Pitt's forthcoming laser shooter could better detect foreign substances for Homeland Security

EurekAlert!

PITTSBURGH—NASA's Mars Rover Curiosity fired its first laser beam in August, blasting a space rock at more than one million watts per shot to determine whether the red planet could be habitable. The method, called laser-induced breakdown spectroscopy (LIBS), is used to detect not only the composition of space-related soils but also an array of foreign materials. Now, with the help of a $1.12 million grant from the U.S. Department of Defense, an engineer from the University of Pittsburgh will build upon the LIBS technique and related instruments to dramatically improve the detection sensitivity of the technology for substances of interest to Homeland Security.

"Our main objective with this project is to develop a technique to enhance the emission process so we can properly analyze samples at a distance with much greater sensitivity than current technology or, in the case of Homeland Security, even pick up trace amounts of conceived substances of interest," said Kevin Chen who received the grant and is serving as a co-principal investigator of the study. He's an associate professor of electrical engineering in the Swanson School of Engineering.

One of the main challenges for the LIBS technique, says Chen, is what's known as the matrix effect. This can occur once a laser is shot, and the material begins to evaporate. In some cases, the composition of the evaporated substance changes in the emission process, no longer resembling the contents of the actual material, resulting in questionable material and potentially spotty analysis. Together with co-principal investigator Yongfeng Lu, professor at the University of Nebraska-Lincoln, Chen hopes to fine-tune the LIBS process by engineering laser pulses on a femtosecond time scale, which is 10-15 of a second—a speed much faster than the reaction time most molecules have to light. By engineering a laser with such intense speed, the team will be able to more easily blast heavy atoms, helping improve detection. Then, they'll work toward building a compact, ultra-fast fiber laser.

"Nothing quite like this exists with the kind of performance we'd like to achieve," said Chen. He foresees his compact shooter wheeling its way into distant and dangerous spaces, allowing scientists to conduct remote measurements on potentially toxic or nuclear materials with ultimate sensitivity. Eventually, he hopes its portability will contribute to a deeper understanding about substance composition and better assist officials with disaster preparedness.

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