

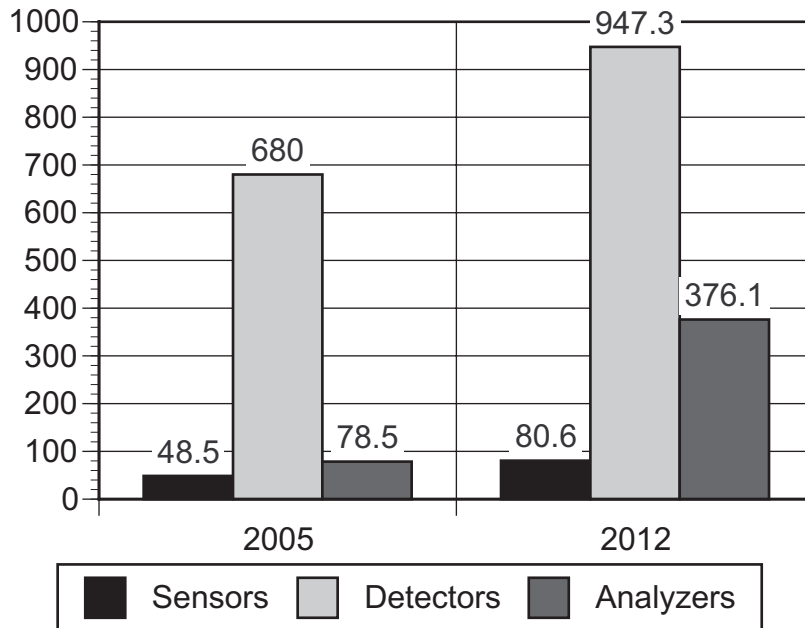
# Fiber Optic *FOS<sub>2</sub>* SENSORS & SYSTEMS

Monthly Newsletter on Worldwide Developments in Fiber Optic Sensors & Systems

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**World gas sensor, detector, and analyzer market (\$ millions)**



Source: Frost & Sullivan

## CONTRACTS

### StockerYale signs supply agreement with NxtPhase T&D for specialty optical fiber and fiber-based components

StockerYale Inc. announced that it has signed a two-year, sole-source supply agreement with NxtPhase T&D, a

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manufacturer of optical sensors and digital protection and recording solutions for the electric power industry. StockerYale will supply a series of specialty optical fibers and fiber-based components optimized for use with the NxtPhase NXCT, NXVT, and NXVCT lines of optical current and voltage sensors. NxtPhase sensors are changing the way high-voltage electricity is managed in the electric power industry.

NxtPhase optical current and voltage sensors are proving to be an attractive alternative to conventional iron-core instrument transformers, bringing a new level of accuracy to electric utilities. Major advantages include improved accuracy over a broader dynamic range, wider bandwidth, zero risk of explosive failure, lighter weight, and an environmentally safe design. The market for optical current and voltage sensors is expected to grow significantly over the next two decades as electric utilities upgrade their aging equipment to more seamlessly control power through the power grid.

"We have worked closely with NxtPhase to develop polarization maintaining optical fibers specific to their applications over the past three years and StockerYale is pleased to enter into this supply agreement with the leading optical sensor manufacturer serving the electric power industry," said Paul Jortberg, senior vice president at StockerYale.

### **Spatial Integrated Systems Inc. awarded \$24 million Seaport-e USV contract**

The US Navy Naval Surface Warfare Center Carderock Division (NSWCCD, MD) has awarded a four-year, \$24.0 million contract to Spatial Integrated Systems Inc. (SIS) of Rockville, Maryland, for the development and integration of a multipurpose sensor system (MPSS), associated technologies, engineering, and technical support for the Autonomous Maritime Navigation (AMN) Program intended to be used on Unmanned Surface Vehicles (USVs).

"This is a very important contract for SIS," said Dr. Ali Farsaie, president and CEO. "This is our first Seaport-e award from the U.S. Navy and marks a major milestone for SIS. I am gratified in the Department of Defense's confidence in our company. SIS and its teammates will have the opportunity to design, develop and integrate intelligent sensor suites for the Navy's USV programs. We are excited at the prospect of incorporating our proven state-of-the-art 3D imaging system, integrated with intelligent agent technology into a state-of-the-art unmanned surface vehicle platform."

As the prime contractor, SIS will integrate and outfit an unmanned platform with sensor fusion, advanced decision-making, data interpretation, and object recognition solutions to allow the autonomous operation in a specified area. SIS's technical approach is centered on using its substantial experience in developing systems and applications using advanced technologies for developing, capturing, and processing data obtained from multiple sensors such as a camera array, RADAR, SONAR, GPS, compass, and digital charts. The use of 3D world representation will allow the USV to make onboard routine operational decisions and capture, process, and record information that is outside the spectral bounds of the human sensory system. This advanced 3D system will provide a valuable tool to the US Navy in its operational mission around the world. SIS's director for business development, Navy veteran David Odenwelder, pointed out that "The Multi-Platform Sensor System (MPSS) will be designed to operate in unmanned surface vehicles (USVs) which will enhance the capabilities of local system data acquisition, resulting in higher level mission decision-making and improved capabilities of the USV performing its mission. SIS will use its experience and expertise in design, development and integration to provide the control autonomy and systems testing and integration."

SIS's teammates include Technology Solutions Inc. (Charleston, West Virginia), West Virginia Institute of Technology (Montgomery, West Virginia), Marshall University (Charleston, West Virginia), and Technology, Research, Development and Education Institution (Tucson, Arizona).

### **Goodrich fine guidance sensor to fly on the next Hubble Space Telescope servicing mission**

NASA's recent decision to approve an additional servicing mission to the Hubble Space Telescope involves Goodrich Corporation. Goodrich will provide an additional highly accurate, sophisticated optical system — the fine guidance sensor — to the Hubble program.

According to Chris Holmes, vice president and general manager for Goodrich's Electro-Optical Systems team, "At Goodrich we were very pleased to learn of NASA's decision to extend the Hubble mission. An additional servicing mission will significantly enhance the telescope's science capabilities and should extend its service life to 2013 or beyond. Our team is currently in the process of upgrading a fine guidance sensor for this servicing mission. This fine guidance sensor will be the third upgrade and it will replace one of the units currently on the telescope. The other two units were installed on previous servicing missions."

The Hubble's original fine guidance sensors and optical telescope assembly were also produced by the company's Electro-Optical Systems team, based in Danbury, Connecticut. The fine guidance sensors are a critical part of the telescope's pointing system and are responsible for keeping the telescope accurately pointed for the long periods of time needed to produce images of distant stars and galaxies.

### **US Army to deploy Lockheed Martin Persistent Threat Detection Systems**

The US Army has awarded Lockheed Martin a \$77.5 million contract to provide

additional tethered aerostat surveillance systems for deployment in support of Operation Iraqi Freedom and Operation Enduring Freedom. The Persistent Threat Detection Systems (PTDS) are equipped with multimission sensors to provide continuous surveillance, detection, and communications in support of coalition forces.

Lockheed Martin will assemble and test the integrated aerostats, sensors, ground stations, and mooring systems at its Defense and Surveillance Systems facility in Akron. When deployed, the PTDS will be operated and maintained by Lockheed Martin Technical Operations headquartered in Colorado Springs, Colorado. The Army's Program Executive Office for Intelligence, Electronic Warfare and Sensors, Project Manager for Night Vision, Reconnaissance, Surveillance and Target Acquisition, and Product Manager for Robotic & Unmanned Sensors will provide program and acquisition management.

Lockheed Martin delivered its first PTDS unit to the Army in 2004. Delivery of the new systems will commence within the next several months.

"Aerostat surveillance systems give the Army the reliable and constant information and intelligence collection capability vital to protecting deployed personnel and high-value assets," said Ron Browning, Lockheed Martin airship business development director. "Our team is committed to completing the PTDS production and integration to field the systems as quickly as possible."

Aerostats and other lighter-than-air systems provide low-cost, long-endurance communications and surveillance capabilities not possible with other types of air vehicles. Attached by a high-strength tether to a relocatable mooring system, aerostats may carry different types of surveillance equipment to conduct multiple missions. They are filled with helium and stay airborne around the clock. Lockheed Martin has delivered 8,000 aerostats for military and commercial uses.

**Richard Heath Associates selects Fiberstars EFO-ICE for California energy efficiency retrofit projects**

Fiberstars Inc., a provider of fiber-optic lighting, announced that dynamic project design and management firm Richard Heath Associates (RHA) will offer Fiberstars EFO-ICE (Fiberstars' fiber-optic solution specifically developed for refrigeration cases and other low-temperature applications) to commercial customers as part of the organization's energy savings program. RHA provides project management and technical services to small commercial businesses including grocery stores and other small commercial firms. RHA will offer Fiberstars' fiber-optic lighting systems for refrigerated display cases as part of an energy-efficient retrofit program.

A 2006 study by Southern California Edison showed that Fiberstars EFO-ICE requires only one-third the energy of state-of-the-art fluorescent lighting while providing comparable luminance. Because of this exceptional energy savings, Fiberstars EFO-ICE helps RHA projects to qualify for zero-interest loans for the retrofit projects. A mini-mart in Fresno, California, is the first RHA customer to take advantage of this highly efficient fiber-optic lighting system, and additional green RHA retrofits are in progress for next year.

"Fiberstars EFO-ICE is the most efficient refrigerated display case lighting system available and we are excited about the relationship with RHA and opportunity for new EFO-ICE installations," said Fiberstars CEO John Davenport. "Traditional lamp-and-ballast systems add additional and unnecessary heat into refrigerated display cases, driving up energy consumption and costs for retailers as the compressor works harder to cope with the additional heat. Since the EFO-ICE light source is outside of the display case, our illuminators do not add additional heat into the case. Also, a customer can expect further savings because EFO-ICE's lamp life is typically twice that of

fluorescents and a single EFO-ICE bulb replaces up to four fluorescent tubes, greatly reducing maintenance and replacement costs."

"We are looking forward to further implementing this technology in 2007 and believe that there are great possibilities for many of our customers to take advantage of the significant energy savings," said Jill Wagner, RHA marketing manager. "We work with small businesses who operate on a very tight budget and any money they can save in energy costs goes directly to their bottom line."

**Fiberstars EFO-ICE offers bright light with no heat for grocery freezer cases**

Fiberstars Inc. announced that PerfectTemp, a company that specializes in remanufacturing cooler cases for grocery chains, will install EFO-ICE at a Redner's store in Maryland, following a recently completed test of the Fiberstars product. Redner's operates a 40-store grocery chain under the Redner's Warehouse Markets banner and a dozen Quick Shoppe convenience stores.

EFO-ICE is Fiberstars' efficient fiber-optic lighting system specifically designed to illuminate refrigerated and frozen display cases without adding the heat associated with all other forms of lighting. This lowers the cooling costs of refrigerated cases, a major component of energy consumption in grocery stores. Redner's Warehouse Markets will use EFO-ICE in all of their reach-in refrigerated cases at their Joppatowne, Maryland, location. In purchasing EFO, Redner's joins Albertsons, Whole Foods, Pathmark, Publix, Shaw's, and other major grocery and retail chains in utilizing Fiberstars' energy-efficient fiber-optic lighting systems.

"Fiberstars EFO is the most energy efficient lighting solution available for refrigerated case lighting," said John Davenport, CEO of Fiberstars. "By utilizing EFO-ICE, Redner's will benefit from higher quality light as well as reduced energy consumption. Further, Redner's will experience additional cost

reductions from lower maintenance costs since one 70W EFO lamp replaces as many as four 58W T8 fluorescent lamps in a freezer case.”

“Redner’s is pleased to be working with Fiberstars and looking forward to the energy savings and reduced maintenance costs from EFO-ICE,” said Douglas Emore, the operations manager for Redner’s.

### **I/O wins major tender for land seismic systems**

Input/Output Inc. announced that it has been awarded a contract to provide 14 state-of-the-art land seismic imaging systems to Oil and Natural Gas Corporation Limited (ONGC), the national oil company of India. Each system includes a pre-specified number of VectorSeis digital, full-wave sensors as well as analog geophones. In total, I/O will be providing nearly 20,000 VectorSeis sensors to ONGC.

Bob Peebler, president and CEO of I/O, stated, “This award represents the largest single sale of land acquisition systems and VectorSeis in the history of I/O. As far as we know, it is also the largest single land systems award in the history of the industry. We are delighted that ONGC sees the potential for full-wave seismic imaging and selected us to be their full-wave provider in this highly competitive tender. With this purchase, ONGC will become the largest user of full-wave technology in the world. The ONGC purchase, combined with previous VectorSeis sales to other contractors, now means that I/O has supplied roughly 80 percent of all the full-wave imaging technology used in land acquisition worldwide. As a company, we are committed to leading the industry’s adoption of full-wave solutions and to helping ONGC realize the maximum potential from the technologies included in this contract.”

The ONGC contract award is worth in excess of \$60 million. Deliveries of the 14 systems will occur during the second and third quarters of 2007.

I/O cable-based land acquisition systems are purpose-built to maximize seismic crew productivity, ensure reliable, error-free recording, and enable high channel count surveys using either full-wave VectorSeis sensors or analog geophones. VectorSeis sensors utilize digital, 3-C MEMS (micro-electro-mechanical systems) accelerometer chips to more accurately sample the true seismic wavefield and deliver broadband, high-resolution images of the subsurface.

For more information on I/O’s land imaging technology, please visit [http://www.i-o.com/land\\_imaging](http://www.i-o.com/land_imaging).

### **FINANCING**

#### **Xytrans Inc. receives investment from the UPS Strategic Enterprise Fund**

Xytrans, a provider of millimeter wave (MMW) sensors used in people-screening and facility security applications, announced that the UPS Strategic Enterprise Fund has made an investment in the company. Other investors participating in the financing include previous investors Alliance Technology Ventures and Crossbow Ventures. Terms of the investment were not disclosed.

“We are pleased to have UPS as an investor,” said Jim Young, president and chief executive officer of Xytrans. “Working closely with UPS, we will be able to better understand how passive and active MMW sensors, as well as the systems in which they are used, can be deployed by corporations to better provide security for their personnel and facilities here in the US and abroad.”

The detection of concealed items — weapons, explosives, or contraband — under or within clothing is one of today’s greatest security challenges. Millimeter waves, on the frequency spectrum between microwaves and infrared waves, readily and safely penetrate plastics, clothing, luggage, paper products, and other non-metallic materials, making MMW

systems vital for concealed items detection and the emerging preferred approach. Xytrans is a provider of both passive and active sensors used in these systems. Xytrans has developed passive sensors that are several times more sensitive than other competing products, and has already shipped hundreds of these sensors for deployment worldwide.

“Safely identifying concealed weapons and other items using MMW technology is an area of interest for UPS,” said Alan Koenning, UPS Strategic Enterprise Fund manager. “Our investment in Xytrans is a key step in understanding how this emerging technology may be used potentially in the transportation and logistics industry to enhance employee, customer, and facility security.”

## **MERGERS AND ACQUISITIONS**

### **VIASPACE acquires added stake in Infrared Sensor Company**

VIASPACE Inc. announced that it had acquired an additional equity ownership in QWIP Systems Inc. (QWIP Systems), a developer of Quantum Well Infrared Photo Detectors (QWIP). QWIP sensors are similar to the electronic sensors in digital cameras and camcorders, except they detect heat emissions rather than light. QWIP sensors are used in military and security applications because they can see in total darkness. Long-wavelength infrared sensors are used for surveillance — a person or vehicle can be detected in total darkness from distances of many miles. Defense applications include missile and aircraft tracking, night vision, tank warfare, and surveillance.

The QWIP technology being pursued by QWIP Systems was originally developed at the NASA Jet Propulsion Laboratory (JPL) with funding from US Missile Defense Agency, NASA, and the Defense Advanced Research Projects Agency. The QWIP technology was licensed from Caltech, which manages JPL for NASA.

QWIP Systems completed an amalgamation agreement on December 1, 2006, with Cantronic Systems Inc. (Cantronics). Under the amalgamation agreement, the company's shares in QWIP Systems will convert into shares of Cantronics.

### **Sensata Technologies completes acquisition of First Technology Automotive and Special Products**

Sensata Technologies B.V. announced that it has closed the previously announced acquisition of Honeywell's First Technology Automotive and Special Products (FTAS) business.

Concurrently, Sensata completed a EUR73 million financing in support of the transaction through an incremental facility under its existing Credit Agreement. Terms were in line with the original issuance.

FTAS designs, develops, and manufactures high-value automotive sensor and electromechanical control solutions. Its products are sold to automotive OEMs, Tier 1 automotive suppliers, large-vehicle and off-road OEMs, and industrial manufacturers. For the year ended December 31, 2005, FTAS had sales of approximately \$69 million.

Formerly the Sensors & Controls business of Texas Instruments, Sensata Technologies was acquired by Bain Capital LLC, a global private investment firm, in April, 2006. Sensata is a designer and manufacturer of sensors and controls for global leaders in the automotive, appliance, aircraft, industrial, and HVAC markets. It has nine technology and manufacturing centers in eight countries, and sales offices throughout the world. Revenues for 2005 were approximately \$1.1 billion.

### **Luna Innovations acquires rights to tunable laser from Coherent**

Luna Innovations Incorporated has entered into a technology transfer and licensing agreement with Coherent Inc. giving Luna the

right to manufacture and sell the former Iolon "Apollo" line of swept tunable lasers. The Iolon laser is a miniaturized, external-cavity laser offering high performance in a compact footprint. Such lasers were designed with systems integration in mind and are applicable to a range of fiber-optic test and measurement, instrumentation, and sensing applications. Under the agreement, Luna acquired manufacturing equipment and inventory previously used by Coherent to manufacture the lasers, as well as non-exclusive licenses to Coherent's patents and other intellectual property rights related to the transferred technology.

Kent Murphy, Luna Innovations' chairman and chief executive officer, commented, "We entered into this agreement with Coherent to allow us to compete more effectively in Luna's existing fiber-optic test and measurement markets by providing our customers with fast, flexible and cost-effective test and measurement products. Acquiring this laser technology also allows us to aggressively pursue business opportunities in new markets such as industrial and medical sensing."

Tunable laser technology is a key element in Luna's existing fiber-optic test, measurement, and sensing products lines. These products employ frequency-tuned lasers to measure various aspects of the transmission properties of telecommunications fiber-optic components and systems. Lasers are also used in fiber-optic sensing applications such as distributed strain and temperature mapping, and distributed measurement of shape. The former Iolon laser was also designed for high-volume manufacturing, which is a critical factor in Luna's growth strategy.

"The Iolon laser comes in a highly reliable, miniaturized package that we believe will improve the scalability, ruggedness and speed of Luna's existing line of fiber-optic test products," said Brian Soller, general manager of Luna Technologies, the test and

measurement division of Luna Innovations. "The functionality of this laser allows faster, more flexible solutions for our customers, which ultimately gives them the ability to make better products at lower costs."

## BUSINESS

### **StockerYale announces new R&D initiative to develop next-generation specialty fibers**

StockerYale Inc., an independent provider of photonic-based products, announced an increase in investment in personnel and equipment to develop fibers for fiber lasers and amplifiers. StockerYale continues to add top industry talent to its specialty optical fiber business in order to focus on advanced development of next-generation rare earth doped fibers.

Richard P. Tumminelli, director of R&D for Specialty Optical Fiber, stated, "It is well known in the fiber laser industry that most commercially available ytterbium fibers used in industrial lasers today display a phenomenon called photo-darkening where the core material darkens with usage. When fiber lasers are operated at high power, this phenomenon will ultimately undermine the laser's performance and lifetime."

Based on recent scientific work conducted at the company, Dr. Ivan Maksymyk, SOF program director, noted, "Research and product development will focus principally on the alleviation of this photo-darkening effect through improved core glass composition, and on the improvement of power conversion efficiency, with respect to currently available ytterbium doped fiber products."

In addition, the company is dedicating further resources to optimize its erbium doped fiber for next-generation high-power amplifiers which are used in network service applications such as video, high-speed Internet, and telephony. Concurrent with the increased R&D, the company will make additional capital

investments to expand both its R&D and production capacities to address these rapidly growing market segments. Based on a recent report by Strategies Unlimited, the emerging market for fiber lasers is expected to grow by a compound annual growth rate of approximately 39 percent, from \$131 million in 2005 to \$674 million by 2010. According to Frost & Sullivan, an independent industry research firm, the fiber amplifier market is estimated to grow from \$412 million in 2005 to \$540 million in 2009.

“Given both the size and growth prospects for rare earth fibers, as well as the fact that there are few independent manufacturers of such fibers, StockerYale is well positioned to service these markets,” stated Mark W. Blodgett, chairman and CEO.

### **AltaSens begins ramping production on the world’s highest-performance CMOS image sensor**

Imaging sensor pioneer AltaSens Inc. announced production availability of its 2/3-inch ProCamHD 3570 CMOS sensor for deployment in the latest high-definition broadcast and professional camera market. Unlike commonly used CCDs, the 3570 CMOS sensor is a highly flexible multiformat imaging device that delivers the lowest power and highest performance.

The 3570’s multiformat capability is supported without compromising key performance aspects and thus enables worldwide global deployment. In addition to natively generating progressive images at up to 72p with full 1920x1080 and up to 120p with 1280x720, it can generate NTSC or PAL images at double resolution and HD-interlaced images at 1920x1080. The resulting camera section is more compact, with lower power and less heat. Other key benefits of the 3570 imaging system-on-chip (iSoC) is its 14-bit signal processing data path and its noise-reducing tapered reset technology.

“CMOS imaging is the future of broadcast,” said Naoki Kashimura, general

manager of Ikegami’s Global Marketing. “Our collaboration with AltaSens allows us to be at the forefront of CMOS imaging in the demanding HD broadcast market.” Mr. Kashimura added, “We have been developing several end-to-end digital CMOS HDTV camera models using this new sensor technology with its multi-format capability and low power consumption. We look forward to ramping deliveries very soon.”

Giuseppe Rossi, AltaSens vice president of technology, commented, “We are pleased to offer for general availability the ProCamHD 3570 CMOS sensor, which serves as the ultimate benchmark for leading high-end imaging applications such as Ikegami’s portfolio of broadcast and professional cameras. Our continued collaboration with Ikegami will benefit all our ProCamHD customers, no matter their application.”

AltaSens is supporting 3570 sensor evaluation and initial setup via a comprehensive evaluation kit and AltaSens’s ProCEED Software Package. The evaluation kit comes with Megapixel-quality lens, cabling, and frame-capture board for use in a PC. The ProCEED software simplifies sensor programming while enabling real-time PC-based imaging and extensive sensor characterization.

### **Image Sensing Systems announces new CEO**

Image Sensing Systems Inc. (“ISS”) announced that its board of directors has named Ken Aubrey to serve initially as the company’s president with a transition to the position of president and CEO as of June 1, 2007.

Aubrey has over 20 years of experience as a multifaceted executive/general manager and major project manager in diverse settings, globally. He has had long-term assignments in Hong Kong, Australia, England, Germany, and the US, with extended periods in Singapore, Taiwan, and Seoul.

Aubrey, 57, has served since 1995 in various positions with Siemens, most recently

as a business unit vice president of Siemens's ITS (Intelligent Transportation Systems) Division, Industrial Solutions & Services Group. He concurrently managed Strategic Projects for the ITS Division. Immediately prior to his current position, Aubrey served as a vice president of Strategic Projects for Siemens's Information and Communication Networks Group, in which he focused on Merger & Acquisition projects.

"Ken has executive level experience in the ITS area that ISS serves, along with a strong global background that we are looking for in our new CEO," said Jim Murdakes, chairman and current president and CEO. "Ken will initially serve as president of Image Sensing Systems Inc. with primary responsibility for developing and advancing the company's international strategy," said Murdakes. "I will continue to focus on and manage other domestic business activities."

"We are very fortunate that Ken has accepted the appointment as we believe ISS has matured to a point where we need an executive with a technical background (Ken graduated with a Physics and Math major and has an MBA) but who also has executive management and international experience," said Panos Michalopoulos, the company's founder and current member of the company's board of directors. Michalopoulos continued, "Ken was one of several candidates for the CEO/president position that had outstanding credentials, but he impressed us most with his technology background in our space and his enthusiastic response to the prospects that lie ahead for ISS."

Aubrey said, "ISS, with its Autoscope machine vision system for traffic management, has been and will continue to be the leader in the industry. I know ISS has many of the top engineers in the ITS space along with international managing directors who are knowledgeable in their individual markets. I'm looking forward to joining and leading the ISS team of engineers, sales and support staff and

working closely with ISS partners, building on its global leadership position."

Aubrey is expected to begin his duties with ISS on or about February 1, 2007, while continuing to live in Germany, where he can be closer to the company's international operations and key distributors in Europe and Asia. He plans to move to Minnesota on or about April 1, 2007, to begin the transition to CEO, which should be complete by June 1, 2007. Once he becomes CEO, Aubrey will be asked to join the board of directors, while Murdakes will continue on as chairman.

### **Inrix expands real-time traffic flow coverage to 73 US markets and 47,000 miles of road**

Inrix Inc., a provider of traffic information, announced the immediate availability of the largest real-time traffic flow data network in the US, covering over 47,000 miles of road in 73 metropolitan markets.

This dramatic expansion in coverage is enabled by the latest release of the company's next-generation platform, the Inrix Traffic Fusion Engine. Using sophisticated statistical techniques and proprietary error correction technology, the Inrix Traffic Fusion Engine intelligently combines real-time information aggregated from the hundreds of data sources in the Inrix Smart Dust Network.

The Inrix Smart Dust Network provides the first scalable approach to enabling ubiquitous, high-quality, real-time traffic information. Leveraging traffic-related data from the world's largest GPS-enabled probe network of over 625,000 vehicles as well as the best available regional information from road sensors, toll tag readers, and numerous other data sources, Inrix delivers the broadest nationwide coverage with unparalleled accuracy.

"Our unparalleled market coverage and dedication to data accuracy significantly enhances the value proposition and navigation experience for consumers, enterprises and fleet

customers,” said Bryan Mistele, president and CEO of Inrix.

Inrix now provides real-time speed data for more than double the metropolitan areas and over five times the amount of road miles as the next leading traffic information provider. With its unique approach, Inrix is able to provide speed information in metropolitan areas with limited or no traditional road sensors, such as Cleveland, Ohio; Hartford, Connecticut; Knoxville, Tennessee; Tampa, Florida; Tucson, Arizona; and dozens of others.

In metropolitan markets with existing road sensors, the Inrix Traffic Fusion Engine significantly improves the quality of the information and extends the flow reporting to many additional miles of roads. Examples of enhanced Inrix market coverage leveraging the fusion of probe data and traditional road sensors include 1,252 road miles in Boston, Massachusetts; 1,811 road miles in Chicago, Illinois; 804 miles in San Francisco, California; 798 road miles in Seattle, Washington; and 1,450 road miles in Washington, D.C. A complete list of Inrix markets and coverage maps, classified using the industry standard Core Based Statistical Areas (CBSAs), are available at <http://www.inrix.com/coverageflow.asp>.

A recent navigation market report by C.J. Driscoll and Associates validates the importance of quality traffic coverage for consumers. “The rapid increase in market adoption of personal, mobile and in-car navigation solutions is converging with a monumental shift in the coverage and quality of relevant traffic information,” said Clem Driscoll, founding partner of market research firm C.J. Driscoll and Associates. “In our navigation survey of over 4000 consumers, we saw strong interest and willingness to pay for traffic information services. Over 60 percent of consumers identified information on traffic conditions as a requested feature in an installed or portable GPS vehicle navigation system or in a cell phone based navigation service.”

## MARKET INTELLIGENCE

### **Plant, personnel safety to turn fortunes of mature gas detectors and analyzers market**

The market for gas sensors, detectors, and analyzers is certainly growing from a global perspective. Market participants expect to tap opportunities by educating end-users on the advantages of using different sensors. There is a shift in the combustible gas market, as catalytic gas detectors are gaining lost ground owing to their extensive detection capability, which is driving the growth of combustible market.

Frost & Sullivan’s (<http://www.sensors.frost.com>) study, “World Gas Sensors, Detectors, Analyzers,” reveals that the three markets earned revenues of \$48.5 million, \$680 million, and \$278.5 million, respectively, in 2005 and estimates this to reach \$80.6 million, \$947.3 million and \$376.1 million in 2012.

If you are interested in a virtual brochure, which provides manufacturers, end-users, and other industry participants with an overview of the latest analysis of the World Gas Sensors, Detectors and Analyzers Market, please send an email to Tori Foster, Corporate Communications, at [tori.foster@frost.com](mailto:tori.foster@frost.com) with your full name, company name, title, telephone number, email address, city, state, and country. An overview will be sent to you through email upon receipt of the above information.

“The increasing awareness for plant and personnel safety in the developing countries is driving the growth of the gas detectors and gas analyzers market,” notes Frost & Sullivan industry analyst Dr. Rajender Thusu. “As the market is inclined towards combustible gas detection, and end users are concerned about plant safety, the need for toxic gas detection is likely to increase in future through awareness programs.”

The recent investments in oil and gas refineries, with low toxic gases usage, are driving the combustible gas detection market. Reduction in work force is also a major restraint.

Due to automation and workforce reduction, the deployment of gas detectors for personnel safety and health is low, and therefore the growth of the toxic gas detectors market is lower than that of combustibles.

The gas detectors market is primarily dependent on industries such as oil and gas, chemicals and petrochemicals, wastewater treatment plants, energy production, healthcare facilities, and power. However, an economic slowdown in North America has slowed the setting up of new infrastructure facilities. Therefore, gas detector manufacturers witnessed minimal new equipment sales and a corresponding lack of growth.

“Construction of new facilities in end-user industries such as oil, gas, and power generation, crucial for the growth of the gas detectors market, has reduced drastically,” added research analyst V. Sankaranarayanan. “There is actually a dearth of construction activities in end-user industries such as power generation.”

As the North American and European markets are maturing, participants can target underdeveloped and developing countries that offer more opportunities. However, this can prove beneficial only if end-users have proper knowledge of gas detectors.

“World Gas Sensors, Detectors and Analyzers Market” is part of the Sensors and Electrical Subscription. It provides an overview and outlook for the above-mentioned markets/ and divides them into various technology segments, 4 geographic segments, and 10 end-user segments. It also includes detailed market opportunities and industry trends evaluated following extensive interviews with market participants. This study provides detailed market opportunities and industry trends evaluated following extensive interviews with market participants in the following segments: toxic gas detectors (electrochemical and semiconductor), combustible gas detectors (catalytic and infrared), and analyzers (NDIR, zirconia, paramagnetic and electrochemical).

### **Sensor technologies witness tremendous advancements**

Research and Markets has announced the addition of “World Pressure; Temperature; and Flow Sensor Technology Developments (Technical Insights)” to their offering.

The Frost & Sullivan research service provides insight into noteworthy and emerging advances in technologies for pressure, temperature, and flow sensors, and the challenges facing their development.

#### *Market sectors*

##### By application:

- Automotives
- Consumer electronics (Computers)
- Industrial controls and monitors
- Medical devices
- Analytical

##### By technologies:

- Piezoceramics
- Thermistors
- Micro-electromechanical systems (MEMS) and Complementary metal-oxide semiconductor (CMOS) based technologies
- Wireless sensor networks
- Energy harvesting
- Coriolis and ultrasound flow technologies
- Infra red (IR) and contact thermal sensors
- Fiber optics
- Nanoflow sensors

The following technologies are covered in this research service:

- Pressure Sensors: A pressure sensor converts some mechanical displacement into an electrical quantity, often using a technology that involves a diaphragm. Diverse technologies are used in pressure sensing. These include piezoresistive, piezoelectric, capacitive, potentiometric, inductive, and resonant. Piezoresistive technology is the main pressure sensing technology.

- Temperature Sensors: Temperature sensors fall into two categories: contact sensors and noncontact sensors. Contact sensors make up the majority of temperature sensors. As the name implies, the sensor is in contact and therefore in thermal equilibrium with the object of the measurement. A key type of noncontact temperature sensor measures temperature from the amount of IR radiation emitted from the object being monitored.

- Flow Sensors: There are a number of different technologies used in flow sensors, including differential pressure flowmeters that provide a volumetric flow rate output. As the name suggests, they use pressure sensors. Computer calculations incorporating absolute pressure, differential pressure, temperature, and viscosity information are applied to the output signal to obtain the actual flow rate.

In keeping with changing end-user requirements, there are a number of novel technologies that have been developed for pressure, temperature, and flow sensors. Most of these are refinements of existing technologies, and particularly noteworthy are those related to delivery of information generated by smart sensors, especially smart sensor wireless networks. Wireless networking is having a major impact on industrial applications. The development of Zigbee standards for low-power consumption applications such as wireless sensor mesh networks is facilitating cost-effective, efficient wireless communications for sensing and control applications. Emerging energy-harvesting technologies that rely on vibrational energy, the movement of a switch, and very small thermal differences promise to free wireless sensor networks of the need to change batteries forever and are also technologies worth monitoring.

With regard to automotive applications, some specific examples of recent developments include sensors that measure and/or control fuel injector pressure and throttle valves. Tire

pressure sensors are also emerging to meet new regulations, and many others have been developed to control specific safety features such as air bags. Medical applications, too, have some very specific use of sensors, and a recent development provides continuous blood pressure monitoring, notes the analyst of this research service. There is now a sensor technology to control the removal of cataracts using a hollow surgical tool, and a portable electronic spirometer that uses a pressure sensor to measure respiration for diagnosing pulmonary disease.

#### *Oil industry adopting FBG fiber-optic sensors*

While it has taken a few years for them to gain acceptance, fiber-optic temperature and pressure sensors are being increasingly adopted by the oil and gas industries. Down in the harsh environment of well holes, the fibers behave as multiple sensors and serve as the data-transmission pathways from that environment. A Fiber Bragg Grating (FBG) sensor can be made with more than 60 different parameters written into the core of a length of virgin optical fiber using a laser, and deployed into an oil well environment that could include temperatures in excess of 250 degrees C and pressure up to 25,000 psi. The FBG fiber-optic technology is far superior to traditional sensor technologies that use a transducer (a piezoelectric crystal or thermocouple) and produce weaker signals.

Notwithstanding these developments, a major challenge for sensor technology, including smart sensors, lies in adhering to the European Union (EU) Reduction of Hazardous Substances Directive (RoHS) that require electrical and electronic equipment to be lead free. Lead-based solder has been used in electronic equipment, including sensors, for years, and the most successful piezo-ceramic materials are lead based, says the analyst. RoHS will hence demand the development of suitable lead-free technologies, and this has proved significantly

costlier to the industries involved than was originally anticipated.

For more information, please visit <http://www.researchandmarkets.com/reports/c46160>.

### SELECTED OFS PAPERS

#### Applications and Technical Progress of Fiber-optic Gyros in Japan

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##### *Abstract*

This paper describes recent progress in production and applications of Interferometer Fiber-optic Gyroscopes in Japan including control of rocket and satellites, camera stabilizer, sweeper robot, etc. Recent researches of the I-FOGs are also described. ©2006 Optical Society of America

##### *Introduction*

30 years have passed from the first experiment of Interferometer Fiber-optic Gyroscope (I-FOG) by Vali and Shortill. Following is brief outline of I-FOG progress of this quarter century.

1976: Proposal and demonstration of I-FOG by Vali and Shortill

1977-1982: Study for basic configuration  
\*Minimum configuration, Open-loop and Closed-loop configuration

1980-1990: Study for error factors and optical components

\*SLD, PM fiber, Coupler, LN IOC, Winding technology

1990-: Practical applications of intermediate grade I-FOG

\*Aerospace area and Industrial area : Study for cost reduction, down sizing and high-performance \*De-polarized configuration (single-mode fiber coil)

\*3-axis I-FOG, EDF ASE source

I-FOG has the significant features, compared with traditional spinning mass gyros, such as short warm up time, long life, high reliability, wide dynamic range, light weight, low cost, etc. These features have developed new applications of the gyroscope not only in conventional aerospace application area but also in industrial application area, such as control and navigation of unmanned vehicles, antenna/camera stabilizers, and so on.

In this paper, recent progress in production and applications of I-FOG are described. On the other hand, additional researches are still continued aiming for small size and higher performance I-FOGs. In this paper, these research works in Japan are also described.

#### Recent advances in fiber-optic EFPI sensors and their use in structural health monitoring

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##### *Abstract*

Fiber-optic Extrinsic Fabry–Perot (EFPI) sensors have been successfully used for a wide range of applications, in particular, structural health monitoring (SHM). The recent progress in EFPI sensors is reviewed in this paper. Firstly, the optical amplification technology is adopted into the EFPI sensor system to enhance the interferometric signal. Secondly, both spatial-frequency- and coarse-wavelength-division multiplexing technologies are proposed and demonstrated for enhancing the multiplexing capacity of modified EFPI sensors, called Fizeau sensors, considerably. Thirdly, the uses of the

EFPI sensors in SHM of composite materials and bridges are described.

#### *Introduction*

Fiber-optic interferometric sensors are of importance as they have many advantages over conventional sensors, such as immunity to electromagnetic interference, capability of responding to a wide variety of measurands, very high resolution, high accuracy, small size, etc. A number of fiber-optic interferometric sensors have been successfully commercialized and widely used for health monitoring of composite materials, large civil engineering structures (e.g. bridges and dams), space aircrafts, and airplanes, etc., which would lead to the realization of so-called smart materials and structures. The fiber-optic Extrinsic Fabry-Perot interferometric (EFPI) sensor is one of the best candidates for such applications. However, weak interferometric signal and difficulty in multiplexing are two major intrinsic drawbacks of EFPI sensors, limiting the applications of EFPI sensors considerably. In this paper, recent progress towards solving these two problems is described.

#### **The Impact of Component Development on the Evolution of Fiber-optic Gyroscopes**

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#### *Abstract:*

This paper will review the impact of component development on the evolution of the fiber-optic gyroscope. Considered will be single-mode and PM fiber, fiber couplers, integrated components in lithium niobate, broadband sources, and configurations for closed loop operation. © 2006 Optical Society of America

An important aspect of the development of fiber-optic gyroscopes has been the continued improvement in components, from the initial availability of single-mode fiber to the development of couplers, polarizers, broadband sources, fiber amplifiers, integrated

components, and ability to achieve desired component configurations. This progress has allowed the reduction of the minimum detectable rotation rate, i.e., the level of the noise floor which limits measurement sensitivity, from rates of degrees/sec to  $\sim 0.001$  deg/hr. This paper will provide a review of the history of this component development, and its impact on the reduction of gyro noise sources, which contributed to the enormous performance improvement available today.

A partial listing of critical component development and its impact on gyro performance follows:

1. Single-mode fiber and fiber couplers — The availability of single-mode fiber was the development that kicked off all fiber interferometry, as it allowed fiber interferometers to be built without spatial modal noise. Fused fiber couplers, and other types of fiber couplers, allowed the rapid introduction of all-fiber configurations, which provided long-term stability and reduced noise from the mechanical fluctuations of bulk components.

2. Integrated beam splitters and electro-optic phase shifters in proton exchanged Lithium Niobate — This component played a key role due to the number of critical functions it simultaneously performed. It provided an integrated, waveguide beam splitter and electro-optic phase shifter, which could be operated at a suitable frequency, and bandwidth, for signal processing purposes. The proton exchange waveguide process, which supports only the extraordinary polarized mode, provides a high quality, integrated polarizer. Simultaneously, these functions were critical to the implementation of “minimum configuration” gyros, which was necessary to provide reciprocity and eliminate error sources.

3. Polarization maintaining (PM) fiber, PM fiber couplers, and fiber polarizers — These components were critical to the reduction of polarization noise, in maintaining reciprocity, and in the demonstration of long-term, inertial grade

operation. PM fibers also played a role in the reduction of non-reciprocal effects due to the Faraday effect, which would otherwise appear as a rotation.

4. Broadband sources — The introduction of superluminescent diodes (SDL's) into fiber gyroscopes probably provided the most dramatic noise reduction in the development of the sensor. Broadband sources provided control of spurious noise due to Rayleigh backscattering, which with HeNe laser sources limited performance to the ~deg/sec range. These sources have sufficient coherence to demodulate the desired gyro signal, but are sufficiently broadband that the sum of the backscattered light from throughout the fiber adds incoherently and amplitude fluctuations average to zero, thus eliminating the noise. Broadband sources also played a role in the reduction of error sources due to the Kerr effect.

5. Superfluorescent fiber sources and fiber amplifiers — Fiber broadband sources, operated in an amplified spontaneous emission (ASE) mode, provided bandwidths similar to SLD's, but with higher optical power (>100mW).

In addition to the benefits described above, the higher power was useful in the reduction of shot noise in the detector. Intensity, or "excess" noise from the source depends on the source bandwidth, and is reduced with broadband sources. In cases where extreme noise reduction is desired, additional optical power can be provided with fiber amplifiers.

6. "Closed-loop" operation — Open-loop gyros, with sinusoidal outputs, have primarily been used as a research tool rather than a practical device. A variety of closed-loop schemes, with feedback to keep the gyro operating point at its maximum sensitivity and most linear operating point, have been developed and are essential to commercial implementation. In addition, these schemes, with appropriate signal processing, can help to reduce the effect of thermal fluctuations in the fiber coil, or "thermal noise." These time varying fluctuations destroy the reciprocity of the gyro configuration, as the index distribution along the fiber can change within a transit time. The resulting noise appears as a rotation signal in the output. This effect can be reduced in part by signal processing.

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