In order to understand how greenhouse gases modify the atmosphere, the ability to detect molecules with mid-infrared laser light is crucial for studying the composition, distribution, and energy of the molecules that make up the gases. Daylight Solutions has perfected Infrared (IR) spectroscopy using infrared lasers in order to make these important measurements.

DAYLIGHT SOLUTIONS, INC.

Turning a newly-discovered quantum mechanical phenomenon into a commercial product that benefits society is the holy grail of applied science, and by no means a common occurrence. This is, however, exactly what Daylight Solutions, Inc. was able to accomplish in a relatively short time after it was founded in 2005 by three high-tech entrepreneurs.

PHASE III SUCCESS
Over $90 million in private and government contracts and projects stemming from the DOE SBIR-funded technology.

AGENCIES
DOE, DOD, NASA, NSF

SNAPSHOT
Daylight Solutions develops sensors and imaging solutions for a variety of industrial applications, such as process control and monitoring. The company's core technology, developed in part by the DOE SBIR program, is in solid-state, Quantum Cascade Lasers (QCL), which provide a significant advantage over other approaches to molecular detection, analysis, and imaging.

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The ability to detect molecules with mid-infrared laser light is driving immense interest in applications spanning standoff detection of Improvised Explosive Devices (IEDs), process control, and pollutant monitoring, to name a few. For instance, to understand how greenhouse gases modify the atmosphere, we need to study the composition, distribution, and energy of the molecules that make up the gases. Infrared (IR) spectroscopy using infrared lasers is a sensitive technique for making these kinds of measurements.

The challenge is that, in order to map out the whole spectral 'fingerprint' of these molecules, the laser needs to be able to tune widely and cover a wide region of the infrared spectrum. This was nearly impossible before the 1990s, when scientists made a breakthrough discovery known as quantum cascade laser (QCL) technology, which relies on the growth of ultra-thin layers of doped semiconductors, referred to as quantum wells.

Upon its founding, Daylight Solutions had the ambitious goal of turning highly experimental QCL laboratory devices into reliable, marketable laser products – and it succeeded. A significant component of this success was the availability in the company's earlier stages of R&D funds through Small Business Innovation Research (SBIR) awards.

"It was thanks to SBIR awards that we were able to make progress on novel design concepts and critical materials science issues. An SBIR award ultimately led to a workable prototype for a widely tunable QCL laser product, for example," said Dr. Leigh Bromley, Director of Scientific Products at Daylight Solutions.

The company's first Phase I SBIR was granted by the Department of Energy (DOE) and successfully seeded the development of a high power, tunable mid-IR laser for use in remote sensing applications. State-of-the-art QCL technology was incorporated in a minitiaturized tunable-laser cavity to provide a field-ready, mid-IR light source, enabling the detection of

Daylight Solutions' External Cavity Quantum Cascade Lasers. Daylight Solutions has developed a suite of mid-infrared (mid-IR) tunable and fixed wavelength lasers to support cutting-edge molecular detection and imaging applications. All molecules of interest have a color in the mid-IR. If it has a color, it can be seen and if it can be seen, Daylight can detect it.

airborne chemicals. Subsequent Phase II SBIR funding came in 2007, and it was awarded by the National Nuclear Security Administration (NNSA) within the DOE.

"That project involved the development of key components for a special laser tuning mechanism that enabled the industry's first widely and continuously tunable mid-IR laser, ideal for studies of atmospheric gas molecules," Dr. Bromley continued.

"It was thanks to SBIR awards that we were able to make progress on novel design concepts and critical materials science issues."

DR. LEIGH BROMLEY
DIRECTOR

SBIR projects helped Daylight establish a foundation of core technologies that provided a platform from which other new, innovative products could be generated, like for example, the first mid-infrared laser-based microscope for real-time spectral imaging of materials and biological tissue. These and other innovations all required substantial R&D to develop a workable prototype and then transfer into production. In several cases this work was supported by SBIR awards with DOE, the Department of Defense (DOD) and the National Science Foundation (NSF).

One of its newest products to hit the market is the ChemDetect™ High-Speed Mid-IR Molecular Sensor – a high-speed OEM/turnkey molecular sensor platform. The sensor's high-brightness, broad-tuning, fast-scan quantum cascade laser engine provides multi-species detection of a host of gas, liquid, or solid-phase molecules. The system can sample thousands of times per second – enabling faster measurements, or greater averaging to achieve increased sensitivity.

"Like any startup, in its early days Daylight Solutions' limited size and financial resources made it challenging for the company to perform the necessary R&D to elevate a proof of concept to the manufacture-ready level," added Dr. Bromley. "The SBIR program is very important because it allows small companies to explore new ideas at a stage in their evolution that they might otherwise not be able to. Using SBIR funds, small companies can make a prototype and test it to see if the concept is technically feasible and scalable. SBIR allows companies to reduce risk factors, test ideas and move them towards production."

Thanks to this approach, Daylight Solution has been able to commit itself to innovation, as testified by the numerous innovation awards received and patents issued. Technological innovation has paved the way to private and government contracts and projects totaling over $90 million. And as a result, Daylight Solutions is today in the process of doubling its staff and manufacturing facilities.

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