COMMERCIALIZATION ASSISTANCE PROGRAM

Rapid Nanoparticle Detection

Business Opportunity:
The company's patented High Resolution Differential Mobility Analyzer (DMA) offers substantially enhanced ability to precisely measure nanoparticle size in the range 0.3 to 100 nm (being extended to 300 nm). This signature size data can be used to detect and identify potentially hazardous nanoparticles. It has applications as a rapid screening method for presence of threats, high-throughput medical research, food and industrial quality control.

Our emerging techniques based upon *physical* property measurement, promise a next generation of portable, economical, automated instruments designed for the rapid detection of a broad variety of nano-sized particles, including viruses, *within minutes or even seconds.* The market for particle detection is $1.2 billion with the portable instrument segment estimated at $0.5 billion. For medical-science applications, company is looking for alliance partners among potential end-users. For military and security applications, company is looking for federal add-on funds to complete end-use design as well as partnerships with major defense system integrators. For its public safety product, company is looking for $6.5 million to complete manufacturing design, initial production, trial services, and rollout campaign.

Company Background:
The company was founded in 2003 and has a staff of ten full and part-time contributors drawn from advanced engineering and research institutions. Our technical focus is on precision instrument design, engineering, development and manufacturing involving aerosol science, particle sizing, and particle separations. We will conduct commercial analysis services as well. Emphasis is on rapid particle identification for human health protection. The company has engineering, new product design, manufacturing, and applications development laboratory operations in West Palm Beach, FL and Vista, CA.

Industry Problem:
Identification of threats to homeland-security, public health, industrial hygiene and the environment are constrained by analytical tools and time requirements of current technology. In addition, requirements for smaller particle size measurement have become a contemporary challenge. Many conventional technologies for the detection and identification of nanoparticles rely on chemical processes requiring reagents that are *specific* to a particular target molecule and useless in detecting other molecules. Development of assays for new emerging targets, such as H1N1 swine flu virus, may take weeks or months and field tests may take hours or days. Many bio-chemical assays must be refrigerated and have a short shelf life.

Technology:

Our advanced DMA is based upon physical property measurement of nanoparticles. The instrument is capable of measuring extremely small particles. Our proprietary technology enhances charged nanoparticles within an air/liquid sample, followed by a separation process induced by directional flow. Within the measurement cells, nanoparticles are volatilized and charged electrically using an electro-spray source. An electric field is imposed while inducing very high speed air flows in part of the chamber yet suppressing turbulence in the air flow. Fast (smaller) ions move across the laminar air flow under the influence of the electric field; slow (larger) ions are dragged downstream. In this manner the air streamlines and electric field lines separate the ions in space according to their speed (mobility). An electrode collects the ion current and amplifies it for detection. Size (mobility) spectra are collected by varying the DMA voltage and measuring resultant ion current.

A cross-cutting *platform* technology, with emerging applications in a large number of industries, the company therefore focuses its expertise principally on the core DMA instrument technology while initiating collaborations - and leveraging complementary resources - with experts in the diverse fields of application. This will lay a solid technical basis for introducing the DMA instrument widely to diverse markets while allowing some customization to meet specific application requirements.

Advantages:

- Our enhanced DMA technology is more sensitive, miniaturized, portable, fully-automated, and capable of remote operation.
- It produces higher resolution and lower margin of error than conventional DMAs.
- It is several orders of magnitude more sensitive than Ion Mobility Spectrometers (IMS), developed in the 1970s and currently used in airport security.
- When compared to mass-spectrometers, our DMA technology is smaller, less expensive, easier to use and maintain. It measures a wider range of particle-sizes and does not require technical experts as operators.

Differentiating Feature:

Our enhanced DMA instrument, based upon physical property measurements instead of chemical methods, provides nearly instantaneous detection on a wide range of nanoparticles. In contrast, most chemical methods of detection require advance knowledge of the chemicals that may be encountered and several minutes to several weeks for analysis.

Stage of Development:

We have completed a needs assessment, proof-of-concept, feasibility, and initial prototyping of the systems. For the core DMA instrument, precision-design drawings have been developed and converted to computer-aided-design and computer-aided-manufacturing software files. Prototype parts have been translated to numerical-controlled machine tools. Suppliers of critical components have been identified and contacted. The company is therefore poised for application-specific design and volume manufacturing.

The company has sold custom-manufactured units to pioneering users including the University of Paris, University of Helsinki, University of Minnesota, Centers for Disease Control and Prevention, the National Institute of Standard and Technology, and Pacific Northwest

Laboratories. Key demonstrations of the high resolution DMA have thus been achieved by 3rd parties and performance data captured.

The company has opened discussions with end-users and is planning to construct ten fully-automated bench-top *turn-key* prototype DMA systems for testing at high-profile beta-sites for various applications.

Competing Technologies:
TSI, Inc., is a manufacturer of conventional (low resolution) Differential Mobility Analyzers. More broadly, there are a number of competing technologies for nanoparticle detection. They include variants of mass spectrometry, gas chromatography and ion-mobility spectrometry with suppliers such as Agilent, Thermo-Fisher, Sciex, GE-Infra and Smiths Detection. Other pertinent technologies involve chemical-based assays, electrochemical sensors, thin-film micro-sensors, optical detection methods using lasers, molecular laser-fluorescence.

Applications:
- Public Health – Rapid-screening for at-risk populations such as nursing homes, schools, cruise-ships, hospitals, or prisons.
- Industrial Hygiene – Samples collected to screen for pathogens in birds (avian flu), cattle (swine flu) and insects (west Nile virus).
- Industrial Processes – Measure nano-particle contaminants in clean rooms.
- Agriculture – Screening herds, crops, flocks, honey-bees and foodstuffs for disease causing pathogens.
- Transportation Security – Automatic monitoring and surveillance of warehouses, airports, passenger portals, vehicle portals, luggage / package handling, and shipping containers to detect traces of explosives, narcotics, chemical agents, biological agents, toxic industrial chemicals and concealed contraband.
- Public Safety & Homeland Security – Robot-mounted instruments to detect IEDs and weapons of mass-destruction.
- Biomedicine – Drug discovery with high-throughput separation of synthetic nanoparticles.

Benefits:
Benefits accrue in the form quicker measurements, faster reaction time, broader particle detection, reduced exposure and harm, greater safety, and less damage. Those benefiting include public officials, business owners, operation managers and field workers, researchers, first responders, and the general public.

Intellectual Property:
The core technology, namely the high resolution DMA technology, is held under an exclusive license from Yale University, covering US Patents 5,869,831; 5,936,242; 6,787,763; and related pending patents covering all fields of use. In addition, the company is filing patent applications pertaining to improvements in:

1. automation of electrospray ionization sources for sample introduction;
2. DMA flow velocity controls to enable precision operation; and
3. ion-current (particle current) electrometer for ultra-high sensitivity.

Also, virus detection patents are licensed from the US Army.