Polarizers may enhance remote chemical detection

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Chemists can analyze the composition of a suspected bomb -- without actually touching and possibly detonating it -- using a technique called laser-induced breakdown spectroscopy, or LIBS. The tool is also commonly used for "stand-off" detection in such harsh or potentially dangerous environments as blast furnaces, nuclear reactors and biohazard sites and on unmanned planetary probes like the Mars rovers.

Information provided by LIBS, however, is sometimes clouded by interfering signals caught by the spectroscope -- and eliminating the background can be expensive. But a group of chemists at the University of Illinois at Chicago reports that equipping LIBS with a polarizing filter can do the job at a lower cost and probably with equal or greater sensitivity than the tools presently in use.

Robert Gordon, professor and head of chemistry at UIC, became interested in polarized light after reading books by cosmologist Brian Greene that described a slight polarization of the cosmic microwave background left over from the Big Bang. Out of curiosity, Gordon had his lab group zap a crystal of silicon by firing pairs of near-infrared laser pulses at 80 femtoseconds -- or 80 millionths of a billionth of a second. This "mini-Big Bang-like" laser ablation caused a brief spark, or plasma, that gave off ultraviolet light, which the group checked for polarization.

"We thought we'd see maybe a few percent polarization," said Gordon. "But when we saw 100 percent, we were totally astonished."

The spectrum of light they studied, similar to the rainbow a prism creates when held up to sunlight, includes a series of lines that are the hidden signatures of chemical elements. To get rid of the background spectrum and focus just on the element lines, current LIBS use a time-resolved method that works like a camera shutter by snapping at nanosecond speeds. Gordon's group discovered that by eliminating the shutter and instead using a rotating polarizer, they could filter out the background and focus on the lines.

"The polarizer costs just pennies, whereas a time-shutter is a very expensive component," Gordon said. "By simply putting a polarizer in a detector and rotating it to get maximum signal-to-noise ratio, you can improve the quality of the signal effortlessly and fairly cheaply."

Gordon said there is still basic work that needs to be done to answer why the light gets polarized. He said that varying the angle and the intensity of the laser pulses used to ablate the sample material may provide additional ways to enhance LIBS.

More information: Gordon and his coworkers first reported their findings in the Feb. 15 issue of *Optics Letters* and will present their results at the Conference on Lasers and Electro-Optics May 31-June 5 in Baltimore.

Source: University of Illinois at Chicago (news : web)