (ERL) proposes to develop an onsite testing kit for dioxins that uses fluorescently tagged ssDNA aptamers for selective binding and subsequent screening and quantitative analysis of dioxin in soil sample. Current dioxin field test kits are immunoassay-based, which are insufficiently specific and sometimes unreliable. Reliable dioxin testing requires laboratory tests, which can take days to weeks for results. The field test kit will provide rapid and easy to use for on-site quantitative testing for dioxin contamination. The kit will be based on the use of aptamers, which are specific binding nucleic acids that can be engineered to bind almost any compound with specificity and reliability. Aptamer mixes also can be designed to have different affinities to the different analytes of interest, hence a toxicity equivalency factor (TEF)-scaled kit is possible. In Phase I, ERL proposes to generate a set of specific fluorescent DNA aptamers to bind 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the dioxin with the highest TEF. These dioxin-specific fluorescent aptamers will be developed by the systematic evolution of ligands by exponential enrichment (SELEX) technique. During development, the dioxin-binding aptamers will be tested for their ability to bind specifically to 2,3,7,8-TCDD in the presence of other potential soil contaminants such as polychlorinated biphenyls (PCBs). In Phase II, ERL plans to define the standard curve for 2,3,7,8-TCDD, develop a TEF-scaled aptamer mix to screen for other toxic congeners, develop the quantitative parameters of ERL's kit, apply the dioxin-specific aptamers in a lyophilized form to be easily used in the kit, and demonstrate their utility for contaminated soil monitoring. ERL will test and validate the kit with U.S. EPA Method 1613B, using archived soil samples and performing the analysis in-house, thus obviating the need for field sampling. ERL's kit will be the first truly TEF-based kit available and will be useful for quick analysis onsite, thus providing a means of contamination monitoring, potential reduction in business risk, and more educated decision on modification in construction plans. ERL's onsite kit will offer a nontoxic environmentally friendly, fast, reliable test for dioxin contamination in soil. | ✓ | | No longer works there. |
| Acrolein Monitor Using Quantum Cascade Laser Infrared Adsorption | Joanne H. Shorter, (978) 663-9500 x208, shorter@aerody | Phase I: March 2006-August | Acrolein (CH2 = CHCHO) is a toxic unsaturated aldehyde that has been classified as a hazardous air pollutant by U.S. EPA because of its adverse health effects, particularly on respiratory systems. There is a need for air quality instrumentation for acrolein for routine air quality monitoring in urban areas for health effect assessment and at specific sites for source | ✓ | ✓ | December 2007 Still in Phase II. |

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| (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | ne.com Aerodyne Research Inc., Billerica, MA | 2006 Phase II: May 2007-April 2009 | assessment studies. EPA Region 10 has identified the development of a measurement technique for monitoring acrolein as a priority issue. In the Phase I program, we demonstrated the feasibility of a quantum cascade (QC) laser-based system for acrolein measurement, offering fast response and high sensitivity (~1 ppbv, 1 sec). The instrument is based on tunable infrared laser differential absorption spectroscopy (TILDAS) using QC lasers. The QC-TILDAS method has distinct advantages over indirect detection methods. Infrared absorption is an absolute, highly specific technique. In the Phase I program, we identified the optimum spectral region for acrolein monitoring; investigated and identified background suppression methods with chemical scrubbers to remove interferences from the acrolein measurements, critical to achieving sensitive acrolein detection; and conducted laboratory studies of ambient and source emissions of acrolein. The objective of Phase II is to fabricate and demonstrate a fully functional, fast response, cryogen-free QC laser spectrometer to measure acrolein. The instrument will have compact size to fit in a rack-mountable box and will be capable of long-term, autonomous operation in the field. It will be able to obtain sensitivities in the parts-per-billion (ppbv) range for source monitoring and sub-ppbv range for ambient conditions. There is a need for commercially available air quality instrumentation for acrolein and other toxic air pollutants. The QC-TILDAS system to be built and demonstrated in this program will have wide commercial applications for both routine air quality monitoring and for source assessment of hazardous air pollutants. | | | |
| AGCS Sensor for Gas Leak Detection (EPA 2000 SBIR Phase I, EPA 2004 SBIR Phase II) | Loren D. Nelson (303) 933-2200 OPHIR Corp., 10184 W. Belleview Ave., Suite 200, Littleton, CO 80127 | Phase I: Sept. 2000 - March 2001 Phase II: June 2002-June 2004 | OPHIR Corporation's (OPHIR) Phase I project was very successful. All tasks identified in the Phase I proposal were met and exceeded. The results of Phase I modeling and trade studies indicate that OPHIR's proposed technology exceeds expectations for sensitivity and detection range. Field test data have demonstrated that OPHIR's technology—(a sensor that uses a new Active Gas Correlation Spectrometer) (AGCS)—can achieve a sensitivity of 50 ppb for methane, and 33 ppb for ethane. This technology holds great promise for meeting the needs of several applications within the natural gas industry.<br><br>This project is focused on developing a cost-effective remote sensing system to detect methane and ethane (the two primary constituents of natural gas). Ethane is an excellent indicator of natural gas because it is scarce within the natural environment and not associated with other common combustible gases. Consequently, this system will provide a significant cost savings to the natural gas industry by reducing the time and effort required to find natural gas leaks and eliminating efforts to investigate false alarms. This technology will provide the essential detector currently needed to reduce the atmospheric emission of methane, a significant greenhouse gas.<br><br>The Phase II effort provides the next logical step toward developing this technology for introduction into the marketplace. During Phase II, OPHIR will perform several test programs with the prototype hardware. This includes supporting the U.S. Department of Energy's (DOE) $CO_2$ Sequestration Project, performing airborne flight testing, performing a leak detection survey with a local gas utility company, and completing an extensive field test for a private | ✓ | ✓ | Yes. |

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| | | | corporation. OPHIR already has received significant financial commitments from private industry and DOE's National Energy Technology Laboratory to support this Phase II effort. These commitments exceed $140,000. OPHIR has gained the support of Xcel Energy, which will be providing engineering and test evaluation support.. | | | |
| An Artificial Neural Network and Optimization Methodology for Detecting and Managing Terrorist Attack Against Water Distribution Systems (EPA 2004 SBIR Phase I) | Emery A. Coppola (PI), 609-637-0039 Neural Optimization Applied Hydrology LLC, Lawrenceville, NJ | March 2004 - August 2004 | This project demonstrated the potential for developing multi-state ANN-based water security systems that continuously assess both hydraulic and water quality conditions in real time for identification of a possible terrorist attack (or accident). A number of possible methods require additional research and in addition, by coupling the technology with mathematical optimization software, appropriate crisis responses can be identified quickly and accurately. Although Phase I was limited to in-house development and testing, implementation of software at the participating water distribution system in Phase II will allow for further development and improvement of the system and enhance its adaptability to other water industry problems. During implementation, it will be benchmarked against actual system operations, providing quantifiable measures of benefits provided by the ANN optimization system. | ✓ | | Process is patented. Looking to license for commercialization. |
| Automated Sample Collection and Concentration System for Multiple Pathogens in Water (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | Fu-Chih Hsu, 574-277-4078, fuchih@scientificmethods.com Scientific Methods, Inc., Granger, IN. | Phase I: Jan 2006- June 2006, Phase II: May 2007- April 2009 | The goal of this research project is to develop a simple, rapid, and highly automated sample collection system that will concentrate a broad range of pathogens simultaneously. The system will integrate continuous flow centrifugation (CFC) with an innovative positively charged filter so that large (i.e., protozoan parasites and bacteria) and small (i.e., enteric viruses) bioparticles can be concentrated under an integrated platform. Because CFC is not subject to the limitations of traditional filtration approaches that are subject to fouling, and because its utility was evaluated extensively through Phase I study using a broad range of waterborne pathogens, the integration of CFC and cartridge filtration will extend the utility of the sample concentration platform to accommodate a diverse range of natural and treated water samples that cannot be processed using current filtration methods alone. The system developed in this research project is intended to be compatible with current and commonly employed analytic detection techniques and other advanced detection methods, such as real-time PCR, DNA microchip arrays, and other biosensors. This innovative sample collection and concentration system will provide concentrated samples for routine and advanced water quality monitoring, and will be readily incorporated as a front-end measure for rapid identification of bio-agents in the face of bioterrorism events and post-attack monitoring. The final product is envisioned as an automated sample collection and concentration device that will accommodate a variety of water matrices ranging from finished drinking waters to particle-rich matrices such as surface and wastewaters. The open design of the automated system also will extend the utility of on-line and real-time sensor arrays for waterborne pathogens and indicator microorganisms. | ✓ | ✓ | December 2007 still in Phase II. |
| Biosensor for Field Monitoring of Pesticides in Water (EPA 2005 SBIR Phase I, EPA 2006 SBIR Phase II) | Michael T. Carter (PI), 303-530-0263, eltron@eltronresearch.com Eltron Research Inc., Boulder, | Phase I: March, 2005 - August 2005, Phase II April | This Phase II research project will develop a field-portable, amperometric biosensor for monitoring organophosphorus (OP) and carbamate insecticides in water. The miniaturized biosensor will use a modified, screen-printed microelectrode with high sensitivity and low limit of detection for OP and carbamate pesticides. This biosensor will be selective for OPs and carbamates. The enzyme used to generate the amperometrically detectable species is selectively inhibited by these insecticides, but not by other common classes of agricultural chemicals, such as triazine herbicides. The device uses a single-use, disposable monitoring chip, because some | ✓ | ✓ | Project in progress. |

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| | CO | 2006-June 2007 | of the active pesticides (e.g., the OPs) irreversibly inhibit enzyme activity. Carbamate inhibition is more reversible, but the device, in this case, was evaluated for a single use mode.<br><br>During Phase I, Eltron Research, Inc., demonstrated effective enzyme inhibition by two representative pesticides, aldicarb (carbamate) and methyl parathion, which is an OP insecticide. Aldicarb was detected with a detection limit of 11 ppb, while methyl parathion's detection limit was 18 ppb. This performance is compatible with existing maximum contaminant limits set by the U.S. Environmental Protection Agency.<br><br>Biosensors that can be taken into the field will enable cost efficient environmental monitoring of water supplies. Pesticide contamination could represent a growing and currently underregulated threat because these toxic chemicals are used extensively in agriculture. Potential pollution sources include rainwater runoff of mobile pesticides and spray drift during aerial applications.<br><br>The proposed sensor will offer a cost-reduction strategy for pesticide screening. Prior field screening of samples could contain costs associated with laboratory testing by providing a means to screen out negative, or pesticide-free, samples | | | |
| Balloon Platforms for Remote Sensing of Water Quality in Mixing Zones (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | Robert L. Doneker, (503) 222-1022, doneker@mixzon.com MixZon, Inc., Portland, OR | Phase I: March, 2006-August 2006, Phase II: May 2007-April 2009 | MixZon hypothesizes that infrared (IR) cameras mounted on unmanned tethered helium balloons accessed via a wireless network can remotely sense water quality in mixing zones at site scales. Mixing zones are limited regions in water bodies where the initial dilution of point-source wastewater discharge occurs. Mixing zones are an important component of the NPDES permitting process within total maximum daily load (TMDL) water quality management programs. In Phase I, MixZon developed a low-cost, rapidly deployable, aerial remote sensing system for monitoring water quality in riverine mixing zones. The patent-pending platform monitors outfall performance and focuses on temperature as a dilution tracer. In cooperation with EPA Region 10 and Oregon Department of Environmental Quality, MixZon successfully field-demonstrated the system at an industrial discharge site. MixZon proved the technical feasibility of the remote sensing concept to gather continuous, real-time, site-scale, geo-reference mixing zone data for NPDES regulatory compliance and ESA habitat assessment. Alternative aerial remote sensing platforms have limited availability, high costs, and long lead times to schedule deployment. The cost of the platform will be one-third to one-tenth of competing technology. The platform can be deployed by 2 to 3 people with minimal operator training and is suitable for monitoring at fixed locations for longer time periods than is practical for alternative airborne sensors. In Phase II, MixZon will continue to focus on mixing zones in rivers, where vertical mixing of point sources discharges is rapid but may exhibit long downstream distances for full lateral mixing. MixZon will develop technology to better aim and control the sensors and to identify temperature differentials and associated wastewater types (e.g., process cooling waters, municipal effluents, pulp mill effluents, etc.), outfall configurations (e.g., surface shoreline, submerged single port, multiport diffuser), and ambient conditions that lead to successful monitoring. MixZon will develop tools for hydrodynamic mixing zone model validation and calibrations, commercialize the platform by demonstrating | ✓ | ✓ | |

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| | | | deployment with industrial sponsors, and work with EPA partners on technology verification. Although the platform detects temperature as a water quality parameter, the potential to model the fate and transport of other discharge constituents may be much more widespread (e.g., shoreline recreational exposure to pathogens from wastewater discharges, determination of spatial extent of contaminated sediment deposits from mining operations, detecting the impacts of contaminated groundwater interactions within in groundwater/surface recharge zones, and analysis of thermal refugia habitat for endangered species management). | | | |
| Chemiresistor Microsensors for Environmental Monitoring Systems (EPA 1999 SBIR Phase I) | Dr. Ross C. Thomas (303) 440-8008 Eltron Research, Inc., 5660 Airport Boulevard Boulder, CO 80301-2340 PI no longer with company | Sept. 1999 - March 2000 | This Phase I project addresses the development of chemiresistor microsensors for improving the performance of field-deployable monitors being developed at Eltron Research to detect hazardous air pollutants. Work accomplished during the Phase I program clearly demonstrated the feasibility of chemiresistor microsensors for detecting toluene. The concept to use arrays of devices along with pattern recognition methods provides a basis to reliably detect a wide range of VOCs as well as relative humidity. Phase I results will be used to continue the development of a prototype device during Phase II for eventual commercialization. | ✓ | | No. |
| Compact, Low-Cost, Long Optical Path, Multiple Gas NDIR Sensor (EPA 2004 SBIR Phase I,) | Mark P. McNeal (PI), 781-788-8777 Ion Optics Inc., Waltham, MA Mr. McNeal can now be reached at 978-215-0500 | March 2004 - August 2004 | Using a custom optical gas cell, strategically selected bandpass filters, and an inexpensive infrared source, a compact, highly field able NDIR VOC sensor was developed. The sensor exhibited sensitivities approaching 50 ppm, very good selectivity, very fast response times, and was used to illustrate a method for mass emissions measurements. The price of the current prototype with custom optics and components falls below the U.S. Environmental Protection Agency's (EPA) threshold capital cost of $15,000. This cost could be reduced substantially by developing molded optics and producing the other components in quantity. Ion Optics has identified niche market opportunities that currently are being pursued. | ✓ | | Yes. |
| Demonstration of a Continuous, Real-Time PM2.5 Chemical Speciation Monitor Based on an Aerosol Mass Spectrometer (EPA 2004 SBIR Phase I, EPA 2005 SBIR Phase II) | Douglas R. Worsnop (PI) Aerodyne Research Inc., Billerica, MA (978) 663-9500 | Phase I: March 2004 - August 2004, Phase II: April 2005 – June 2006 | The technology developed and proven in Phase I shows Aerodyne Research is capable of producing an aerosol chemical speciation monitor (ACSM) instrument that measures non refractory submicron $PM_{2.5}$ ambient aerosol mass and chemical composition in real time, providing quantitative measurements of particulate ammonium, nitrate, sulfate, chloride, and organic mass. The Phase II project will develop a prototype that addresses the need for improved monitoring technologies for continuous particulate mass and chemical speciation of ambient aerosols. The ACSM will be designed to run autonomously for extended periods of time and will need no expensive post-processing analysis. | ✓ | ✓ | Project in progress. |
| Detecting Metals in Ambient Particulate | Thomas J. Hope (PI), 518-452- | Phase I: March | The Phase I goal is to develop a prototype instrument capable of performing specialized elemental speciation of ambient particulate matter (PM) in near-real time (1-hour batch | ✓ | ✓ | Project in progress. |

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| Matter: X-Ray Fluorescence Analysis of High-Volume Impaction Deposits (EPA 2004 SBIR Phase I, EPA 2005 SBIR Phase II) | 0065 Rupprecht & Patashnick Co, Inc., Albany, NY | 2004 - August 2004, Phase II: April 2005-June 2006 | collection/analyses). The prototype monitor will incorporate high-volume impaction and x-ray fluorescence technology to accomplish the stated task. The Phase II goal is to produce a Beta instrument capable of providing reliable, quantitative measurements of ambient PM elemental composition on an hourly basis. The system is integrated in a package whose size, weight, and power consumption compare favorably with continuous gaseous and particle instrumentation currently deployed in air quality monitoring networks. | | | |
| Development of a Fine and Course Particulate Continuous Emissions Monitoring System (EPA 2005 SBIR Phase I, EPA 2006 SBIR Phase II) | Tom Baldwin (PI), 775-850-1800, tbaldwin@baldwinusa.com Baldwin Environmental, Inc., Reno, NV | Phase I: March, 2005 - August 2005 Phase II: April 2006-June 2007 | In Phase I of this research project, Baldwin Environmental, Inc. (BEI) successfully demonstrated the feasibility of designing and producing a Fine and Coarse Particulate Monitoring Continuous Emissions Monitoring System (FCPMCEMS). This system simultaneously measures and reports mass concentrations of fine and coarse particulate material using atmospheric dispersion simulation (ADS) and beta attenuation monitoring (BAM). A design and list of tasks were proposed that will result in a commercially viable product from Phase II.<br><br>The commercialization marketing conducted in Phase I indicated that the potential market is estimated at more than 6,000 potential installations in the United States, and possibly double that number internationally, depending on enabling government regulations.<br><br>For Phase II of this research project, BEI will develop an FCPMCEMS capable of continuously measuring and reporting particulate matter (PM), both PM10-2.5 and PM2.5, on most particulate emitting sources. Proposed research and development includes: design; production and testing of two prototype systems, including documentation; development of a calibration scheme; testing on a wide variety of possible samples; and a basic field test of the technology and implementation. Upon completion of Phase II, these products will be ready to begin commercial activities.<br><br>A commercialization option is proposed that will extend the research to include testing of the FCPMCEMS on several different types of emission sources. This research will determine the critical application parameters for these different sources. The data will provide the basis for BEI to configure systems for different applications and generate the printed materials it needs to facilitate sales of the product. It also includes research to assist writers of the enabling regulations. BEI has the distribution channels to sell the FCPMCEMS once rules are promulgated.<br><br>An Environmental Technology Verification (ETV) Program testing option is proposed that will subject the system to independent design performance verification, further enhancing the commercial potential of the technology.<br><br>Successful commercialization of this product requires that the states and the U.S. Environmental | ✓ | ✓ | |

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| | | | Protection Agency enact emissions rules that require owners and operators of sources to measure and report PM10-2.5 and PM2.5 emissions. The reference methods need to be changed to support the ADS approach, such as USEPA CTM 039. | | | |
| Development of a Multianalyte Biosensor Instrument (EPA 1997 SBIR Phase I, EPA 1998 SBIR Phase II) | Dr. John C. Schmidt (410) 321-5200 Environmental Technologies Group, Inc., 1400 Taylor Ave., P.O. Box 9840, Baltimore, MD 21284-9840 | Phase I: Sept 1997- March 1998 Phase II: Sept. 1998 – Sept. 2000 | In this Phase II project, Environmental Technologies Group, Inc. will develop a multianalyte electrochemical biosensor field screening instrument with the potential to reduce the annual cost of environmental analyses in the United States by more than $20 million by reducing the average analysis turnaround time from 19 days to less than 15 minutes, and reducing sampling errors. The instrument will use a common disposable biosensor that is capable of eventually being adapted to dozens of analytes. Second, using the instrument case, electronics, and sensor housing of the Metalyzer 3000TM currently manufactured by ETG, INC will minimize the development cost. The Phase II effort will fabricate a prototype instrument and demonstrate the performance of the system for phenols and pesticides. The instrument could eventually be used to analyze over 20 analytes. | ✓ | ✓ | Company is out of business no information on commercialization. |
| Development of an Improved Detector for Use with a Gas Chromatograph to Measure NO2 and PAN in the Atmosphere (EPA 2008 SBIR Phase 1) | Dennis R. Fitz, 951-676-0324 Fitz Aerometric Technologies, Temecula, CA | March 1, 2008 to August 31, 2008 | The objective of this proposed research is to develop a luminal-based chemiluminescent gas chromatographic detector that is a sealed system. The amount of luminal in a liter of reagent is enough for tens of thousands of parts per million (ppm)-hours of detection in a gas chromatograph. The primary problem is maintaining a consistent wetted surface for contact with the effluent of the chromatographic column. In the past, this was done by continuously pumping fresh luminal reagent to the top of the wick and allowing the excess reagent to flow out by gravity with the effluent carrier gas. An alternative method is proposed to maintain a wetted surface and eliminate the liquid pump. | ✓ | | |
| Development of Antibodies for the Detection of the Toxin Anatoxin by Immunoassay (EPA 2006 SBIR Phase 1) | Fernando M. Rubio, (215) 957-6477 Abraxis, LLC, Hatboro, PA New contact number (215) 357-3911 | March 2006- August 2006 | Fresh water cyanobacteria algal blooms potentially have many adverse environmental impacts. For instance, bloom mats of filamentous algae are believed to reduce ambient light levels below those required for submerged aquatic vegetation to survive. Blue-green algae form blooms that make a surface scum and have been associated with low levels of dissolved oxygen that can be lethal to fish and invertebrate species. In addition to the overt environmental impact, blue-green algae blooms also can produce significant quantities of natural toxins. The toxins produced by these cyanobacteria are extremely toxic to many species. Cyanobacterial toxins (anatoxin-a, microcytins, saxitoxin) also have been identified as potential biological weapons. If these toxins were to be introduced into our water systems, they could not be removed efficiently by conventional water treatment systems and potentially could kill many people. Anatoxin-a also is known as "the very fast death factor" (LD50 for mice is 200 mg/kg with 4-7 minute survival); wild and domestic animals poisoned through ingestion have been observed in the field to be staggering, gasping, and suffering convulsions, followed by death within minutes to hours. Current analytical methods for quantifying the concentration of cyanobacterial toxins in water and in biomass include the mouse bioassay, high-performance liquid chromatography, and the | ✓ | | Research does not support continuation. |

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| | | | phosphatase inhibition assay. Some of these methods are not sensitive enough or require the use of many animals. Although chromatographic methods are capable of detecting and identifying compounds, these methods are time-consuming, labor-intensive, and use flammable and/or toxic solvent for sample extraction. Faster, more sensitive, and less expensive analytical methods, such as enzyme-linked immunosorbent assay (ELISA) for the detection of cyanobacterial toxins, are ideal for the establishment of efficient and cost-effective screening programs that could be used onsite without the use of solvents in water samples. ELISA allows more precise prophylactic and corrective treatment of water at treatment facilities, ultimately benefiting the environment and public health. This Phase I research focuses on creating polyclonal antibodies and hybridoma cell lines that produce monoclonal antibodies. These antibodies react with anatoxin-a with sufficient selectivity, affinity, and avidity to be utilized in a commercial immunoassay system. Once these antibodies are available, commercial immunoassays to detect the cyanobacterial toxin in water and other environmental matrices will be developed and validated (Phase II). | | | |
| Development of a Reliable, Low-Cost, and User-Friendly Spot Test Kit for Leaded Paint and Dust Based on Recent Advances in Bionanotechnology (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II)) | Juewen Liu, jliu2@uiuc.edu DzymeTech, Inc., Champaign, IL (217) 377-9806 | Phase I: March 2006- August 2006 Phase II: May, 2007- April 2009 | On-site and real-time detection and quantification of lead in paint/dust are very important to homeowners and certified lead-based paint removal professionals. DzymeTech, Inc., proposes to develop a reliable spot test kit based on patented and patent-pending technologies developed by Dr. Yi Lu's group at the University of Illinois, Urbana-Champaign. The technology employs catalytic DNA for lead detection. Under SBIR Phase I funding from EPA, DzymeTech has demonstrated the feasibility of using the catalytic DNA-based detection approach for lead in dust in terms of sensitivity, selectivity, interference, precision, stability, and long-term storage. In Phase II, we propose to build and test a prototype of the lead sensor. The prototype kit will contain all the sensor reagent and components with minimal manual transfer of solution needed. The prototype kit will be characterized in terms of sensitivity, selectivity and stability, and will be tested by different users (including EPA inspectors and home-owners) for field sample assays. To achieve the objective of developing a reliable, low-cost, and user-friendly spot test kit, DzymeTech will investigate methods for efficient dust sample collection, lead extraction, and applications of the colorimetric lead sensors under different conditions. Both simulated and real lead dust samples will be used for the test kit evaluation. Factors that improve the user friendliness, shelf life, and cost effectiveness of the test kit will be evaluated. | ✓ | ✓ | |
| Engineered Magnetic Nanoparticles for Advanced Biosensor Signal Processing and Detection of Waterborne Pathogens (EPA 2005 SBIR Phase I, EPA 2006 SBIR | Nile Hartman (PI), 678-287-2408, nhartman@ngimat.com nGimat Co., Chamblee, GA | Phase I: March 2005 - August 2005, Phase II April 2006- June 2007 | The contamination of water resources (drinking, recreational, and agricultural) in developed and/or developing countries, including the United States, necessitates a fast, reliable water safety detection method. The potential use of biological weapons by terrorists to contaminate water supplies is a more recent development that poses additional challenges because such agents are difficult to observe at the time of initial deployment and typically do not produce immediate effects. This Phase II research project identifies an innovative and versatile approach for detection/identification of pathogens based on an integrated optical chip sensor system with improved on-chip signal processing. The sensor is enabled by the incorporation of magnetic nanopowders. This technology employs a multi-channel interferometer design that offers trace level detection sensitivities, rapid response, and multiple agent detection/identification capabilities in a compact package that can be used by unskilled personnel. | ✓ | ✓ | Project in progress, hoping for commercialization in 6 months to a year. |

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| Phase II) | | | The proposed Phase II research will build upon and expand the success achieved in Phase I. In Phase I, nGimat demonstrated that suitable magnetic nanoparticles could be synthesized and attached to an optical chip and magnetic field modulation of the phase of a guided optical wave. The basis of this research is to enable an advanced signal processing scheme to enhance optical biosensor detection sensitivity (sub-ppb) through magnetic field-induced nanoscale displacements of tethered magnetic particles immobilized on the waveguide surface. The nanoparticle displacement will induce a phase shift in the output of a waveguide interferometer that could be utilized to discriminate noise from the collected signal through signal processing. The technology will build on the base optical sensor technology and be ultimately capable of real-time, direct detection (no labeling, additional chemistry steps, or reagents) of multiple biomolecules (proteins, toxins, nucleic acids) in the femtomolar concentration range. It also will be able to detect pathogens (bacteria, viruses) at concentrations of less than 100 organisms/mL.<br><br>This Phase II research project will validate the use of functionalized magnetic nanoparticles as a means of phase modulating a guided wave and demonstrate the detection of specific biological agents based on a phase-lock detection method. It will concentrate on particle size and functionalization optimization, proper magnetic field modulation compatible with the use environment, and field verification at a selected U.S. Environmental Protection Agency site. Phase II and Phase III efforts will be facilitated by the experience of O'Brien & Gere, a leader in water engineering and a committed partner in commercializing the sensor for water quality monitoring. In addition to water quality, nGimat's sensor has the potential to fill needs within food safety, environmental remediation, homeland security, medical drug discovery, and medical point-of-care service industries. | | | |
| Environmental Monitoring Compact Raman LIDAR System Utilizing APD Array Detectors (EPA 1999 SBIR Phase I) | Dr. Arieh Karger (617) 926-1167 Radiation Monitoring Devices, Inc., 44 Hunt Street, Watertown, MA 02472 | Sept. 1999 - March 2000 | This Phase I project will examine the feasibility of producing an inexpensive, compact, ultraviolet (UV) light detecting and ranging (LIDAR) system for environmental monitoring. RMD has successfully completed all of the Phase I tasks and demonstrated the capabilities of Raman LIDAR for environmental monitoring applications. The Compact UV Raman LIDAR system is expected to result in a variety of commercial environmental monitoring products, including smokestack, automobile pollution, and fence line monitoring. | ✓ | | Yes. |

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| Feasibility of Monitoring Heavy Metal Emissions From a Coal-Fired Thermal Hazardous Waste Incinerator Using a Multi-Metal Continuous Emissions Monitor (EPA 2007 SBIR Phase I) | John A. Cooper, 503-624-5750, jacooper@cooperenvironmental.com Cooper Environmental Services, LLC, Portland, OR | March, 2007-August 2007 | Under the current Hazardous Waste Combustor Maximum Achievable Control Technology rule, heavy metal emissions from the nation's thermal hazardous waste combustion facilities are estimated using control efficiencies determined during performance testing and estimated metal feed rates during normal operation. The error in estimates of metal emissions from this approach can be on the order of 100% or more. This error could be greatly reduced by measuring emissions continuously using a multi-metal continuous emission monitor (CEM). Cooper Environmental Services, LLC has developed a multi-metal CEM, the Xact, which recently has been accepted by U.S. EPA for compliance purposes on a gas-fired thermal hazardous waste incinerator. The stack effluent from this facility, however, does not represent a particularly challenging environment. The particulate matter (PM) levels, the moisture content, and the SOx and NOx levels are all low relative to other types of facilities. The research described for this project will demonstrate the feasibility of using the Xact on a coal-fired thermal hazardous waste incinerator. The proposed EPA coal-fired test facility would have higher levels of PM, SOx, and NOx, higher moisture content, and higher temperatures, thus representing a more challenging environment for Xact operation. Procedures used for feasibility demonstration will be similar to those used for EPA Method 301 validation of the Xact on the gas-fired incinerator. These procedures will test the Xact for accuracy and for the linearity of its response to a dynamically spiked metal concentration. If successful, this feasibility study could pave the way for the Xact to be used on coal-fired thermal hazardous waste sources, as well as other coal-fired sources with regulated metal emissions, including municipal waste incinerators, coal-fired power plants, and industrial furnaces and boilers. | ✓ | | Have applied for Phase II (December 2007). They think it has commercialization potential. |
| Field Test Kits for Rapid Detection of Hazardous Contaminants on Indoor Surfaces (EPA 2007 SBIR Phase I) | Xichun Zhou, 303-792-5615, xichunz@adatech.com ADA Technologies, Inc., Englewood, CO. | March, 2007-August 2007 | ADA Technologies, Inc. proposes to develop novel test kits for the rapid collection and identification of biological and chemical hazards on indoor surfaces. The field test kits include litmus paper-like test strips, treated cotton swabs for collecting indoor surface contaminants, and a portable fluorescent reader. The proposed test strips are based on binding-induced fluorescent resonance energy transfer (FRET) detection by employing an aptamer molecular beacon specific to the hazardous agent as the recognition element and fluorescent quantum dots as signal development. The test strip combines the advantages of highly specific and stable aptamer receptors, nanotechnology, and immunochromatographic bioassays. In the Phase I feasibility demonstration, ADA will develop and evaluate prototype test strips based on the binding-induced FRET immunoassays for detection of biological simulants of anthrax spores and ricin and botulinum toxins. Based on the success of Phase I, in Phase II ADA will generate aptamers specific to other biological and chemical hazards such as smallpox, plague, and highly toxic pesticides, and develop test strip panels embedded with multiple aptamer probes in arrayed format for simultaneous detection of multiple biological and chemical hazard contaminants in a single measurement. Phase II work also will include leveraging a commercially available portable fluorescence reader in addition to testing field performance in terms of the selectivity and robustness. This proposed research will provide an improved understanding of the use of aptamers as a specific receptor for the detection of a wide range of chemical and biological toxins. The results of this research will lead to rapid, cost-effective, fieldable test kits with prolonged storage life and low rates of false positive/false negative response. The test kit technology also can be adapted to construct tests for many other important substances, such as | ✓ | | No. |

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| Fiber Optic Diisocyanate Personal Monitoring Device (EPA 2005 SBIR Phase I) | Steven A. Lis (PI), 781-449-5297, stevenlis@comcast.net LightLine Technologies, Inc., Needham, MA | March 2005 - August 2005 | LightLine Technologies plans to develop a highly sensitive fiber optic personal monitoring device targeted for the simple and convenient measurement of total isocyanate and diisocyanate (I&DCY) airborne exposure. The commercial application of this technology is primarily as a personal sensor directed at assuring the safe use of these chemicals during the production and use of a wide range of polyurethane products. The largest potential user group is associated with automotive painting and auto repair (auto body shops). | ✓ | | Did not apply for EPA Phase II, but did apply for another Phase I through CDC. |
| Fiber Optic DNAPL Monitor (EPA 2002 SBIR Phase I) | Michael T. Carter, PI, (303) 530-0263 Eltron Research, Inc., 4600 Nautilus Court, South, Boulder, CO 80301-3241 | April 2002- Sept. 2002 | Eltron Research, Inc., will develop a fiber-optic sensor, which uses a solvatochromic probe to reversibly detect the presence and nature of contaminants. The Phase I project will address the development of sensor materials and chemistry, neural network-assisted data interpretation, and design of a sensor system that can identify and quantify contaminants. | ✓ | | |
| Fiber Optic Sensors With Hydrophilic, Radionuclide-Selective Cladding for the Detection of Radionuclides in Water Supplies (EPA 2007 SBIR Phase I) | Andrea E. Hoyt-Haight, 505-346-1685, adherenttech@earthlink.net Adherent Technologies Inc., Albuquerque, NM. | March 2007- August 2007 | In this proposed Phase I project, Adherent Technologies will develop a fiber-optic scintillator system with radionuclide-selective cladding for use in the detection of radionuclide contamination in water supplies or wastewater streams. The major advantage of this technology relative to current off-site laboratory methods of detecting radionuclides in water systems is "instant" on-site detection, which would allow for an appropriate and timely emergency response. Monitoring of radiological threats to water supplies is similar to the problem of monitoring groundwater contamination at DOE facilities around the country. Significant challenges include the development of a robust detection system that can be used in a continuous monitoring mode and will be sensitive to extremely low levels of contamination. The selective scintillating fiber-optic devices to be developed during this project are expected to be capable of real-time or on-demand analysis and also are amenable to long-term and/or remote monitoring scenarios. When a large volume of scintillator is employed (either as a single-fiber sensor or in sensor bundles), these systems also should be capable of providing detection levels corresponding to drinking water standards. In addition, the use of chemically selective preconcentrating layers is expected to improve further the sensitivity and detection limits of the proposed sensor platform. Desirable attributes of these fiber optic devices include small size, light weight, low cost, low power consumption, and easy integration into a wide variety of application environments. These devices would represent a significant improvement over the current baseline methods that are based on costly laboratory analysis procedures performed at centralized laboratories. | ✓ | | Have applied for Phase II (December 2007). |
| Field Analytical | Richard H. | March | Perchlorate is a widely used component of solid fuel, missile and rocket propellants, explosives, | ✓ | | Yes. |

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| Method for Perchlorate (EPA 2006 SBIR Phase I) | Smith, (734) 995-9338, rsmith@sphinx.biosci.wayne.edu<br>IA, Inc., Ann Arbor, MI | 2006-August 2006 | and pyrotechnics. It has been shown to reduce iodide uptake into the thyroid gland. The U.S. EPA has found perchlorate contamination in 18 states and believes contamination may exist in as many as 39 states. In early January 2005, the National Academy of Sciences, in an EPA-sponsored study, recommended a reference dose (RfD) for human ingestion of 0.7 ug/kg/day, which suggests a maximum contaminant level (MCL) of 24.5 ug/L (ppb) or lower; several states allow between 1 and 6 ug/L. Based upon this recommendation, there is a need for field monitoring of perchlorate in ground and surface waters to test the effluent of remediation facilities and to determine soil cleanup levels. To provide a field analytical method, IA, Inc., has devised a technology that combines ion chromatography (IC), similar to that used in EPA Method 314, with specific perchlorate detection using a low detection limit ion-selective electrode (ISE). Use of the perchlorate ISE as the detector results in lower interference from common anions than is found using Method 314. For this method, IA received a patent in 2004 (U.S. Patent No. 6,736,958). This method simplified and improved Method 314, as the ISE replaced both the conductivity detector and the suppression unit. It also improved the approach of measuring perchlorate by ISE, because the presence of sufficiently high levels of competing ions, measured without separation, can yield false-positive results. The innovation of this Phase I research is to simplify and standardize electrode construction by casting the electrode on thin-walled, porous tubing after having defined free space. The objectives are to (1) cast electrodes on a selection of porous tubing, selecting one that provides optimum robustness and reproducibility; (2) optimize electrode response by selecting the ionophore, plasticizer, and other ISE components; and (3) determine the selectivity obtained when using the perchlorate ISE as the detector for IC. Phase II will focus on optimizing calibration, developing analytical software, and field testing a prototype instrument. The resulting instrument will be suitable for field use, adaptable to batch analysis in the laboratory, and capable of remote sensing. Potential markets include U.S. Department of Defense contractors, environmental engineers and testing laboratories, state and municipal water authorities, and remediation firms. | | | |

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| Field Rugged, Portable H2O2 Monitor (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | Michael B. Frish, (978) 689-0003 contact@psicorp.com Physical Sciences Inc., Andover, MA | Phase I: March 2006- August 2006 Phase II: May 2007- April 2009 | This Phase II SBIR project will develop a field-portable instrument for monitoring and controlling hydrogen peroxide ($H_2O_2$) concentration during building decontamination after accidental or purposeful exposure to hazardous biological materials. This product will enable accurate real-time $H_2O_2$ measurements over the concentration range of 1-10,000 ppmV. The product is an adaptation of a portable gas-sensing platform based on tunable diode laser absorption spectroscopy (TDLAS) technology. The sensor will offer a combination of sensitivity, specificity, fast response, dynamic range, linearity, ease of operation and calibration, ruggedness, and portability not available in alternative $H_2O_2$ detectors. Compared to other spectroscopic gas analyzers, TDLAS offers the benefit of probing individual spectral lines, rather than spectral bands. This capability enables $H_2O_2$ to be distinguished from water, thus overcoming a cross-sensitivity that has limited the accuracy of other $H_2O_2$ analyzers. In Phase I, Physical Sciences, Inc. (PSI) acquired the data needed to select the best $H_2O_2$ spectral features for these measurements, thereby establishing the feasibility of developing the novel $H_2O_2$ sensor. In Phase II, PSI, working with industrial collaborators, will specify the requirements of a field-worthy sensor, build a prototype, calibrate it, test it in realistic deployment scenarios, and verify that the sensor meets its performance specifications. In the Phase II Commercialization Option, PSI will build and calibrate a TDLAS system that measure both $H_2O_2$ and $H_2O_2$ vapors. The initial application for the $H_2O_2$ sensor will be for building decontamination applications. Customers for this product include government agencies (e.g., EPA) and their contractors. Commercial uses of the product include pharmaceutical manufacturing and other sterilization applications. | ✓ | ✓ | Research in progress. |
| Field Screening Detector for Metals in Soil (EPA 1998 SBIR Phase I, EPA 2000 SBIR Phase II) | Amy J.R. Hunter, 978-689-0003 New Contact David Sonnenfroh (978) 738-8235 Physical Sciences, Inc., 20 New England Business Center, Andover, MA 01810-1077 | Phase I: Sept 1998- March 1999, Phase II: Sept. 2000 – Sept. 2002 | Although instrumentation is available for field-screening samples for volatile organic compounds (VOCs), metals field monitors are not widely available. Physical Sciences, Inc. (PSI), proposes to complete the development of a spark-induced breakdown spectroscopy (SIBS) system as a practical field instrument for the measurement of metals in soil. This instrument has a cost goal of less than $15K and will enable rapid site characterization by minimizing the number of samples sent offsite to analytical laboratories. | ✓ | ✓ | No but technology has been incorporated into another product that will be commercialized. |
| Field-Portable Fluorescence Sensor for Polycyclic Aromatic Hydrocarbons (EPA | Kristen Peterson (PI), 505-984-1322, peterson@swsciences.com Southwest | March 2005 - August 2005 | Southwest Sciences proposed to design, build, and test a real-time, field-portable instrument for the detection of polycyclic aromatic hydrocarbons (PAHs). The technology uses time- and wavelength-resolved fluorescence spectroscopy (T&WFS) to identify PAHs at sub-parts-per-billion concentrations in water. Although the Phase I research project did not reach all of the proposed goals, it demonstrates that the T&WFS approach is feasible for PAH detection in a field instrument. A market niche survey indicated that potential users are more interested in | ✓ | | No. |

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| 2005 SBIR Phase I) | Sciences Inc., Santa Fe, NM | | detecting PAHs in soil than in water. They do not have plans to commercialize this technology, as the results of the research were not positive. | | | |
| Fluorescent Nanoparticle-Aptamer-Magnetic Bead Sensor for Bioterrorism Detection in Water (EPA 2004 SBIR Phase I) | John G. Bruno (PI), 210-731-0015 Operational Technologies Corporation, San Antonio, TX | March 2004 - August 2004 | During Phase I, OpTech demonstrated the feasibility of developing a sensitive multianalyte microfluidic cartridge that will incorporate MB antibody-aptamer-QD or MB-aptamer-aptamer-QD sandwich assays. They also developed and tested a breadboard fluorescence reader via its subcontractor, Taboada Research Instruments, which appears capable of at least nanogram detection of QDs. This project demonstrated the feasibility of developing MB-based and QD-based sandwich immunoassays or aptamer-based assays for use in plastic cartridges. These assays could be quite sensitive even if quantified by a handheld fluorometer for which there now are commercial examples, such as the Turner Biosystems Picofluor™. | ✓ | | |
| Graded Interference Filter Spectrometer (EPA 2007 SBIR Phase I) | Joseph Cosgrove, 860-528-9806, cosgrove@AFRinc.com Advanced Fuel Research Inc., East Hartford, CT | March 2007-August 2007 | The release of volatile organic compounds (VOCs) from industrial processes can have negative impacts on the environment while also posing significant health and safety concerns. Although chemical recovery and waste treatment strategies are employed to reduce the emissions of VOCs, there is a strong need for a low-cost, compact sensor that can quickly and reliably identify leaks in the facility process line. Infrared spectroscopy is an excellent method for the analysis of VOCs; however, infrared spectrometers are complex instruments that are too expensive and physically bulky for leak detection applications where low cost, portability, and maneuverability are critical. Advanced Fuel Research, Inc. proposes to develop a low-cost, very compact infrared spectrometer based on a novel graded interference filter, in combination with an infrared microbolometer focal plane array detector. Phase I will fabricate the graded interference filter. A prototype spectrometer then will be assembled with the filter coupled to a microbolometer focal plane array. Gas-phase measurements will demonstrate the spectral accuracy and resolution of the instrument. Phase II will result in a complete infrared spectral sensor covering the mid- and long-wavelength infrared regions, including the analysis algorithms and light-gathering optics for remote chemical sensing. In addition to applications as a remote VOC leak detector, the technology developed in this program will have applications for gas sensing in process monitoring and control and in continuous emissions monitoring. | ✓ | | |
| Handheld Laser-Based Sensor for Remote Detection of Gas Leaks (EPA 1999 SBIR Phase I EPA 2000 SBIR Phase II) | Dr. Michael B. Frish (978) 689-0003 Physical Sciences, Inc., 20 New England Business Center, Andover, MA 01810 | Sept. 1999 - March 2000 Phase II: Sept 2000-Sept 2002 | This SBIR effort is dedicated towards developing a new optical tool that will facilitate the detection and location of toxic or hazardous gas leaks in petrochemical refineries, chemical processing plants, natural gas production facilities, and natural gas distribution pipelines. The tool is based on Tunable Diode Laser Absorption Spectroscopy (TDLAS). TDLAS is a sensing technology that is rapidly gaining acceptance in industrial environments for detecting releases of selected gases. The novel sensor illuminates a distant surface with laser light, like a flashlight. Unlike any other TDLAS instrumentation, the sensor measures the amount of target gas along the line of sight transmitted by the laser beam without the use of any special retroreflective materials. Unlike other types of portable gas detectors, this laser-based device does not need to be immersed within the gas leak.<br>In Phase I, this sensor was shown to be technically feasible. A breadboard prototype was built, calibrated, and tested. The ability to remotely sense a small gas leak from a distance of up to 20 inches was proven. Methane was used as the test gas, and path-integrated methane concentrations of less than 10 ppm-m were readily detectable in less than 1 second. | ✓ | ✓ | Yes. |

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| | | | The basic Phase II effort will develop portable prototype versions of this novel sensor with the objective of acquiring data to demonstrate its capability to detect and quantify gas leaks in a significant market. Working in collaboration with potential users of the technology, a field-worthy prototype sensor will be specified and built. The sensor will be tested and compared against current gas sensing instrumentation, leading to an appraisal of the economic value of the sensor to the users. In addition, engineering documentation that comprises an early step towards product manufacturing will be compiled.<br><br>Assuming that the sensor meets the specified technical requirements during the field tests and that the market potential estimated during Phase I is verified, it is anticipated that one or more third parties will contribute financially to the advanced engineering development as part of the Phase II option. The result of this work will be an engineered product that is ready for transition to a manufacturing environment, where it is anticipated that hundreds of units will be produced annually at a sales price of approximately $10,000. Manufacturers of related instrumentation that serve the intended multimillion dollar gas leak sensing market are prepared to license the technology. | | | |
| Handheld MEMS-Based Detector of Toxins and Toxigenic Organisms Indicative of Harmful Algal Bloom (EPA 2007 SBIR Phase I) | Stephen Hobson louis@seacoastscience.com (760) 268-0083 Seacoast Science, Inc. 2151 Las Palmas Drive, Suite C Carlsbad CA 92011. | March 2007-August 2007 | Seacoast Science proposes the extension of MEMS-based sensor technology to provide near real-time detection, identification, and quantification of toxins and toxigenic organisms indicative of cyanobacteria harmful algal blooms (cyanoHABs) in drinking water to provide administrators the information for public safety. Different monoclonal antibody conjugates will be mapped onto each sensor using a proprietary inkjet deposition process. Both the selective and nonselective binding of the antigen (toxin) with the mAb-C conjugate array will result in a change in dielectric properties of the sensor matrix that will be detected and processed, giving appropriate readings. Specificity inherent in the antigen-antibody binding should limit the fraction of false positives and the use of redundant sensors should lower the fraction of false negatives. The nature of the proposed system allows for rapid analysis (</=10 minutes) with immediate display and optional linking (remotely or directly) of the signal to a computer system for automated reading and storage. | ✓ | | Have not directly commercialized because they haven't received phase II funding. |
| Hybrid Electrochemical-Piezoelectric Sensor for RCRA Metals in Groundwater: Detection of Hexavalent Chromium (EPA 1998 SBIR Phase I, EPA 1999 SBIR Phase II) | Dr. Jeffrey C. Andle (207) 856-6977 BIODE, Inc., 100 Larrabee Road, Westbrook, ME 04092 | Phase I: Sept. 1998 – March 1999 Phase II: Sept 1999-Sept 2001 | BIODE is developing a hybrid sensor that combines the sensitivity of piezoelectric nanobalance technology with the selectivity of stripping potentiometric analysis for the detection of heavy metals in aqueous samples. Prior SBIR effort has resulted in a single sensor that is capable of parts-per-billion levels of ionic mercury. By improving the electrochemical circuitry and using suitable electrode modification, the technique is being extended to the detection and speciation of additional toxic heavy metals. The long-term goal is an array of electrochemical nanobalances for the simultaneous detection and speciation of all Resource Conservation and Recovery Act (RCRA) metals.<br><br>Phase I of the proposed effort focused on demonstrating the feasibility of this sensor technology for the speciation of ionic Chromium. In addition, Phase I demonstrated the ability to detect carcinogenic Chromium (VI) while distinguishing it from the essential nutrient, Chromium (III), | ✓ | ✓ | Company bought by Vectron—no longer exists. |

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| | | | and the species already detectable by the sensor, Mercury (II).<br><br>Phase II will pursue improved sensitivity and increased integration of the prototype. In particular, surface transverse wave (STW) technology offers a hundredfold sensitivity improvement while offering substantial size reductions. Application-specific integrated circuits (ASIC) development will improve reliability while decreasing size and cost. Finally, matrix and interferent effects will be explored for typical aqueous detection applications.<br><br>The proposed Phase II effort will result in a small prototype of a highly sensitive chromate sensor. Phase I effort has demonstrated the feasibility of the technology. Phase II effort will increase sensitivity, develop a completed prototype, and obtain essential test data. The result of the Phase II project will be a prototype sensor and the performance data necessary for commercialization funds.<br><br>Commercial applications exist in environmental testing and wastewater treatment in present and past industrial sites in which chromate has been employed. Chromate has been extensively employed by the aerospace and electronics industry and is especially associated with aircraft maintenance.<br><br>The proposed Phase II effort may be expanded to multiple heavy metals and other ionic toxins, offering vastly expanded commercialization opportunities in water quality testing. These might include drinking water testing (e.g., mercury, lead, cadmium, chromate, perchlorate), blood testing (e.g., lead), environmental screening, nuclear plant safety, and nuclear nonproliferation treaty verification. | | | |
| Identifying and Monitoring Environmental Toxicity Using Ceriodaphnia Microarrays (EPA 2008 SBIR Phase 1) | Owen Hughes, 530-758-5804 Eon Research Corporation, Davis, CA | March 1, 2008 to August 31, 2008 | The aim of this work is to show that Ceriodaphnia dubia microarrays can be a practical technology for identifying, characterizing, and monitoring environmental impact. Specifically, Eon Research hopes to show that microarrays can provide information on the degree of environmental impact and the identity and effects of multiple contaminants in complex mixtures. In Phase I, three reference chemicals (diazinon, chlorphyifos, and copper), whose toxic effects on C. dubia have been well-defined by conventional testing, will be used to generate expression signatures using a 10,000-element spotted cDNA array developed in previous work. Each of these chemicals will be tested individually over a range of concentrations. Eon Research hopes to identify different expression signatures at different levels of toxins corresponding to specific toxicity responses at low dose, and more general stress and cell death responses at higher doses where acute lethality becomes apparent. Additionally, the expression signatures of the binary mixtures of the three chemicals will be examined and compared to the signatures of the individual components. These experiments will help us gauge the difficulty of determining what chemicals are in a mixture based on the mixture’s | ✓ | | |

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| | | | expression signatures. In Phase II, Eon Research will identify expression signatures for a wide range of important environmental contaminants using sequence-defined oligo microarrays. By the end of Phase II, Eon Research will have commercially available environmental contaminants in applications ranging from assessment characterization to monitoring of environmental contaminants and in applications ranging from Toxicity Identification Evaluation (TIE) studies to new chemical registration to Whole Effluent Toxicity (WET) testing. | | | |
| Improved Rapid Detection of Viable Waterborne Pathogens (EPA 2006 SBIR Phase I, EPA 2007 SBIR Phase II) | Richard A Montagna, 716-773-4232, rmontagna@ibi.cc Innovative Biotechn-ologies International, Inc., Grand Isle, NY | Phase I: March 2006-August 2006 Phase II: May 2007-April 2009 | The successfully completed Phase I efforts demonstrated that exceedingly low numbers (five or less) of oocysts from human pathogenic strains of Cryptosporidium, including C. parvum and C. hominis can be detected in drinking water using the isothermic Nucleic Acid Sequence Based Amplification (NASBA) method combined with a rapid liposome nanovesicle-based biosensor technology. Additionally, the CryptoDetect™ Test System that has been developed can distinguish viable from nonviable oocysts and can correctly detect low number of C. parvum, even in the presence of overwhelming numbers of other contaminating waterborne pathogens. In direct head-to-head comparison against Method 1622, the CryptoDetect™ Test System yielded equivalent results. The assay system is based on the immunocapture of low numbers of oocysts, which can be heat shocked to induce the production of a specific mRNA, which in turn can be amplified by NASBA and detected in an easy-to-perform and interpret manner. The entire assay can be completed in less than 4 hours, is less complicated to perform than current methods, and can distinguish nonviable oocysts. Furthermore, the improved assay system will reduce the number of false positive determinations caused by misreading of immunofluorescence slides. Phase II efforts will focus on transforming the above laboratory findings into a commercial product with applications in the drinking water industry. Those efforts will (1) finalize the detection limit of the test, (2) compare current viability/infectivity assays against results of the CryptoDetect(tm) Test System, (3) determine the effect of contaminants that might be found in raw water samples and whether changes need to be made to overcome any such effects, (4) further simplify the test methods required, and (5) evaluate the CryptoDetect(tm) Test System in head-to-head comparison against Method 1622 using and independent Verification Testing Organization (VTO) approved by U.S. EPA. Information contained within the "Technology Niche Assessment" completed by Foresight Technologies on behalf of EPA will continue to be used to attract a commercial partner to manufacture and market the product to the drinking water industry. | ✓ | ✓ | |
| Integrated Downhole Gas Chromatograph and Automated Sampler for Direct Push (EPA 1999 SBIR Phase I, EPA 2000 | Dr. Michael Dvorak, 701-237-4908 Dakota Technologies, Inc., 2201-A 12th Street, | Phase I: Sept 1999-March 2000 Phase II: Sept. | During Phase II, Dakota Technologies, Inc. (DTI) will refine the downhole gas chromatograph (dhGC) prototype that was successfully field demonstrated in Phase I. The dhGC is a complete high-performance gas chromatograph that operates inside a direct push probe. The innovation provides chemically specific, quantitative data that compare favorably to data provided by conventional gas chromatographs in fixed-base laboratories. The data provided by the dhGC prototype are available not in weeks, days, or even hours after the sample is collected, but in less than 5 minutes. The approach completely avoids discrete sample collection, sample | ✓ | ✓ | No. |

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| SBIR Phase II) | North Fargo, ND 58102-1803 (NO LONGER THERE) Contacted Roxanne | 2000 – Sept. 2002 | manipulation steps, or the need for the participation of a field chemist. The only operator requirement is to send a single-keystroke trigger signal once the depth of interest is reached. Independent measurements can be taken at different depths during the same push. The technique can be applied to the entire concentration range from below maximum contaminant levels (MCLs) to free product. Individually and collectively, these attributes represent an enormous advance over the current state-of-the-art for site characterization and monitoring (SCAM). One unit with a photoionization detector (PID) and another with a halogen-specific detector (XSD) will be built and tested in Phase II. | | | |
| Interferometric Continuous Emission Monitor for Active Control of Organic Emissions (EPA 1999 SBIR Phase I) | Dr. Arthur T. Poulos (609) 259-0501 Optomechanical Enterprises, 7 Waterbury Court, Allentown, NJ 08501 | Sept. 1999 - March 2000 | Active process control offers to reduce transient and steady state emissions from combustors and incinerators (mobile and stationary sources). The goal is to alter combustion parameters (equivalence ratio, feed rate, diluent flow, combustion staging) in rapid response to the appearance of products of incomplete combustion (PICs) and PIC precursors. Although Phase I dealt primarily with detection of benzene and acetylene (which may be measured in the 10-14 micron wavelength range), the device range may be extended to wavelength regions appropriate for detection of other combustion species. These include CO, NOx, CO2, HCl, NH3 and others, which are detectable in the near-mid IR, 3-5 micron range, as well as other hydrocarbon species in the "fingerprint" range, 8-14 micron. Assuming equivalent performance, the end-user would be a combustion or process industry that currently uses relatively expensive traditional infrared equipment to analyze for incomplete combustion or impure feedstock gas streams. OME's technology will lower costs, expected as a function of higher efficiency, and lower initial capital investment costs. Improved ruggedness is a long-term advantage, as state of the art FTIR instrumentation has moving parts that require some maintenance and hence, enhanced labor costs. | ✓ | | |
| Low Cost Imager for Pollutant Gas Leak Detection (EPA 2008 SBIR Phase 1) | Lawrence H. Domash, 978-694-1006 Agiltron Inc., Woburn, MA | March 1, 2008 to August 31, 2008 | Infrared (IR) imaging is the best method for detecting leaks of pollutant gases, but current technology based on cooled IR imagers is far too expensive ($75,000 to $150,000) for everyday field use by those who need it to meet regulatory limits, such as electric and petrochemical utilities, manufacturing plants, and businesses like supermarkets. Agiltron will demonstrate a new class of IR imager instrument for the detection of leaks of pollutant gases. Variants of the camera will be demonstrated for the long-wave (8 to 12 um) and mid-wave (3 to 5 um) IR, which between them will be able to locate leaks for dozens of pollutant gases. The proposed technology combines Agiltron's LightLever(tm) photomechanical thermal imager technology with a tunable IR filter developed originally for the telecommunications industry. In Phase I, Agiltron will show the feasibility of the long-wave version using sulfur hexafluoride as a target gas. The mid-wave version will be able to visualize leaks for methane, benzene, and VOCs. The new technology will lead to a hand-held gas-leak viewer that can be sold to end users for less than $5,000. | ✓ | | |

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| Low-Cost Instrument for Long-Term Monitoring of Hazardous Contaminants in Drinking Water (EPA 2007 SBIR Phase I) | John Chetley Ford, 617-668-6801, cford@rmdinc.com Radiation Monitoring Devices Inc., Watertown, MA.<br><br>New Contact Tim Tierman (617) 668-6856 | March 2007- August 2007 | Radiation Monitoring Devices, Inc. (RMD) proposes to design and build a miniature, permanent, magnet-based nuclear magnetic resonance (NMR) spectrometer that can be lowered into drinking water systems. NMR utilizes the same technologies as those used to scan the human body in clinical magnetic resonance imaging machines and uses no harmful radiation. NMR proton spectra will provide continuous, precise, and specific monitoring of the water concentration of substances, such as pesticides, toxic industrial chemicals, chemical warfare agents, and bioaccumulative metal-based and organic toxins, such as mercury and polychlorinated biphenyls. NMR signal sensitivity will be enhanced several orders of magnitude by using nano-scale solid-state sensors rather than conventional wire radiofrequency coils. A major advantage of the technical approach is that because it is NMR-based, any number of chemical compounds can be monitored simultaneously without modification to the hardware or software. Several of these low-cost systems, wirelessly connected to a central computer, can be deployed at various strategic sites within a drinking water facility. Time-sequenced maps of contaminant concentrations, overlaid on a facility map, can pinpoint the source of contaminant release, affording timely information to alert emergency response personnel. During Phase I, RMD will design and build a bench-top NMR spectrometer that will serve as a test bed to develop innovative solid-state sensors that provide extraordinary sensitivity. The outcome of Phase I will be an optimized NMR sensor as well as the most advantageous NMR data collection parameters for measuring trace contaminants in water. The knowledge gained from the Phase I effort will lead to a Phase II prototype capable of unprecedented capabilities in long-term monitoring of drinking water contaminants at very low cost. The Phase II prototype would find many applications within the commercial sector, such as in the petroleum industry for oil well logging and for monitoring contaminants in storage facilities. It also could be utilized to monitor groundwater in or around manufacturing facilities. The instrument would find numerous screening and monitoring applications within the agricultural sector and food industry. | ✓ | | Have applied for Phase II. |
| Low-Level Speciation of Cyanide in Waters (EPA 2001 SBIR Phase I) | Dirk Wallschläger, 206-622-6960 Frontier Geosciences Inc., 414 Pontius Avenue, North, Seattle, WA 98109 | April 2001 – Sept. 2001 | Frontier Geosciences, Inc., proposes to develop a novel method for the speciation of a variety of different covalent and complex cyanides in waters, based on the coupling of a chromatographic separation to the most sensitive and selective cyanide detector currently is available commercially. The method provides several advantages over other currently available analytical methods for cyanide determination and speciation. It is one of the first methods that can actually measure free cyanide ($CN^-$) independent of other cyanide species present with detection limits that allow the analysis of anticipated environmental concentrations. After this Phase I project, the prototype method will be introduced to the market for routine analyses. After further refinement and improvement, Frontier anticipates having a fully developed and tested method available by January 2003. | ✓ | | |
| LSPR Nano-Immunosensor for Simple and Sensitive Water | Glenn J. Bastiaans, 310-530-7130, gbastiaans@int | March 1, 2008 to August 31, 2008 | Intelligent Optical Systems intends to address the current limitations of available water monitoring technologies by applying emerging optical detection and nanotechnologies to develop on-line water monitoring instrumentation that will be capable of detecting a wide range of organic pollutants, toxins, and microorganisms in a multiplexed fashion. | ✓ | | |

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| Monitoring (EPA 2008 SBIR Phase 1) | opsys.com Intelligent Optical Systems Inc., Torrance, CA | | One innovative aspect of the proposed detection method is that immunoassays can be performed in a simplified manner where no additional reagents or labeled molecules are required. The assays can be performed using inexpensive, disposable flow cell cartridges that can be chosen for the assays of interest. Thus, it will be possible to obtain near real-time results in a portable field-use format. The objectives of the proposed study are to demonstrate the use of this innovative optical assay for both a toxin and a microorganism present in a flowing stream of water. As part of the proposed studies, a disposable flow cell will be designed and fabricated to implement the innovative optical immunoassays. These cells will be used to demonstrate the assay of a toxin, microcystin, and E. coli bacterial cells. The success of the proposed work will result in the capability to conduct water monitoring for organic chemicals, toxins, and microorganisms in near real time using economical instrumentation that can be operated in an unattended fashion. The anticipated commercial applications for this water monitoring system include monitoring surface water, monitoring source water at drinking water processing facilities, monitoring water in air conditioning systems, and monitoring drinking water in distribution systems. | | | |
| MEMS-Based Volatile Organic Compound Monitor (EPA 2004 SBIR Phase I) | Dharanipal Doppalapudi (PI), 781-933-5100 Boston MicroSystems Inc., Woburn, MA | March 2004 - August 2004 | Boston MicroSystems, Inc. (BMS), proposes to develop a microelectromechanical system (MEMS)-based volatile organic compound (VOC) monitor by integrating analyte-specific polymer films with SiC-AlN microresonators that are compact and robust, and have low cost and power requirements and high sensitivity. By using an array with multiple sensors, each with high sensitivity to a particular pollutant, a high selectivity is achieved. The fully functional multichannel monitor is expected to be a battery-powered instrument consisting of a microresonator array, drive/sense electronics, rechargeable power supply, visual display, self-test, data storage, and an interface for data downloading. The proposed VOC monitor will provide a compact handheld or remotely operated instrument that enables rapid, real-time, low-cost measurement of multiple pollutant gases for industrial applications. | ✓ | | Did not get Phase II grant. Still working on project but on smaller scale. Not yet commercialized. |
| MEMS Biosensor for In Situ Drinking Water Analysis (EPA 1999 SBIR Phase I, EPA 2001 SBIR Phase II) | Noe Salazar (PI) JCP Technologies, Inc., P.O. Box 80010, Austin, TX 78708-1375 (512) 671-1369 | Phase I: Sept 1999- March 2000 Phase II Sept. 2001 – Sept. 2003 | In completing the Phase I program, JCP Technologies has successfully (1) developed an assay that takes advantage of DNA probe specificity with increased sensitivity through coupled branch DNA (bDNA) signal amplification, (2) designed the microfluidic system necessary to perform the assay on an integrated miniaturized instrument, and (3) demonstrated the microfabricated components for the system. In this Phase II, JCP Technologies will proceed to integrate the assay with microfluidics and MEMS components to develop a compact and portable biosensor for specific detection and identification of Cryptosporidium and other microbial pathogens in drinking water. | ✓ | ✓ | No. |
| Microbial Community Microarrays to | Michael Marshall, 919-572-6581, | March 2007- August | This Phase I SBIR project intends to demonstrate the feasibility of a freshwater microbial community microarray, called the WaterChip™, for detecting the presence of an important model for a mercury chemical pollutant in freshwater. By demonstrating its utility for detecting | ✓ | | Company is out of business. |

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| Assess Chemical and Biological Characteristics of Water Quality (EPA 2007 SBIR Phase I) | klevert@setechinv.com<br>Southeast TechInventures, Inc., Research Triangle Park, NC. | 2007 | evidence of this pollutant, the basis for expanding the WaterChip's™ capability to other environmental toxins and pollutants will be undertaken in Phase II. The ultimate goal of the proposed work is to develop a tool that provides comprehensive, economic, and rapid evaluation of water quality. The proposed WaterChip™ technology is based on detecting individual DNA fingerprints derived from environmental samples to indicate the presence of specific chemical and biological contaminants. This approach will offer a single, rapid, broad-spectrum environmental diagnostic platform that facilitates protection of the environment and public health. The microarray also has the potential to serve as a discovery tool for environmental microbes that are useful for bioremediation. The water-test equipment and service market is a multi-billion dollar industry with a 5-7% steady growth rate. The ultimate goal is to develop a unique water quality test that can be used as a laboratory tool and in remote, real-time monitoring systems. The test platform can reduce the fixed costs of equipment and laboratory training, providing economies of scale for routine testing of water supplies. | | | |
| Microchip Capillary Electrophoresis for Online Measurement of Inorganic Aerosols (EPA 2004 SBIR Phase I, EPA 2005 SBIR Phase II ) | Susanne Hering (PI), 510-649-9360<br>Aerosol Dynamics Inc., Berkeley, CA | Phase I: March 2004 - August 2004<br>Phase II April 2005-June 2006 | Aerosol Dynamics will produce a compact, inexpensive, and sensitive instrument using capillary electrophoresis (CE) mounted on a microchip. Ambient particles are deposited directly on the CE chip by means of humidification, growth, and impaction. Ambient particles are extracted directly in a small aqueous volume for the in situ CE analyses of particle-bound inorganic ions. Both cations and anions will be determined. This "laboratory on a chip" technique will provide online, time-resolved quantification of a suite of PM2.5 inorganic ions found in ambient aerosol. This approach will provide a 5-minute time resolution for ions with detection limits of 10 ng/m3 or better. Commercial applications include monitoring in homes, schools, and offices in addition to central monitoring sites. The CE technique is inherently far more cost-effective than current approaches. | ✓ | ✓ | Project in progress. |
| Microdischarge-Based Multimetal Emission Monitoring System (EPA 2004 SBIR Phase I, EPA 2005 SBIR Phase II) | Cy Herring (PI), XX(217-265-6070) no longer works there<br>Caviton Inc., Champaign, IL (217) 337-6445 | March 2004 - August 2004<br>Phase II: April 2005-June 2006 | Caviton, Inc., developed a novel technique for the continuous monitoring of trace metals emissions. This technique is based on a microdischarge light, which is collected by a spectrometer and analyzed. All metals tested to date can be detected, and the focus of this Phase II research project is to develop a sampling system, carry out laboratory tests, and perform field tests of sampling and analysis. Finally, an instrument design will be completed, which will detail the final form of the instrument. This system will consist of a collection tube, a filter, a sample collection surface that can be heated to release the sample, and a microdischarge device with related analysis equipment. The entire instrument will have no moving parts and will be made from corrosion-resistant materials. To date, detectors have been operated at temperatures higher than 1,000°C with no signs of degradation. Caviton, Inc., will consult with an experienced stack tester to provide side-by-side comparisons to current equipment. This consultant also will aid in the final instrument design to ensure ease of use and real-world functionality. Caviton, Inc., intends to produce a rugged, sensitive, and cost-effective solution to multiple metals monitoring that will be useful for surveys and for continuous emissions monitoring in harsh environments such as smoke stacks, burners, boilers, and incinerators. The company also will consult with a business development and marketing expert with whom it has had a long-standing relationship to identify the proper partners for licensing and producing the resulting instrument. | ✓ | ✓ | Project in progress. |

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| Miniature Membrane Inlet Gas Chromatograph for Cone Penetrometers (EPA 1999 SBIR Phase I) | Dr. Michael Dvorak (701) 237-4908 Dakota Technologies, Inc., 2201-A 12th Street North, Fargo, ND 58102-1803 | Sept. 1999 - March 2000 | Dakota Technologies, Inc. (DTI) has successfully adapted three different gas chromatography (GC) detectors (photoionization, halogen-specific, and electron capture) for operation inside a cone penetrometer. In this Phase I project, DTI will achieve exceptional sensitivity and specificity by making GC measurements while the cone is stopped. A hollow fiber permeation membrane, a sorbent preconcentrator, and a short chromatographic column will be introduced between the microporous membrane and the detector. The result will be the complete functionality of a sophisticated gas chromatograph in a downhole configuration. All the technical objectives as originally defined in the Phase I proposal were met, although approaches were modified in a few cases to incorporate improved information. | ✓ | | No. |
| Miniaturized Electrochemical Sensor for Cr(VI) in Groundwater and Surface Water (EPA 2001 SBIR Phase I, EPA 2002 SBIR Phase II) | Veronica M. Cepak, PI Eltron Research Inc., 4600 Nautilus Court, South Boulder, CO 80301-3241 (303) 530-0263 | Phase I: April 2001-Sept 2001, Phase II: June 2002 - June 2004 | This project will utilize photolithography and microfabrication in the assembly of a Cr(VI) monitoring device that is compact, portable, and cost effective. The proposed sensor will be a self-contained laboratory that samples, analyzes, and stores the results of onsite testing under a variety of sampling conditions. The device will rely on the pressure-driven introduction of aqueous samples that will be combined with a small, specific volume of electrolyte. Analyte streams of arbitrary ionic strength and composition will be sampled with minimal pretreatment. The use of a microelectrode array sensor chip will allow for increased sensitivity via enhanced diffusion of the analyte to the sensor element. In addition, use of a miniaturized detector will reduce solution waste during testing. Eltron Research, Inc.'s proposed electrochemical detection scheme allows for the use of simple, inexpensive instrumentation that is capable of the remote monitoring of groundwater and surface waters for Cr contamination. Phase II will focus on the optimization of the proposed Cr(VI) sensor in addition to the assembly and design of a prototype unit for field analysis of groundwater and surface waters using minimal analyte and supporting electrolyte.<br><br>In Phase I, Eltron Research Inc., successfully demonstrated that self-assembled monolayer (SAM) modified microelectrode arrays could be used for the electrochemical detection of Cr(VI) in aqueous solutions. Cr(VI) solutions with concentrations varying from 0.1 ppb to 100 ppb could be detected using a sensitive electrochemical method. Using photolithography, a robust microelectrode array was fabricated and incorporated into a microfluidic flow cell for Cr(VI) detection. Furthermore, this flow cell was successfully coupled to a peristaltic pump to introduce analyte and supporting electrolyte for Cr(VI) detection, and was interfaced to benchtop electrochemical instrumentation (a potentiostat) for potential use in long-term monitoring situations. The performance of the miniaturized Cr(VI) detector was studied as a function of such variables as pH, supporting electrolyte concentration, SAM deposition time, Cr(VI) exposure time, electrolyte type, and Cr(VI) concentration.<br><br>The electrochemical detection of Cr(VI) in water is a cost-effective method for long-term, remote monitoring of suspected environmental contamination sites. This approach could find general use in both specific U.S. Environmental Protection Agency applications and those of the private sector; for example, the monitoring of Cr waste in the electroplating industry. Other industries requiring wastewater monitoring for hexavalent chromium include metal processing, | ✓ | ✓ | Laboratory prototype. |

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| | | | galvanic plants, tanneries, wood preservation, chemical manufacturing, aerospace, and electronics. | | | |
| Monitoring Groundwater Contaminants (EPA 2004 SBIR Phase I) | Anuncia Gonzalez-Martin (PI), XX(979-693-0017) new location Lynntech Inc., College Station, TX (408) 266-9214 CA | March 2004 - August 2004 | During Phase I, Lynntech developed and successfully tested a bench-scale miniature sensor capable of identifying CHCs and BTEX in water at the ppb level. The sensor combined an effective array-based chemical sensor with an efficient preconcentrator system. A computer carried out operation of the monitor, sample collection, and data analysis. | ✓ | | Not Commercialized would like to. |
| Monitoring Multiple Volatile Organic Compounds With Cost-Effective Optical Remote Sensing Instrumentation (EPA 2004 SBIR Phase I) | Loren D. Nelson (PI), 303-933-2200 OPHIR Corporation Littleton, CO | March 2004 - August 2004 | The goal of this Phase I research project is to prove the concept of combining Ophir's proven long-path (fenceline), active correlation spectrometer method with synthetic spectra gratings. The Phase I effort was a success. At this time, there are no plans to commercialize the findings. | ✓ | | No. |
| Multi-Analyte Nanoelectronic Air Pollutant Sensors (EPA 2004 SBIR Phase I) | Alexander Star (PI), 510-428-5300 Nanomix Inc. Emeryville, CA | March 2004 - August 2004 | Nanomix, Inc., proposes to develop and commercialize nanoelectronic chemical sensors for the detection and measurement of air pollution. The end product of the work, a tiny, low-cost nanosensor chip, will measure concentrations of three different analytes down to the single molecule level. The Phase I goal is to build and demonstrate a nanosensor prototype to detect and measure real-time concentrations of three types of analytes: (1) aromatic hydrocarbons; (2) acidic gases (e.g., HCl, HF, SOx, NOx); and (3) basic gases (e.g., NH3). The sensor itself consists of two major components: a transducer array made of single-wall carbon nanotubes on a complementary metal oxide semiconductor silicon substrate and chemical recognition layers or coatings that increase the transducer's sensitivity and selectivity to the target analytes. The major focus of Phase I will be the selection of a recognition chemistry for each analyte and sensor array fabrication and testing in a laboratory environment. Successful commercialization of the technology will allow designers to place air pollution sensors anywhere they are useful for leak detection and air quality monitoring. | ✓ | | Yes. |
| Multimetals Emission Monitoring System | Amy J.R. Hunter, 978-689-0003 | March 2004 - August | Physical Sciences, Inc. (PSI) proposes to develop a multimetals emissions monitor to support Title V permitting of large air pollution sources based on its patented spark-induced breakdown spectroscopy (SIBS) technology. Work prior to Phase I has shown that this technique is capable | ✓ | ✓ | No. |

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| Based on Spark-Induced Breakdown Spectroscopy (EPA 2004 SBIR Phase I, EPA 2005 SBIR Phase II) | Physical Sciences Inc., Andover, MA New Contact: David Sonnenfroh (978) 738-8235 | 2004, Phase II April 2005-June 2006 | of sensitively monitoring metals in airborne particles that emit in the visible range (e.g., Pb, Cr, and Cd). To be useful for measuring all metallic hazardous air pollutants (HAPs), however, use of SIBS in the deep ultraviolet must be developed.<br><br>In Phase I, therefore, PSI began the development of SIBS capability to monitor As and Se, which have strong emissions at 193.7 and 196.0 nm, respectively. This ability will be optimized in Phase II and then it will be married to the existing SIBS technology to create the basis of a monitor that is able to identify and quantify all HAP metals. This monitor will be very useful in enabling large air pollution sources, such as incinerators and power plants, to meet the Title V obligations of emissions monitoring and reporting. The SIBS monitor will operate in real time, an improvement over the currently used U.S. Environmental Protection Agency Reference Method 29, an extractive technique that is labor intensive, slow, and not amenable to automation. | | | |
| Multiplexed Chemical Sensor for Water Security (EPA 2005 SBIR Phase I, EPA 2006 SBIR Phase II) | Stuart Farquharson (PI), 860-528-9806, stu@rta.biz Real-Time Analyzers, Inc., East Hartford, CT | Phase I: March 2005 - August 2005 Phase II April 2006-June 2007 | The goal of this Phase II research project is to provide municipal authorities and the U.S. Environmental Protection Agency with a chemical sensor that can be multiplexed into water distribution systems to provide early warning of poisoned water supplies. This will be accomplished by developing surface-enhanced Raman (SER) sensors that can be integrated into water supply systems and coupled to a central Raman analyzer via fiber optics.<br><br>All of the test chemicals, pesticides, chemical agent hydrolysis products, and cyanide were measured at the Phase I detection goal of 1 ppm (1 mg/L) within 5 minutes. The estimated limits of detection suggest that the Phase II detection goal of 10 ppb (0.01 mg/L or 0.01 ppm) can be obtained. Furthermore, in the case of cyanide, a 10 ppb flowing sample was detected in 1 minute.<br><br>The overall goal of Phase II will be to fully develop the proposed analyzer and improve sensitivity to allow detection at 10 microorganisms/L in 10 minutes. (This meets or exceeds requirements for drinking water.) The project will include: ruggidizing the SER-active, sol-gel capillaries; developing a universal sampling system with a fiber optic probe interface; and developing comprehensive analysis that includes rapid chemical identification. Capabilities will be developed using real-world samples from a drinking water distribution system and water supply. An additional field test, performed at the U.S. Army's Edgewood Chemical Biological Center, will involve the analysis of HD and VX (chemical agents) added to a close-loop water test system. | ✓ | ✓ | Project in progress. |
| Nanocomposite Sensor Array for the Detection of Multiple Toxic Air Pollutants (EPA 2001 SBIR Phase I) | Debra J. Deininger, 720-494-8401 Nanomaterials Research Corp., 2620 Trade | April 2001 – Sept. 2001 | This proposal is to develop a low-cost, sensitive, and selective sensor array for the detection of volatile organic compounds (VOCs). The results have shown that it is feasible to produce a simple and portable low-cost sensor array for the detection of multiple toxic air pollutants. The detector array is based on variations in sensor composition and operating method, and the data are manipulated using multivariate analyses. The resulting prototype product is envisioned as a portable instrument that is capable of quantitatively identifying small groups of VOCs for | ✓ | | |

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| | Center Ave., Ste. C, Longmont, CO 80503 Reorganized into Nanomaterials Research LLC | | specific target applications. | | | |
| Novel Detection Interface for Gas Chromatography/ Fourier Transform Infrared Spectroscopic Analysis (EPA 2001 SBIR Phase I) | Ronald H. Micheels 781-449-2284 Polestar Technologies, Inc., 220 Reservoir St., Ste. 32, Needham Heights, MA 02494-3149 | April 2001 – Sept. 2001 | Polestar Technologies, Inc., proposes to develop a field-portable gas chromatography/Fourier transform infrared spectroscopy (GC/FTIR) instrument based on a novel infrared detection interface for the GC/FTIR analysis technique. The prototype innovative FTIR detection/ sampling device developed in the Phase I project did not have sufficient sensitivity and response time for successful application as a GC/FTIR interface, but it did show promise as an FTIR detection/sampling system with lower cost and greatly reduced size relative to existing FTIR sampling systems of related design. Commercialization of the device developed in the Phase I project is being pursued for the latter application, where the device has advantages in cost and ability to handle small samples. | ✓ | | No. |
| Nanoparticle-Based Lateral Flow Microarray Test Strip Assay (EPA 2007 SBIR Phase I) | Srivatsa Venkatasubbarao, 310-530-7130, sbirproposals@intopsys.com Intelligent Optical Systems Inc., Torrance, CA | March 2007-August 2007 | Nanoparticles exhibit unique optical properties that can be exploited in the development of highly sensitive assay systems. This project describes the development of a lateral flow test strip microarray that will utilize nanoparticle amplification to detect waterborne pathogens. Waterborne pathogens have been chosen for this study because they can cause severe illness, and even death, and therefore the identification of these pathogens in water is critical. The proposed system will be field-usable, easy to operate, and inexpensive. Furthermore, it will have very high sensitivity and multiplex capabilities to allow detection of several different pathogens simultaneously in a single assay. In the proposed Phase I project, the lateral flow test strip microarrays will incorporate the nanoparticle amplification strategy, and a sensitive and inexpensive hand-held reader will be fabricated. The Phase I feasibility will be demonstrated by simultaneously testing three different pathogens in a water sample. We will demonstrate the ability of this technology to meet or exceed the performance of laboratory-based ELISA test kits. We also will describe the path that will lead to truly multiplexed assays in Phase II and beyond. The successful completion of this project will result in an indispensable tool to be used in water treatment facilities. It also will be beneficial in food testing and medical applications. Beyond these civilian uses, the proposed technology will be useful for detecting pathogens in military environments. | ✓ | | No. |
| On-Line, Near Real Time Water Security BioMonitoring System (EPA 2006 | Salvador M. Fernandez, (Passed Away) (860) 528-9737 Ciencia Inc., | March 2006-August 2006 | Ciencia, Inc., proposes to develop an innovative biosensor system for near real-time, on-line monitoring of water for the presence of pathogens and biotoxins. The proposed optical biosensing approach possesses a unique combination of features: (1) it does not require the use of labels for detection (such as fluorescent, enzymatic, or radioactive tags), which enables easy automation of immunoassays and direct real-time detection of analytes, and (2) it is microarray- | ✓ | | Not yet commercialized, still hoping to. |

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| SBIR Phase I) | East Hartford, CT<br>Arturo Pilar-new contact | | based, thus providing for highly parallel detection of multiple analytes, including viruses, bacteria, spores, and biotoxins. Ciencia anticipates that the system will provide continuous monitoring with a sampling period of less than 1 hour and with a detection limit for bacteria on the order of one organism per mL. Potential commercial applications include environmental water testing and water supply security, biodefense and homeland defense, biomedical research, clinical diagnostics, agricultural bioterrorism, food safety testing, and environmental contamination and remediation. | | | |
| Optical Monitor for Noninvasive, Chemical- and Size-Differentiated Characterization of Airborne Aerosols (EPA 2001 SBIR Phase I) | Harry C. Lord III, (626) 813-1460<br>Air Instruments & Measurements, Inc., 13300 Brooks Dr., Ste. A, Baldwin Park, CA 91706 | April 2001 – Sept. 2001 | The Phase I objective is to examine the feasibility of producing an inexpensive, compact, robust laser-based system for continuous monitoring of anthropogenic aerosol emissions. The proposed optical PM analyzer will have the flexibility to be used in an in situ (i.e., across-stack) configuration for stationary source monitoring and in a remote sensing configuration for noninvasive sensing of vehicle exhaust emissions and open path monitoring. Consequently, numerous commercial opportunities for this technology exist in a wide range of industries. | ✓ | | Yes. |
| Pneumatic Focusing Gas Chromatography: A Continuous, Automated, Ambient, Fenceline and Fugitive Emissions Monitoring Instrument (EPA 2004 SBIR Phase I) | Thomas M. Hard (PI), 503-725-3881, hardt@pdx.edu<br>VOC Technologies Inc., Portland, OR | March 2004 - August 2004 | VOC Technologies, Inc., will use the new technique of pneumatic focusing gas chromatography (PFGC, patent pending) in the development and testing of a commercial, continuous, speciated monitor for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). The Phase I goal is to produce a PFGC instrument that costs less than $15,000. Once minor design problems and difficulties were solved, the constructed PFGC instruments were found to be sensitive, precise, rugged, and portable. Further work will address remaining technical issues and demonstrate long-term performance. The advantages of VOC Technologies' PFGC over conventional analysis methods include significantly higher automation, lower cost, internal calibration on every sample, as well as a continuous record of emissions, which invites correlation with weather patterns and emission sources. VOC Technologies is in the final stages of patent approval for this technology. Instruments are available for sale or lease. Contract monitoring also is possible. | ✓ | | Project in progress. |
| Polymer-Based Competitive Flow Sensor Detects Contaminants in the Field (EPA 1999 SBIR Phase I, EPA 2001 SBIR Phase II) | Dr. M. Todd Coolbaugh (540) 731-0655<br>American Research Corporation of Virginia, P.O. Box 3406, 1509 Fourth Street, Radford, VA 24143-3406 | Sept. 1999 - March 2000<br>Phase II: Sept 2001-Sept 2003 | This Phase II project addresses the development of technology that would provide field-based quantitative detection of a wide range of environmental contaminants through the use of molecularly imprinted polymers and fluorescence detection. The proposed method would complement immunological methods of analysis that have been adapted to contaminants such as herbicides and pesticides. The well-documented advantages of these methods, including high sensitivity and selectivity and fairly low cost per analysis, are offset by a number of disadvantages. Antibodies have somewhat limited physical and chemical durability and cannot be used at elevated temperatures, beyond a fairly restricted pH range or in nonaqueous environments. In the Phase I program, American Research Corporation of Virginia developed a compact displacement flow sensor utilizing molecularly imprinted polymer (MIP) technology and diode laser-excited near-infrared fluorescence detection. In the Phase II program, work will be performed to optimize and field test the MIP sensor. The innovation of the Phase II program | ✓ | ✓ | |

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| | | | is the development and use of a new generation of biomimetic MIP to provide analyte selectivity and down-stream near-infrared fluorescence as a sensitive means of detection. Phase II also will address the selectivity of the MIP system. The Phase I results have shown that MIP specific for atrazine and 2,4-D can be conveniently prepared and processed. Methods were developed to fabricate rapidly interchangeable cartridges. A low-cost diode-laser based fluorimeter was developed and shown to be capable of extremely low detection limits and very stable operation. Synthetic strategies for preparing fluorophore labeled analyte molecules were developed. The Phase II technical objectives include the preparation of MIP and competition reagents and development of assay methodology optimized for environmental analysis, and fabrication extensive testing of the sensor system.. | | | |
| Portable Fast GC System for Field Environmental Monitoring and Measurement Problems (EPA 2001 SBIR Phase I) | Mark A. Klemp, (734) 662-3410 Chromatofast, Inc., 2901 Hubbard Rd., Ann Arbor, MI 48105 | April 2001 – Sept. 2001 | Chromatofast, Inc., has developed a proprietary, high-speed laboratory GC inlet system that generates a narrow injection bandwidth so chromatographic analyses can be obtained in tens of seconds to a few minutes, features well suited for a field-deployable instrument. It also can be a sample collection device with its ability to sample air directly. Successful completion of the proposed Phase I project will result in a high-speed GC laboratory prototype that incorporates a novel, low-powered microcolumn. | ✓ | | No longer in business. |
| Portable Methane Flux Meter (EPA 1999 SBIR Phase I) | Dr. David Christian Hovde (505) 984-1322 Southwest Sciences, Inc.,1570 Pacheco St., Suite E-11, Santa Fe, NM 87505 | Sept. 1999 - March 2000 | This Phase I project will investigate achieving a low power, portable system for measuring methane concentrations and fluxes by combining diode laser-based trace gas concentration measurements with rapid wind speed measurements to determine fluxes using eddy correlation. By employing advanced diode laser modulation methods with signal processing electronics developed for the communications industry, a low-cost, lightweight system can be developed. | ✓ | | License agreement with company but without EPA funding. Looking to commercialize. |
| Rapid, Accurate, Single-Step Test Strip for Low Level of Arsenic in Water (EPA 2000 SBIR Phase I) | Dr. John A. Bognar, (303) 792-5615 ADA Technologies, Inc., 304 Inverness Way South, Suite 365, Englewood, CO 80112-5840 PI no longer with company. | Sept. 2000 - March 2001 | The goal of this Phase I project is to develop and commercialize an easy-to-use, nontoxic test strip that will indicate the presence of arsenic in water at levels down to 0.1 ppb. The SBIR Phase I project conducted by ADA Technologies, Inc. (ADA) has successfully developed a test kit that responds to approximately 200 ng (200 x $10^{-9}$ g) of arsenic, giving a detection limit of 10 ppb arsenic in a 20 mL sample. The user is required only to measure the sample into a small vial and attach the cap. The results are read as a colorimetric change in the filter held within the cap. The device is responsive to both arsenate and the more dangerous arsenite ions; however, the design also will allow an alternative chemical system that will only respond to arsenite ions. | ✓ | | No. |

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| Rapid Immunochromatographic Strip Tests Detecting Lead-Based Paint (EPA 2006 SBIR Phase I) | Mark Geisberg, (626) 359-8441, mgeisberg@silverlakeresearch.com Silver Lake Research Corporation, Monrovia, CA | March 2006-August 2006 | Exposure to lead-based paint (LBP) is the major source of potentially dangerous levels of lead in children and adults in the United States. This project aims to develop rapid, on-site test kits for the detection of harmful levels of LBP. The proposed test kits will be calibrated to current regulatory standards, will require no user training or instrumentation, and will resemble a home pregnancy test. The proposed test kits will produce a yes/no result, with the negative result providing extremely high confidence that the sample does not contain lead in excess of the regulatory limit and the positive results informing the user that further testing may be warranted. The test kits will be designed to replace current instrument-based assay methods for screening purposes. The successful product will (1) increase the effectiveness and reduce the cost of large-scale screening and mapping of LBP contamination, and (2) enable nontechnical users to quickly and accurately detect or rule out LBP contamination at home or onsite. In Phase I, Silver Lake Research Corporation will attempt to develop a laboratory-format immunoassay for detecting lead extracted from paint chips. At the successful conclusion of Phase I, Silver Lake Research will have demonstrated an extraction-immunoassay procedure capable of discerning whether a given sample of paint contains lead in excess of the regulatory limit. In Phase II, Silver Lake Research will transfer the immunoassay capability developed in Phase I into a rapid immunochromatographic test strip format. Silver Lake Research has been producing test strips of this type since 1998, and possesses considerable expertise in the design, development, and manufacturing of immunoassay test strips. All of these products share the principle of replacing costly, time-consuming, and labor-intensive analyses with a rapid and accurate screening test. | ✓ | | No. |
| Real-Time Analysis of Metals in Aqueous Waste Streams (EPA 2002 SBIR Phase I) | Rhys N. Thomas, PI, (660) 248-1911 Fayette Environmental Services, Inc., P.O. Box 30, Fayette, MO 65248 | April 2002 – Sept. 2002 | The proposed innovation, a new form of spectrometry, will be able to quantify the metals in aqueous effluents to 100 ppb in real time. In addition to meeting the analytical burden cost effectively, the instrument will reduce liability by documenting all discharges in small increments of time. The instrument also will find application in monitoring process baths for trace metals contamination and for primary metal concentration. Monitoring trace metal contamination will allow the user to determine when a bath requires replacement or cleanup. Monitoring primary metal concentration will allow the user to extend the life of a process bath to the maximum. These analyses require no sampling or sample treatment; personnel who are not trained in analytical chemistry may monitor the baths. The software method developed in this research has application to all forms of spectroscopy in which complex spectra must be resolved into a list of known elemental or molecular components. The immediate objective of this research is to measure the necessary constants and demonstrate the mathematical theory can be applied to a real problem. Phase I will result in an instrument that lacks only the user interface software, which will be developed by Fayette Environmental Sciences, Inc. | ✓ | | |
| Real-Time Analytical Technology for Environmental Applications (EPA 1999 SBIR Phase I) | Dr. Bijan Miremadi (303) 702-1672 Nanomaterials Research Corporation, 2620 Trade | Sept. 1999 - March 2000 | Real-time measurement and monitoring technologies are needed for objective and prompt reduction of pollutants and hazardous vapor emissions. Nanomaterials Research Corporation (NRC) seeks to address this need and develop and commercialize real-time microanalyzers for pollutants in general and ammonia in particular. During Phase I, NRC will demonstrate the proof-of-concept. | ✓ | | No. |

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| | Center Avenue, Longmont, CO 80503 Company reorganized to Nanomaterials Research LLC | | | | | |
| Real-Time Multi-Parameter Analysis of Pollutants in Stormwater and Other Complex Analyte Matrices Using Electrospray Ionization-Ion Mobility Spectroscopy (EPA 2002 SBIR Phase I, EPA 2003 SBIR Phase II) | Thomas E. Coleman, PI, (509) 454-5094 dTEC Systems, LLC, 3012 16th Avenue West, Seattle, WA 98119 | Phase I: Oct. 2002 – July 2003 Phase II: Oct. 2003- Dec. 2004 | The adverse affects of stormwater runoff on water quality in the United States have become an increasing concern in recent years. In 1996, the U.S. Environmental Protection Agency reported to Congress that urban runoff was the leading source of pollutants causing water quality impairment related to human activities in ocean shoreline waters and the second leading cause in estuaries across the United States. Historically, the measurement of nutrients and priority pollutant compounds at trace levels in the complex sample matrices typical of stormwater discharges has required time-consuming and expensive offline measurement in laboratories. This Phase II research project is expected to lead to the development of a portable electrospray ionization-ion mobility spectroscopy (ESI/IMS) analytical system that will be broadly applicable to the monitoring of stormwater runoff and combined sewer overflows. It also will be applicable to the monitoring of drinking water treatment systems for arsenic and other contaminants, including biological and chemical toxins. The ESI/IMS instrument to be developed in this research will enable real-time aqueous phase measurement of conventional parameters, such as ammonia, phosphorus, nitrate, and nitrite, as well as a wide range of organic and inorganic compounds, in the field or online, without the need for transportation of samples or complex sample preparation.<br><br>The important findings that have been demonstrated in the first 6 months of the Phase I research project include: (1) quantitative detection of many of the chemical species of interest in stormwater at parts per billion and low parts per million levels, (2) a significant improvement in the design of the electrospray ionization component of the ESI/IMS instrument, (3) the response time and stability of the ESI/IMS measurements are very good, (4) multiple analytes in mixtures can be measured quantitatively at the same time, and (5) significantly lower detection limits can be expected by incorporating improved thermal and electronic noise reduction in a prototype instrument design.<br>. | ✓ | ✓ | Reworking technology to be able to commercialize. Still hoping to commercialize. |
| Real-Time Reagentless and Arrayed Detector for the Monitoring of Harmful Algal Bloom Toxins (EPA 2006 SBIR Phase I) | Richard McAloney, (979) 693-0017, info@lynntech.com Lynntech Inc., Bryan, TX | March, 2006- August 2006 | Harmful algal blooms (HABs) occur in aquatic environments when conditions trigger an increase in the abundance of organisms that produce toxins. The toxins are transferred through the food web where they affect and even kill zooplankton, shellfish, fish, birds, marine mammals, and possibly humans. HABs have been estimated to cost the United States as much as $50 million per year as a result of the closure of fisheries, recreational waters and beaches, and the treatment of human illness from exposure to toxins. Early detection of blooms and rapid response to such events is the most effective way to mitigate the impact of HABs. The official methods to test for HAB toxins are the mouse bioassay and high-performance liquid | ✓ | | Plans to in the future. |

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| | | | chromatography. These methods are generally laborious, time-consuming, and require expensive laboratory equipment. Currently, there are no real-time, stand-alone monitoring devices to test for the presence of biotoxins from HABs. Lynntech will develop an inexpensive, rugged, reagentless, and real-time detection system for shellfish toxins in seawater. The versatility and arraying ability of the proposed technology will enable detection of a multitude of toxins and pathogens (e.g., cyanobacteria) in fresh or ocean water. Lynntech's proposed technology is based on diffraction-based sensing that utilizes the changes in diffracted light intensity upon the absorption of a target onto specific areas of a patterned surface of antibodies. The specific recognition and the use of diffraction detection eliminate the need for any secondary labeled-antibodies and reagents and are quantifiable. In Phase I, Lynntech will develop the proposed sensor technology for the detection of various brevetoxins from the dinoflagellate Karenia brevis, a common species associated with HABs. The subcontractor, Dr. Baden, from the University of North Carolina at Wilmington, is a brevetoxin expert and the major work supplier of brevetoxins and brevetoxin antibodies. In Phase II, an alpha generation system will be assembled and incorporated into the Texan Automated Buoy System in collaboration with Dr. Lisa Campbell from the Department of Oceanography at Texas A&M University. The main commercial application of this proposed research is for coastal monitoring of HAB biotoxins for health and safety. The technology is easily amenable to detecting pathogens, further enhancing the commercialization potential in the food safety and water monitoring markets. | | | |

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| Real-Time Transformer Oil Polychlorinated Biphenyl Sensor (EPA 2006 SBIR Phase I and EPA 2007 SBIR Phase II) | Carl R. Evenson, (303) 530-0263 info@eltronresearch.com Eltron Research Inc., Boulder, CO | Phase I: March 2006-August 2006 Phase II: May 2007-April 2009 | Analysis of PCB concentration is currently performed by SW-846 Method 8082 standard method in an analytical laboratory using gas chromatography. This type of analysis is time consuming and costly. For this offsite analysis, oil must be removed from the transformer, which potentially exposes workers and the environment to PCBs. Eltron is developing a new, portable real-time sensor that can be used on site to quantify the PCBs that are present and determine PCB concentration. In the EPA Phase I SBIR project, Raman spectroscopy and multivariate analysis were combined to create a rapid in situ sensor capable of a simultaneous detection of PCB concentration and composition within transformer oil. Regression models were prepared that could detect PCB concentrations as low as 5 ppm, and classification models were prepared that could predict the type of Aroclor present in transformer oil. During the Phase II project, sensor sensitivity will be improved by testing all major transformer oil types and accounting for appropriate interferences. Surface-enhanced Raman spectroscopy will be used to lower the sensor detection limit, and a prototype instrument (including user-friendly software) will be prepared for field testing. The final product of this project will be a real-time sensor that is cost effective, portable, user friendly, and most importantly will reduce the hazardous removal and transportation of contaminated transformer oil for PCB analysis. The expected instrument capital cost is equivalent to current GC costs ($30K); however, the per-sample testing cost will be significantly less than GC methods. This type of hand-held sensor will find extensive use by electric utilities (Sacramento Municipal Utility District) and hand-held Raman instrument manufacturers (Raman Systems, Inc.). An expected global market of $119 M is expected for this type of instrument by 2009. | ✓ | ✓ | |
| Remote, Real-Time Monitor for Elemental Speciation of Air Particulates (EPA 2005 SBIR Phase I, EPA 2006 SBIR Phase II) | Ning Gao (PI), 518-880-1500, ngao@xos.com X-Ray Optical Systems, Inc., East Greenbush, NY | March 2005 - August 2005 Phase II April 2006-June 2007 | In Phase I, XOS successfully demonstrated the performance of the proposed approach by retrofitting the new x-ray optic technology into an existing particulate monitoring system. Even with the non-optimized prototype, a detection limit of 10 to 40 pg/m3 was achieved for Fe, Cu, Zn, Br, Sr, and Br with a 50 watt x-ray source and 8-hour sampling time. It was estimated that this sensitivity was more than two orders of magnitude higher than that of the conventional EDXRF method.<br><br>The ultimate objective of this Phase II research project is to develop a prototype system capable of collecting samples and performing composition measurement in a continuous and automatic operating mode. XOS expects to achieve the equivalent detection limit of Phase I with 1-hour time resolution for transition elements with a 50-watt system. The system, which can be configured for PM2.5, PM10, or total suspended particulate, will be packaged as a field-deployable instrument with the size, weight, and power consumption similar to those currently deployed in U.S. Environmental Protection Agency networks. | ✓ | ✓ | |
| Remote Sensing Instrument for Particulates and NOx From Heavy-Duty Diesel Vehicles (EPA | J. Barry McManus, PI, (978) 663-9500 Aerodyne Research Inc., 45 Manning | Phase I: April 2001-Sept 2001 Phase II: June 2002 | Aerodyne Research has successfully completed a prototype instrument for soot, indexed to $CO_2$ and measured in an open path. The soot measurement is based on four coaligned lasers, from the blue to the near infrared (405, 635, 690, and 980 nm). $CO_2$ is measured on the same path with a 2,000-nm laser. The firm has used its instrument to measure soot up to a range of 50 meters. The Rainbow Soot instrument worked well enough in tests to observe plume $CO_2$ and opacity for a diesel vehicle with relatively low particulate emissions. Despite the fact the truck plume was not | ✓ | ✓ | Prototype. |

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| 2001 SBIR Phase II EPA 2002 SBIR Phase II) | Rd., Billerica, MA 01821 | - June 2004 | visually smoky, Aerodyne Research observed correlated multiwavelength plume opacity and $CO_2$ column for a diesel vehicle while stationary and when driven through the sensing beam. In multiple traverses of the sensing beam, Aerodyne Research observed $CO_2$ in the exhaust plume (approximately 2,000 to 3,000 ppm-m) and associated opacities of approximately 0.02 to 0.04, with a data rate of 10 Hz. Additional work is needed to produce user interface and automatic data processing software, and to compare the instrument to others. Phase II efforts will be conducted in association with a commercial partner that builds remote sensing instruments to detect motor vehicle pollution. | | | |
| Remote Sensing of Automobile Emissions Using Raman LIDAR (EPA 2000 SBIR Phase I) | Karger, Arieh (617) 926-1167 Radiation Monitoring Devices, Inc. 44 Hunt Street Watertown, MA 02172 PI no longer with company. | Sept. 2000- March 2001 | The Phase I objective is to demonstrate the capabilities of Raman LIDAR for remote sensing of automobile emissions. A short range UV Raman LIDAR system will be developed to detect automobile emissions (NO, NO2, CO, CO2, hydrocarbons, etc.) by detecting the Raman backscatter with a pulsed UV laser source. The system will consist of a Cassegrain telescope, solid-state laser, and an extremely high sensitivity avalanche photodiode (APD) array detector. The system will capture the entire Raman return signal in a single pulse and convert the Raman return into pollution concentrations. The unique array of APD detectors will allow simultaneous acquisition of all the spectral components of the Raman return signal. The utilization of solid-state system components will result in a cost-effective, robust solution for remote sensing of automobile emissions.<br><br>The development of a remote sensing Raman LIDAR system for automobile emissions monitoring will significantly improve the ability to monitor on-road automobile pollution. EPA requirements for on-road monitoring of automobile emissions necessitates the deployment of remote sensing systems in states with excessive automobile pollution. By using short range UV Raman LIDAR, this on-road monitoring may be performed at arbitrary remote locations resulting in improved coverage of the automobile fleet. | ✓ | | No. |
| Sample Conditioning System for Real-Time Mercury Analysis (EPA 2000 SBIR Phase I and 2001 Phase II) | Sharon M. Sjostrom, (303) 783-9599 Apogee Scientific, Inc., 2895 West Oxford Ave., Suite 1, Englewood, CO 80110 | Phase I: Sept. 2000 - March 2001 Phase II: Sept. 2001- Sept. 2003 | Testing results indicate that the SCS was effective at conditioning a mercury-laden gas sample for total mercury measurement in a commercially available, real-time mercury analyzer. Further testing is required to improve the effectiveness of the speciation technique, to package the system for prolonged field use, to conduct extensive verification tests in the laboratory, and to conduct longer-term field performance evaluation. The focus of the Phase II research project was to conduct field-testing on the SCS to demonstrate the feasibility of this technology. The SCS is capable of conditioning gas streams for Hg measurements at a variety of utility locations encompassing a variety of fuel types. The SCS can be used to monitor Hg in flue gas from multiple types of coal. The SCS is capable of long-term operation without supervision and frequent maintenance. The efforts under this Phase II research project have demonstrated the feasibility and effectiveness of the SCS technology. | ✓ | ✓ | Project in progress. No longer with company. |
| Sensitive, Quantitative, and Portable Anatoxin Assay Using | George W. Jackson BioTex Inc., Houston, TX | March 1, 2008 to August 31, 2008 | The focus of this research project is to develop a rapid assay kit for cyanobacterial anatoxins using aptamers as the primary molecular recognition element. The developed sensor chemistries will result in a detectable signal in 20 minutes or less and will require a very inexpensive, portable solid state detector system for quantitative | ✓ | | |

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| Apatamers and Quantum Dot Nanoshell Reporting (EPA 2008 SBIR Phase 1) | | | test interpretation (readout). BioTex will first develop aptamers for highly sensitive and specific binding to anatoxins and then optimize the composition of a fluorescence resonance energy transfer (FRET)-based sensor employing quantum dot (QD) fluorescence reporters and aptamers labeled with quenching chromophores. Finally, BioTex will demonstrate the sensitivity and specificity of the novel sensing chemistry for field and laboratory use. | | | |
| Speciation of Metallo-Cyanide Complexes by Ion-Interaction Chromatography and Ultra-Trace Fluorescence Detection (EPA 2000 SBIR Phase I) | Dr. John W. Haas III, 802-763-8348 Applied Research Associates, Inc., 415 Waterman Rd., S. Royalton, VT 05068 | Sept. 2000 - March 2001 | The Phase I objective is to establish feasibility for separation and ultra-trace detection of metallo-cyanides by assembling, optimizing, and interfacing a novel digestion/derivatization system to a conventional high performance liquid chromatography (HPLC)-fluorescence instrument. Phase I of the experiment was successful, but a Phase II was not funded. | ✓ | | |
| Subsurface In Situ Volatile Organic Contaminant Sampling Using Multiple Sorbent Traps With Rapid On-Site/Off-Site Quantitative Speciation (EPA 2001 SBIR Phase I) | Michael Dvorak, (701) 237-4908 Dakota Technologies, Inc., 2201-A 12th Street, North Fargo, ND 58102 | April 2001 – Sept. 2001 | In another SBIR grant, Dakota Technologies, Inc. (DTI), successfully demonstrated key technologies used in the operation of a miniature gas chromatograph (GC) that fits inside a push rod for field screening and quantification of subsurface volatile organic compounds (VOCs). The GC is soft-pushed (no percussion) into the earth and uses a heated microporous inlet membrane on the side of the probe to transfer VOCs from the soil formation to a sorbent trap. For this SBIR, DTI proposes the design, construction, and field testing of a novel trap and valve assembly (TVA) that fits into a similar narrow-bore push rod for direct, hard-push, percussion delivery. The TVA consists of a series of sorbent traps and three-way solenoid valves for gas flow control. The strategy for site characterization is based on trapping VOCs at multiple depths using the multiple sorbent traps. The TVA is easily removed from the push rod and can be connected to a miniature, fixed-setting GC analyzer that permits rapid (less than 5 minutes) identification and quantification of the ballistically desorbed and eluting species. This GC analyzer is small enough that analysis can take place in a mobile laboratory or at a later time in a standard analytical laboratory. | ✓ | | Yes. |
| The Application of MASC Technology to the Problem of Contaminant Monitoring for the Water and Wastewater Industries (EPA 2002 SBIR Phase I) | Cindy S. Orser, PI, (818) 501-2880 Areté Associates, P.O. Box 6024, Sherman Oaks, CA 91413 PI no longer | April 2002 – Sept. 2002 | The Phase I SBIR provided funding to complete the feasibility study of the amperometric sensor through continued characterization of the electrode selectivity, extended testing of electrode stability (robustness), nitrate analysis with standard EPA drinking and wastewater solutions, and sample analysis provided by third-party water and wastewater professionals. The results from this Phase I research demonstrated that the MASC sensor is sensitive (< 2 ppm N-NO3), accurate to 96.7 percent, selective, and highly reproducible (Coefficient of Variation = 1.12%), and thus merits continued research and development support and funding of the concept. The sensor demonstrates remarkable selectivity in the first round of examinations. Thirteen different commonly encountered contaminates (such as nitrites, sulfates, sulfites, potassium, and sodium) | ✓ | | No. |

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| | with company. | | were tested, and none of them were found to interfere with the detection of nitrate. | | | |
| Toward Developing a Rapid Field-Testing Device: Regenerable Fujiwara Reagent as a Portable Technology for Measuring Drinking Water Pollution (EPA 2004 SBIR Phase I) | Kisholoy Goswami (PI), 310-530-4974 InnoSense LLC, Lomita, CA | March 2004 - August 2004 | The goal of Phase I is to establish the feasibility of a regenerable chemical sensor for in situ detection of halogenated hydrocarbons (HHCs) in water. The technology is expected to generate a device for rapid field tests related to spills and accidents involving HHCs, such as trichloroethene (TCE). InnoSense will develop a chemical sensor for detecting HHCs using a modified Fujiwara reagent. Innovative regenerable and user-friendly reagents will enhance performance and cost effectiveness and reduce risk potential to field personnel. The approach to be investigated in this project is designed to remove the difficulties encountered by previous researchers using liquid pyridine. | ✓ | | |
| Ultrasensitive Acrolein Sensor for Environmental Monitoring (EPA 2006 SBIR Phase I) | Bruce Richman, (408) 962-3900 Picarro, Inc., Sunnyvale, CA | March 2006- August 2006 | Picarro, Inc., will build a trace-gas sensor based on cavity ringdown spectroscopy (CRDS) targeting the acrolein absorption band at 1623 nm for environmental monitoring. Acrolein is a ubiquitous airborne pollutant. Its sources include burning vegetation (e.g., forest fires), waste incinerators, furnaces, fireplace, gasoline- and diesel-engine emissions, power plants, polyethylene combustion, cigarette smoke, and the cooking of food. Acrolein is extremely toxic to humans and is listed by the U.S. EPA as one of 33 hazardous air pollutants. Picarro intends to determine whether a sensor based on CRDS can be used to detect acrolein with a sensitivity of 1 ppb in the presence of H2O, CO2, CO, and other potential sources of interference in the atmosphere and in combustion exhaust. Picarro will measure the optical absorption spectrum of the 1623 nm band along with potential interferants. Picarro also will determine the performance characteristics of the sensor including precision, accuracy, linearity, and lower detectable limit. | ✓ | | |
| Ultrasensitive Biosensor for Detecting Biotoxins in Drinking Water (EPA 2004 SBIR Phase I) | Michael Miller (PI) (617) 301-6000 Bioscale, Inc., Boston, MA | March 2004 - August 2004 | The goal of this Phase I research project is to develop a novel microelectromechanical systems (MEMS)-based sensor capable of detecting low levels of biotoxins in drinking water. Central to the proposed sensing approach is a resonating microstructure optimized for sensitive system-level identification of the vibratory modes and, hence, detection of target analytes. BioScale's sensor technology can be developed into a field-portable instrument capable of detecting low levels of toxins (< 1 ng/ml) in drinking water, with a time-to-result of less than 30 minutes. A Phase II effort has been proposed that will focus on the development of a detection protocol for botulinum toxin in drinking water. The protocol will include a sample preparation process that can be executed in the field. | ✓ | | Project in progress. |
| Ultra Sensitive Raman Device for Detecting Arsenic in Water Utilizing Fractal/Microcavity Composite (EPA 2006 SBIR Phase I) | Won-Tae Kim, (505) 524-3664 LaSys, Inc., Las Cruces, NM | March 2006- August 2006 | Using the unique spectral characteristics of its proprietary fractal-microcavity composite, LaSys, Inc., will perform the proof-of-concept research required to develop an ultra-sensitive optical detector of low concentration of arsenic in water based on the Raman effect. The Phase I technical objectives are designed to demonstrate that fractal microcavity composite-surface-enhanced Raman scattering spectroscopy is capable of quantitatively detecting arsenic in water at levels that are useful for determining compliance with the upcoming U.S. EPA maximum contaminant level (MCL) of 10 ug/L. The goal at the end of Phase III is to develop a hand-held, | ✓ | | |

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| | | | easy-to-use instrument for the field detection of arsenic at or below the January 2006 MCL. This ultra-sensitive instrument will provide accurate, precise, and quantitative measurement of arsenic in the 1 to 200 ppb range in real time via a visual digital readout. This commercial, field-portable device of robust construction will be battery powered and weigh approximately 1 pound and be simple to use in the hands of nontechnical individuals. It will provide significant advantages over currently available colorimetric test kits and chemical sensors and be competitively priced. | | | |
| Ultrasensitive Toxic Chemical Detector (EPA 2004 SBIR Phase I) | Stephen N. Bunker, 617-246-0700 Implant Sciences Corporation, Wakefield, MA | March 2004 - August 2004 | The goal of this Phase I research project is to combine an array of new technologies, including laser-based ion mobility spectroscopy, a unique long-distance cyclone gas sampling method, induced long-distance vapor emission from the environment, solid-phase microextraction fiber preconcentration with fast desorption, and bipolar mode analyses to significantly increase the sensitivity to trace toxic chemicals. Implant Sciences Corporation will produce a portable, ultrasensitive toxic chemical detector for field analyses of buildings. The improvements were successfully demonstrated. It was, however, the conclusion of the Foresight Science and Technology, Inc., market research study that the product cost of such a high-performance unit is incompatible with the expectations of potential customers in the chemical warfare industry and in environmental communities, and there would be no market for the device. Specifically, Foresight's study determined that customers are satisfied with the performance of existing commercial detection units, so cost is the major determining factor for product acceptance. At the present time, it does not appear that the added performance can be provided at the same or less cost than existing sensing devices. | ✓ | | No. |
| Using Flathead Minnow Microarrays to Test Toxicity of Nanoparticles (EPA 2008 SBIR Phase 1) | Barbara J. Carter, 386-418-1400, bcarter@ecoarray.com EcoArray Inc., Alachua, FL | March 1, 2008 to August 31, 2008 | Assessing the potential effects of nanoparticles on human health is not an easy task, as the properties of nanoparticles depend not only on the size of the particle, but also on the structure, microstructure, and surface properties (coating). The uptake of nanoparticles by aquatic biota is a major concern. Concerns about environmental contaminants that adversely affect health, development, and reproduction of exposed wildlife have lead to the development of specific in vitro and in vivo assays to test for these effects. Gene microarrays integrate in vivo exposures with mechanistic outcomes. Using this technology, thousands of genes can be tested at one time with mRNAs isolated from tissues of exposed animals. These tools show potential for providing more precise, quantifiable data than existing assays, and are now affordable. The overall goals of this Phase I grant are to employ microarrays to identify genes that fluctuate in fathead minnows after acute exposure to nanotubes. The data will be analyzed to determine what, if any, pathways are affected in the fathead minnow. This information should enable EcoArray to identify "genetic fingerprints" and to use the database as a tool for identifying contaminants in unknown situations (class prediction), which may lead to an interpretation of human health issues. The research undertaken in the Phase I study of nanotubes should help validate the expediency and affordability of the high density fathead minnow microarrays for compound screening and use in environmental | ✓ | | |

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| | | | toxicology. | | | |
| Water Security Sensor for Automatic Measurement of Micrograms of Heavy Metals in Drinking and Waste Water (EPA 2005 SBIR Phase I) | Ingrid Repins (PI), 303-420-1141, info@itnes.com ITN Energy Systems, Inc., Littleton, CO PI no longer with company. | March 2005 - August 2005 | ITN Energy Systems, Inc. (ITN) will adapt its advanced x-ray fluorescence (XRF) technology to create an automated smart sensor for trace amounts of toxic heavy metals in water. The goal of this research project is to adapt ITN's XRF technology to provide a smart, automatic, early warning sensor for trace levels of toxic metals in water on a ug/L scale. In Phase I, showing will prove the feasibility of this approach that the sensor can detect 20 ug/L Hg in water without interference from other metals, chemical state of the metals, or organic material. In Phase II, sensor capabilities will be expanded. These improvements may include higher sensitivity, calibration for more elements, portability, remote communication of data, participation in EPA's Environmental Technology Verification program, or cost reduction. | ✓ | | No. |
| Water Security Monitoring Using Surface-Enhanced Raman Spectroscopy (EPA 2008 SBIR Phase 1) | Kevin M. Spencer, 781-769-9450, spencer@eiclabs.com EIC Laboratories Inc., Norwood, MA | March 1, 2008 through August 31, 2008 | It is virtually impossible to protect every river, stream, or lake that contributes to the nation's drinking water supply; therefore, rapid detection of a chemical/biological attack followed by rapid remediation is paramount. Many toxins are deadly at very low dosages (low parts per billion [ppb] or less for chemical, 1 to 100 cts/mL for biologic), requiring sensitive and precise measurements. Immediate on-site identification and action precludes the transport of samples to a laboratory setting. This program will demonstrate the capabilities of a hand-held sensor that potentially could be used in-line. This sensor is based on the technique of surface-enhanced Raman spectroscopy (SERS); the ability of SERS to detect chemical warfare agents was demonstrated at EIC Laboratories during the Joint Services Agent Water Monitor program. In addition, bacteria, toxins, pesticides, cyanotoxins, and explosives have been effectively detected in water. The ability to mass produce reproducible sensors has recently enabled increased precision and sensitivity. In the Phase I program, the ability to precisely detect an agent degradation product, seven pesticides, and a toxin will be tested in water samples in the presence of various natural interferents. During the Phase II program, the SERS database will be extended to include additional pesticides, toxic industrial chemicals, toxins and bacteria, and a field portable unit, incorporating the SERS library, will be produced and tested at an EPA-defined site. | ✓ | | |
| Wireless Electrochemical ClO2 Monitor for Decontamination Operations (EPA 2007 SBIR Phase I and EPA 2008 SBIR Phase 2) | Mourad Manoukian, 781-529-0500, avaccaro@ginerinc.com Giner, Inc., Waltham, MA. | Phase I: March 2007- August 2007 Phase II: May 1, 2008 to April 30, 2010 | To address the EPA's concern and need for portable, accurate, and field-rugged chlorine dioxide (ClO2) monitors for use in monitoring building decontamination operations, this Phase II project will continue the developmental work started in Phase I to design, develop, and demonstrate a simple-to-operate electrochemical ClO2 microsensor (sensor cell with integrated potentiostatic control and signal-processing circuit) and demonstrate its successful operation with wireless data transmission. The proposed microsensor will be rapid (<30 seconds for 90% of full response, T90), accurate, selective, and capable of measuring 0 to 3,000 ppm ClO2 in real time with a detection limit of 2 ppb. The unique and advanced sensing technology is based on integrated solid | ✓ | ✓ | |

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| | | | polymer proton-conducting electrolytes and thick-film electrode (sputtered or screen printed on alumina substrates) technology. The proposed microsensor will be configured for continuous unattended or handheld operation and be fully integrated with wireless data transmission and configured into a compact and lightweight monitor. | | | |
| Wireless Decontamination Gas Monitor (EPA 2005 SBIR Phase I) | Todd Mlsna (PI) tmlsna@seacoastscience.com, and Louis Haerle (Co-PI) louis@seacoastscience.com Seacoast Science, Inc., Carlsbad, CA, 858-449-2151 | March 2005 - August 2005 | In Phase I, Seacoast Science will develop chemoselective coatings on their existing MEMS capacitor sensors and test these sensors by exposing them to chlorine dioxide and hydrogen peroxide. This information will be used in Phase II to fine-tune the coatings and ultimately produce four prototype units. The Phase I research project established the viability of Seacoast Science's capacitive sensors by demonstrating detection of two classes of fumigants. This was accomplished through the preparation of new sensor designs and the synthesis and testing of new chemoselective polymers, network materials, and organometallic compounds. The project demonstrated the successful integration of a commercial radio transmitter and redesign of Seacoast Science's system to minimize power. Further research and development into the sensor design, chemoselective materials synthesis, and pattern recognition will result in a sensor capable of detecting $ClO_2$ and $H_2O_2$ vapors for potential applications in building remediation (in response to a BWA attack or mold infestation) and in the food industry. | ✓ | | Commercialized some products that may have been related however not much of a market. |
| Wireless Underwater Telemetry System for Surface Water Quality Monitoring (EPA 2004 SBIR Phase I) | Philip Schaefer (PI), 828-645-1026 Vortant Technologies LLC, Weaverville, NC | March 2004 - August 2004 | The goal of this Phase I research project is to create a product to revolutionize the planning, installation, damage resistance, and cost effectiveness of in situ, real-time water quality monitoring systems. The proposed project will develop a water quality telemetry system that eliminates the wires, cables, and above-water electronics currently needed for real-time monitoring. Laboratory testing verified the WQTS approach is feasible for interfacing with standard, commercially available water quality sensing instruments, and that it is straightforward to integrate the WQTS system components into a working system. Power drain measurements and calculations showed the product is very conservative in battery usage and can operate continuously for months in the field using low-cost battery packs. Using this equipment, successful water quality telemetry transmission was demonstrated over many miles both from stream locations, as well as from deep lake monitoring locations. Also, these results were obtained without the use of any overly exotic or esoteric electronic or mechanical components, indicating the cost of the WQTS product will be competitive with that of older cable-based technologies. | ✓ | | No. |

**All SBIR grants can be viewed at http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/outlinks.sbir/**