EPA

SBIR Success Stories

Hand-Held Sensor for Carbon Dioxide

Bridger Photonics
www.bridgerphotonics.com

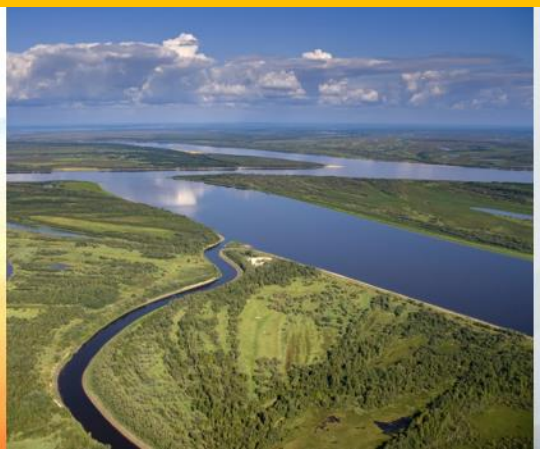
Environmental Problem

The U.S. Environmental Protection Agency (EPA) regulates carbon dioxide (CO_2) emissions under the Federal Clean Air Act. A proposed rule by the EPA would limit CO_2 emissions from new fossil fuel-fired power plants. CO_2 is one of the greenhouse gases that contributes to climate change. Studies have shown that CO_2 concentrations are at unprecedented levels as a result of human activity and that it is very likely that those elevated levels are responsible for an increase in average temperatures and other climate changes. The potential effects of rising atmospheric concentrations of greenhouse gases include increased drought, more heavy downpours and flooding, more frequent and intense heat waves and wildfires, a steeper rise in sea levels, and harm to water resources, agriculture, wildlife and ecosystems.

Fossil fuel combustion is the primary source of CO_2 pollution, with electricity generation and vehicle exhaust accounting for the majority of these emissions. EPA regulations could impact CO_2 emissions from industrial smokestacks, carbon sequestration sites and other sources. Existing technologies require sampling emitted gases with point-source gas-intake measurement devices, which is a time-intensive and tedious process. This makes it difficult for regulators to identify or quantify CO_2 pollution sources. Current laser-remote sensors and other standoff measurement instruments do not provide spatial identification of the pollution source and cannot measure and pinpoint the location of elevated CO_2 concentrations, such as plumes from a smokestack or vent.

SBIR Technology Solution

With support from EPA's Small Business Innovation Research (SBIR) Program, Bridger Photonics developed a mid-infrared laser for use in a remote CO_2 sensor with high-range resolution for onsite CO_2 monitoring and spatial mapping from a distance. The company has commercialized the unique laser source first as a stand-alone product as it has broad ranging applications in other fields, with a full CO_2 gas sensor in development. The sensor will be used to spatially scan CO_2 sequestration or industrial sites for leaks and to provide precise, 3-dimensional (3-D) coordinate mappings of emissions sources. The CO_2 concentration of a smokestack plume will be determined by directing a laser beam at the distant plume. Based on light detection and ranging (LIDAR) technology, the device will probe CO_2 plumes and measure the emitted CO_2 concentration, the distance to the source and the spatial extent of the plume. CO_2 absorbs light in the infrared part of the spectrum, acting as a greenhouse gas by trapping the sun's energy and heating up the atmosphere. Bridger Photonics' laser sends out a pulse of light at the wavelength absorbed by CO_2, and some of that light is absorbed by the CO_2. A small amount of that light comes scattering back to a receiver. By measuring the amount of returning light and determining the amount of light absorbed, the concentration of CO_2 that would absorb that amount of light can be calculated.


Producing a single optical output wavelength from the laser is critical in mid-infrared remote sensing. The laser system uses a novel technique to measure absorption through atmosphere, overcoming the pulse-to-pulse energy fluctuations that challenge sequential differential detection, to provide precise, 3-D coordinate mapping of the emission source. Bridger Photonics' tunable pulsed lasers are capable of spatial mapping of atmospheric molecular concentration with better than 1 meter range resolution from greater than 100 meters away, and detection of molecular concentrations of less than 100 parts per million.

A considerable advantage of Bridger Photonics' mid-infrared laser is that, for the powerful pulses it produces, it is extremely compact, with a form factor of 8" x 7" x 4". Another benefit is that the laser can enable remote gas concentration measurements from more than 100 yards away from the source. In addition, the laser system is air cooled, its output energy is adjustable (internal variable attenuator), it is less expensive than any optical parametric oscillator on the market, and it is robust for field applications.

Commercialization Success

The EPA's SBIR funding has helped Bridger Photonics commercialize its laser, with the full gas sensor to follow. The company has developed and delivered two laser prototypes and received orders for 12 production lasers for tissue ablation applications. For this application, Bridger Photonics has a product supply agreement with Protea Biosciences to support an advanced form of in vivo mass spectrometry. The same laser, with some altered components, will serve as the basis for Bridger Photonics' CO_2 sensor and its other laser-based sensor, which can be used to uncover illicit methamphetamine laboratories and was developed with support from the National Science Foundation and the Montana Board of Research and Commercialization Technology. Bridger Photonics has rapidly grown to become a world leader in three closely related areas of advanced laser-based technologies: precision distance measurement, remote gas sensing and 3-D imaging. Commercialization of its laser-based sensors has boosted the company's annual revenues from $110K to $2 million in 4.5 years..

Company History

Bridger Photonics was founded in 2006 by three physicists to develop lasers and laser-based measurement systems that identify sources of pollution, improve manufacturing quality and efficiency, and help in the fight against illicit drug use. Located in Bozeman, Montana, the company had 18 employees by the end of 2011, and experienced a revenue growth rate of nearly 1,800 percent from 2007 to 2010. The September 2011 issue of Inc. magazine named Bridger Photonics among the *Inc*. 500 list of fastest growing private companies in the United States and ranked it #1 in the engineering sector. Bridger Photonics also was awarded the 2012 Tibbetts Award, which is presented to those small businesses and individuals judged to exemplify the best in the SBIR program. Bridger Photonics has developed the highest resolution distance measurement systems available, and the only affordable, compact, mid-infrared, high-energy pulsed laser for gas detection.

U.S. EPA SBIR
SMALL BUSINESS
INNOVATION RESEARCH