Sergei Skripal, a former Russian intelligence officer who became a double agent for the United Kingdom, and his daughter, Yulia, weren’t the only people affected by a nerve-agent attack in Salisbury, England, in March. Nearly 40 others were sickened, including three police officers who were hospitalized, one of them for more than two weeks. A swarm of hazmat-suited chemical warfare experts inspected every place the Skripals had been recently in the hope of finding out what happened and whether there was still a danger to the public.

U.S. intelligence agencies have been on the hunt for a technology that would make such investigations faster and safer and perhaps even prevent this kind of attack altogether. The Standoff ILluminator for Measuring Absorbance and Reflectance Infrared Light Signatures (SILMARILS) program at the

CAREFUL WORK: Investigators examine a bench in England for chemical traces of a nerve agent after two victims were found there.

SPYING DEADLY CHEMICALS FROM 30 METERS

U.S. intelligence agencies seek tech to spot bombs, nerve gases, and other threats
This quantum cascade laser built by Block MEMS is one of several approaches to standoff chemical detection being developed for SILMARILS.

The three teams in the program are developing a complete system that includes both illumination and spectroscopy, but they each have specialties. Defense contractor Leidos is relying on a pulsed supercontinuum laser. Such devices are typically optical fibers doped with chemicals and with micro- or nanostructures built into them to produce a peculiar nonlinear effect. Specifically, some light pumped into the fiber stimulates the production of a continuous spectrum of wavelengths. Using a series of differently doped fibers, Leidos and researchers at the University of Michigan recently managed to produce a supercontinuum laser with wavelengths that span from 2 micrometers all the way to 11 µm.

Block MEMS, based in Marlborough, Mass., is also using a specialized laser, although one that’s less experimental. The company already provides several chemical detection products based on its quantum cascade lasers. These lasers are made of semiconductors with precisely controlled subnanometer thicknesses. Electrons see these layers as if they were a “staircase” of energy and emit a photon at each step. Block MEMS’s twist on this technology is a laser that rapidly sweeps through a range of infrared wavelengths, by adjusting optical components outside of the semiconductor, explains CEO Petros Kotidis.

Honolulu-based Spectrum Photonics has leveraged its experience building compact, low-power hyperspectral imaging systems. These camera-based spectrometer systems capture a rapid series of images, each with encoded spatial and wavelength information. Spectrum Photonics president Ed Knobbe says the company is developing an imaging spectrometry system for SILMARILS that can detect light with wavelengths of 1.2 µm (short-wavelength IR) to 13.5 µm (long-wavelength IR). “Most of the primary spectral information is in longwave infrared,” explains Knobbe. “But there is a tremendous amount of complementary information in midwave and shortwave IR bands.”

Much of the work now lies in interpreting the returned signal—the brains of the system rather than its beams, says DeWitt. “One of the hardest problems is dealing with the fact that the signature on a surface is not the same absolute bar code you’d get from a chemical floating in the air. When you have small quantities of chemicals on a surface, the spectrum changes considerably according to the substrate and the particle size.”

If any of these teams can solve the remaining problems, the applications will extend well beyond intelligence agencies’ needs. “It changes the whole idea of standoff detection,” predicts Block MEMS CEO Kotidis.

For Leidos’s principal investigator, Augie Ifarraguerri, it’s kind of a dream come true. “There was always this sense that out there, somewhere, was the ability to make the ultimate sensor—the ‘Star Trek’ tricorder,” he says. When he started his career in the 1990s, “it seemed very elusive.” But the technology is close now, and he’s finally getting to do what he’d wanted to do “for, I don’t know, 30 years.”

—SAMUEL K. MOORE

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