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Spectral presence

Fitchburg photonics firm helps clients 'see' color

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FITCHBURG— All the world's a color to Headwall Photonics Inc.

Everything has a spectral fingerprint, an unseen and unique pattern of colors emitted by people, animals, rocks and literally everything else.

For decades, scientists have amassed spectral libraries, databases detailing which minerals and molecules emit which colors. The Jet Propulsion Laboratory at the California Institute of Technology, for example, maintains a library of more than 2,000 spectral fingerprints.

Inside the former Fitchburg Paper Co. headquarters here, the employees of Headwall Photonics make equipment used to "see" those spectral fingerprints.

This high-tech work has some surprisingly varied uses.

Headwall Photonics' technology has been used to determine how much fertilizer to use on a corn field, to detect the edges of a chemical spill and to match paint colors.

It also can be used to locate troops in hostile territory, to find pilots lost at sea — even to identify minerals on Mars.

"Designing instruments for a Mars mission is very demanding," said Phillip P. Jenkins, principal scientist at the Ohio Aerospace Institute. "The Mars environment is harsh, and the available payload space is very small. A large lander to Mars may have only 100 pounds available for instruments. We worked with Headwall Photonics to produce a spectrometer that is small, lightweight and rugged."

It's no accident that Headwall's gear works in places as unforgiving as Mars.

"High-performance instruments in a harsh environment — that's something we do well," said David P. Bannon, chief operating officer of Headwall. "We have product at the depths of the ocean and literally in outer space. We're used to being deployed in environments where there's a lot of money at stake."

Headwall Photonics was founded in 1976 as American Holographic Inc. in Littleton. In April 2000, publicly traded Agilent Technologies Inc. acquired American Holographic, which by that time had moved into the former Fitchburg Paper Co. headquarters on River Street. Financial terms were not disclosed.

For three years, the company was operated as a division of Agilent. In 2003, Mr. Bannon and Headwall CEO Larry W. Barstow led an \$8 million management buyout of the company.

Agilent took a position as an investor in the business, and remains one of Headwall's key customers.

Since then, Headwall has grown from 14 to 24 employees, with plans to add four more. The company does not disclose its annual sales, but has been profitable since the buyout, Mr. Barstow said.

The company is best known for its ability to make spectral-analysis equipment that is far smaller than ever made before.



Headwall Photonics Inc. Director of Engineering Darrin Milner uses a laser to test a high-performance holographic grating in a lab last week in Fitchburg. Below are company CEO Larry W. Barstow, left, and COO David P. Bannon.

"Our vision is to shrink down the equipment needed to do spectral analysis," Mr. Bannon said.

The business has won two contracts from NASA in the past 18 months. In May 2004, NASA contracted the company to make a device about the size of a basketball that can be used to identify minerals on Mars. The analyzer sits inside heavy-duty dark plastic, and has an arm that reaches out to grab a sample of a Martian rock or other material. When a laser is shined on the material, the spectral fingerprint is revealed and captured by the analyzer. That device is scheduled for launch to Mars in 2010.

"These type of opportunities are great for Headwall," said Mr. Barstow. "If you can meet the technical demands and optical demands for something to fly up to space, it gives you great confidence in what you can do commercially."

Earlier this year, NASA awarded the company a second contract to make devices that do the same thing, but are smaller than a typical telephone. "I was particularly impressed in the degree to which they can miniaturize old technologies," said U.S. Rep. John W. Olver, D-Amherst, who visited the company last week and has a Ph.D. in chemistry from the Massachusetts Institute of Technology. "Some of the technologies they are doing used to be done in rooms the size of a barn, compared with the lunchbox-size space they're doing them in."

Headwall's technology has been installed in the nose cones of planes used in search-and-rescue missions. Using the devices to scan the ocean can help searchers find a downed pilot, for example, because the pilot will emit a different spectral fingerprint than the rest of the sea.

The U.S. military also has used the technology to keep track of Special Forces, Mr. Bannon said. By attaching a spectral transmitter to the soldier, the soldier's whereabouts can be soundlessly traced by searching for that spectral image.

Mr. Olver believes the company will find more government applications for its work.

"Obviously, there are applications here that probably would be of interest to several different federal agencies, including the Department of Defense, Environmental Protection (Agency) and Interior (Department)," he said. "I hope we can keep them independent as a company and grow the company."

The optical field is as competitive as it is technical, Mr. Barstow said. Companies in Michigan, Massachusetts and Europe do similar work, he said.

But Headwall hopes to stand apart by making its devices smaller, more rugged and more specialized, he said.

"The competition is a big challenge for a small company in Fitchburg," he said. "That's where the NASA and Homeland Security contracts help. They let the world know what kind of talent we have here."

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