INNOVATION IN SPECTRAL SENSING
INNOVATION

It’s an extraordinarily challenging world we live in. Innovation is derived from understanding real, high-magnitude approaches to business problems that impact our environment. Headwall is applying advanced spectral technology to help solve complex problems in critical application areas such as environmental monitoring, remote sensing, precision agriculture, cultural heritage (documents, artifacts, and paintings), ‘high value’ industrial process-control, and in-line product inspection. Advanced spectral instrumentation can result in breakthroughs and advantages for a broad range of industries with a competitive vision.

Focusing on all aspects of the innovative science of spectral analysis and imaging is where Headwall has established technical leadership and application vision. As a U.S.-based manufacturer, Headwall designs and deploys complete, integrated solutions for end-users and also develops application-specific spectrometers and optical engines for OEM customers worldwide.

Headwall’s customers are worldwide leaders representing millions of consumers. Markets include spectral vision products, next-generation industrial inspection systems, and airborne sensor systems that provide real-time target detection for the military & defense community. In each case, Headwall delivers innovative solutions that allow companies to realize breakthroughs in how the world is viewed while achieving long-term, sustainable business advantages.
As a research partner with the USDA, Headwall is introducing high-speed hyperspectral imaging to agricultural processing and poultry, beef, and fish inspection to improve food safety and quality.

Chemical (spectral) imaging offers scholars, curators, and conservators the ability to enhance faded or hidden features of artifacts and documents, detect restorations and repairs, and assess original coloring and pigmentation on artwork.

Nano-Hyperspec® is Headwall’s newest, smallest and lightest hyperspectral sensor for use on UAVs.
QUALITY & INDUSTRIAL INSPECTION

Analytical spectral instruments and machine vision technologies improve the quality of products we use every day. Application areas include the inspection of poultry and specialty crops, semiconductors, photovoltaic cells, and pharmaceuticals moving along high-speed lines. Emerging areas of science such as plant genomics and high-throughput phenotyping are enabled through spectral instrumentation designed and manufactured by Headwall.

The key in all cases is to rapidly and precisely evaluate product characteristics in real-time with unfailing accuracy, and then communicate that information to downstream stations. The ability to define spectral signatures and process anomalies, disease conditions, and the presence of ‘foreign matter’ helps companies boost quality of inspection far beyond the capability of standard vision systems. The result is demonstrably higher yields of safer, higher quality products. Equally important is production efficiency, which leads to higher profits and increased throughput for process manufacturing.

While exceptionally well suited for the rigors of industrialized processing and inspection, Headwall’s spectral instruments are also right at home in laboratory environments that focus on forensics, biotechnology, color-measurement, and other mission critical applications.
Headwall’s Hyperspec® Inspector silently and rapidly monitors in-line processes for product quality and safety.

**FOOD SAFETY & QUALITY**
High-speed/high-volume inspection of nuts, specialty crops, poultry, and seafood complement hyperspectral sensors perfectly, leading to healthier, high-quality products for consumers.

**COLOR MANAGEMENT**
Managing color is critically important for industries such as apparel and textile, paint and coatings, automotive, plastics, photography, ink, and printing. The precision of spectral imaging assures uniform color matching and brilliant results!

**PLANT GENOMICS**
Advances in plant genomics are complemented by high-throughput hyperspectral imaging, yielding abundant high-resolution phenotyping data on plant growth and development.
DEFENSE AND SECURITY

Intelligence, Surveillance, and Reconnaissance (ISR) programs demand technological leadership to process, exploit, and distribute data for situational advantage. With high spectral and spatial resolution, Hyperspec® sensor capabilities extend beyond the visible spectrum into Ultraviolet, Near Infrared (NIR), Very Near Infrared (VNIR), Extended VNIR, Shortwave Infrared (SWIR), and Long-Wave Infrared (LWIR) spectral regions.

Taking reflected light and dispersing it into thousands of spectral wavelengths is the basis for Headwall’s patented, multi-spectral and hyperspectral sensor designs. The resulting hyperspectral data cubes enable spectral tagging, target selection, and enhanced ISR capability. Deployment areas include reconnaissance missions, real-time target detection, airborne and satellite-based remote sensing, undersea exploration, and bio-chemical threat assessment.

Headwall’s technology leadership is focused on diffractive optics and then combining that with advanced algorithms and data processing capabilities. Headwall’s sensors are rugged and SWaP-optimized to meet stringent operational and environmental demands. Deployment solutions range from handheld and ground-based sensors to tactical UAVs, small payload satellites, and high-altitude manned aircraft that have precise payload restrictions.
Small tactical UAVs require payloads optimized for size, weight, and power consumption (SWaP). Headwall’s innovative hyperspectral sensors accomplish this while maximizing spatial and spectral resolution within a wide field-of-view.

Headwall is bringing spectral imaging to the battlefield, with portable and simple-to-use sensors that represent a valuable asset for reconnaissance and surveillance missions. Innovation here keeps our troops and assets safer than ever.

Headwall sensors are based on a concentric design using lightweight materials, aberration-corrected optics and no moving parts. This means instruments that fit precise size and weight budgets.

Micro-Hyperspec® is light and athermalized. It provides very high resolution, high signal-to-noise, a wide field of view, and outstanding spatial and spectral resolution.
A critical area for environmental biologists, geologists, and crop scientists is the deployment of hyperspectral sensing technology. Non-contact acquisition of information about an object or spatial area of interest is what remote sensing is all about. Most often, remote sensing occurs from airborne platforms such as high-altitude aircraft and earth-observation satellites. Water, land, and atmosphere can be analyzed with tremendous spectral and spatial fidelity through passive techniques such as hyperspectral sensing or active sensing techniques such as Raman imaging.

Remote sensing makes it possible to collect data on dangerous or inaccessible areas, and then analyze that data more rapidly than ever. Environmental monitoring, disaster mapping, vegetation health, erosion, forestry, and land use can be imaged, tracked and analyzed. With the ability to collect full spectral information on a per-pixel basis, hyperspectral sensors are uniquely capable of capturing and accumulating scene data. In all cases, Headwall’s vertically integrated approach means that solutions move from concept to prototype and full production very rapidly and cost-effectively.
DISASTER MANAGEMENT
Remote sensing from commercial satellites is a particularly valuable deployment of hyperspectral technology. Small and precise sensors can successfully mitigate the long-term effects of a wide range of ecological disasters.

ENVIRONMENTAL MONITORING
Commercial UAVs used for environmental monitoring represent an important application area for hyperspectral sensors including precision agriculture, petroleum science, pollution control, and ecology. High resolution and a wide field-of-view are key features of every Headwall sensor.

RESOURCE EXPLORATION
Ground truth is an integral part of remote sensing, and it represents a process by which image data can be related to real features and materials on the ground. Optical products from Headwall form the basis for high spectral performance in many OEM applications.

Micro-Hyperspec® SWIR covers the spectral range from 900 to 2500 nanometers, critical for a wide range of airborne remote-sensing applications.
Biotechnology and medical science represent advanced application areas for spectral instruments, which include hyperspectral imagers, multi-point instruments, and Raman analyzers. Headwall’s precision spectral instruments and products for end-users and OEMs represent a highly resolved, noninvasive means of imaging tissues or identifying disease conditions at either microscopic or cellular levels.

The use of high-efficiency diffractive optics allows Headwall to produce instruments having the level of spectral and spatial resolution necessary to impact crucial life-saving decisions and technology advances. This includes the detection of cancerous brain cells, where Headwall sensors are playing a lead role in the groundbreaking European HELICoiD trials. Every point (pixel) within the field of view can be resolved using hyperspectral imaging, resulting in a data-rich mosaic that can be used by doctors and biologists to uncover healthcare issues or conditions not otherwise seen. In the field of pharmaceuticals this technology is tremendously beneficial during formulation (API) and during product inspection.

Headwall’s hyperspectral and Raman products are optimized for specialized applications such as cellular spectroscopy, non-invasive diagnostic imaging, and bio-sensor nanobeads. The technology is rapidly and cost-effectively enabling advances in scientific instrumentation across biotechnology and health care.
PHARMACEUTICAL
New pharmaceuticals and healthcare solutions are brought to market faster through utilization of NIR instrumentation and Raman technology. Drug discovery as well as scaling to high-volume manufacturing are key benefits.

DIAGNOSIS
Headwall’s hyperspectral imaging sensors are delivering high-resolution data that is able to distinguish cancerous brain cells as part of the highly successful HELICoID project in Europe.

MICROSCOPY
Cellular spectroscopy and nanoparticle research is made more reliable and data-rich by integrating spectral-sensing technology onto laboratory microscopes. The medical research community benefits from highly-resolved sample data on disease conditions and tracking of molecular interactions.

Hard-to-detect cancerous brain cells are easily distinguished with the use of Headwall’s hyperspectral imaging sensors, which deliver a highly-resolved view in a non-invasive manner.
Providing Innovative Spectral Solutions to End-Users and OEM Partners Around the World.

TECHNOLOGIES & CAPABILITIES
- Diffractive optics
- Advanced optical modeling
- Collaborative engineering
- Application-specific solutions
- ISO-9001:2008 certification

PRODUCT CATEGORIES
- Instruments
- Sensors
- Software
- OEM spectral engines
- Optics

SPECTRAL RANGES
- UV-VIS
- VNIR
- Extended VNIR
- NIR
- SWIR

- MWIR
- LWIR

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