SBIR·STTR America's Seed Fund

U.S. DEPARTMENT OF ENERGY | SBIR/STTR Programs Office

DOE SBIR/STTR SUCCESS

Nanowire sensing technology for energy, space, healthcare and defense applications.

INNOSENSE LLC

InnoSense LLC (ISL) has adopted a commercialization strategy that consists of developing multiple application opportunities for different markets. This approach requires understanding the different uses a given technology can have and further tailoring some of its aspects to meet the demand of different customers. ISL has leveraged R&D funds from the Department of Energy (DOE) and subsequently from other Federal agencies with missions that complement DOE's goals, such as the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA). This has been the strategy of choice for ISL's *nanowire chemical sensing technology*, which was originally funded by the DOE SBIR/STTR Programs for developing a polymer-based sensor array toward subsurface CO_2 detection and monitoring.

FACTS

PHASE III SUCCESS
Building on DOE SBIR/STTR Phase II awards and additional DOD grants, ISL obtained Phase III funds and investment totaling $3.7M from DOD and a prime contractor.

IMPACT
Nanowire sensors from conducting polymers offer a low-cost, customizable platform for detection of desired gases, toxic chemicals, hypergolic fuels, and biomarkers for cancers and disease diagnosis.

DOE PROGRAM
Office of Fossil Energy (FE)

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ISL successively advanced the technology further to produce other types of sensors addressing critical needs for the National Aeronautics and Space Administration (NASA) and for the Missile Defense Agency (MDA). In addition, ISL nanowire sensing technology is currently being tailored for applications in biodiagnostics, such as the detection of certain biomarkers associated with Alzheimer's disease both in cerebrospinal fluid and blood samples.

ISL was founded in 2002 by Dr. Kisholoy Goswami, current president and CEO of the company. Dr. Goswami pioneered the field of fiber optic hydrocarbon sensors and gained extensive experience in developing commercially viable products prior to establishing ISL. Working for a private company, Dr. Goswami raised $3M in investments and commercialized the world's first chemical sensor to detect hydrocarbon in aboveground and underground storage tank environments, marketed as PetroSense®. The PetroSense family of products earned a cumulative revenues of $8 M from 1990 to 1996 before the company was acquired by another business group based in Europe.

To date, the largest commercialization success for ISL's nanowire sensing technology has been achieved within the missile defense program. ISL was successful in modifying the sensing technology developed through a 2013 DOE Phase II STTR project to achieve detection of leakage of hypergolic fuels, which are used in missiles for inducing spontaneous ignition. Hypergolic fuels are used in anti-ballistic missiles such as the Terminal High Altitude Area Defense (THAAD) missiles. They are highly toxic and corrosive, requiring very sensitive monitoring of leakage over a prolonged period. Currently, MDA uses leak detectors that are sole-sourced and have a limited shelf life, resulting in significant costs for their annual replacement. By leveraging the DOE STTR project and additional SBIR funds from the Department of Defense (DOD), ISL was able to obtain a $200,000 Phase III from the prime contractor to develop a prototype that would meet their specifications. Working with MDA and the prime contractor, ISL developed and tested a drop-in replacement for the existing MDA sensors, which exhibits long-term operational stability and can withstand the operational shocks and vibrations. In recognition of the technology potential, MDA granted ISL a total of $3.5M in additional funds for the company to accelerate the field deployment of their sensors in 2020, before they can be widely adopted. "This is a big success for us", commented ISL R&D Chief Uma Sampathkumaran, "because the prime contractor is vested in our technology. Further engineering for field deployment will likely result in ISL serving the entire market for this type of sensors." A total of 120 prototype sensors have been delivered to date to the prime contractor for validation purposes.

ISL sensor technology, which is marketed under the name HyperGoLeak™, utilizes carbon nanotubes (CNTs) or electrochemically grown conducting polymer nanowires. The nanowires are grown between micron-scale electrodes and their surface chemistry adjusted to ensure reactivity with the compound to be sensed, the target analyte. CNTs and polymer nanowires offer high level of device sensitivity due to the large surface area and the high aspect ratio. They are amenable to a versatile surface chemistry, allowing for a wide range of conjugation and functionalization options for detecting a variety of chemicals, including biological molecules. Exposure to the analyte, whether in gas or liquid form, alters the electrical properties of the nanowire's surface via the change in conductivity and transport mechanism. The result is a sharp change in resistivity, which is recorded by the electrodes. Made of micron-sized junctions, the sensors can also be integrated into an array for multi-analyte detection.

“The SBIR-STTR projects offer the necessary seed money for developing a commercially viable product,” answered Dr. Sampathkumaran when asked about the value of the SBIR-STTR Programs. “Without this program, a startup would have to rely on private investors, who often do not understand the technical challenges involved with productizing a technology and make demands or impose deadlines that are impossible to meet,” added Dr. Sampathkumaran recalling her previous experience with a telecom startup. Similar to many other high-tech startups, ISL soon understood that launching a product takes more than just one SBIR/STTR Phase II award. The company’s approach has been to leverage multiple awards from different federal agencies, to develop different applications by taking each aspect of ISL core technology to the next level with each additional grant. “Some of the projects we worked on did not have immediate applicability,” explains Kris Miller, ISL Commercialization Specialist, “but later on, we were able to apply our findings from those projects to science areas that were different but overlapped our primary field. Without SBIR/STTR we would have only been able to focus on a single R&D area, and efforts to develop adjacent technologies would have been phased away for lack of funds, never reaching the full potential.” In the case of the nanowire sensing technology, the R&D results obtained through the DOE STTR on carbon dioxide detection were crucial to secure subsequent DOD awards and get the attention of a prime contractor, which led to the final stages of development for the HyperGoLeak technology.

Written By Claudia Cantoni, Commercialization Program Manager, DOE SBIR/STTR, February 2019.