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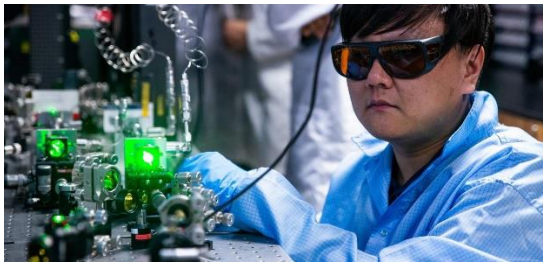
New laser method offers accurate detection of harmful gases

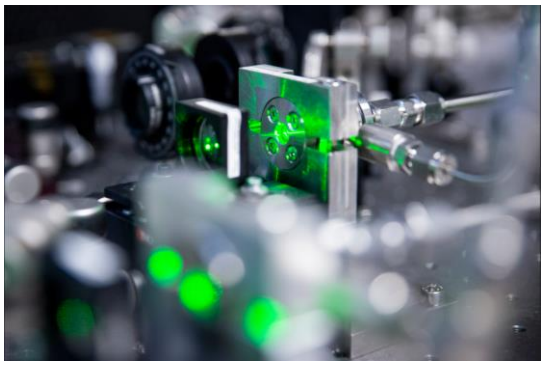


The powerful mid-infrared lasers developed by the NTU researchers can accurately identify trace amounts of pollutants and hazardous gases outdoors (Image: NTU University)

Researchers from the Nanyang Technological University (NTU), Singapore, have unveiled a method for generating powerful mid-infrared lasers that can accurately identify trace amounts of pollutants and hazardous gases outdoors.

The research, published in Laser & Photonics Reviews, details how the mid-infrared lasers, which operate in the 2-20 micrometre wavelength range, offer unique advantages in detecting various substances.

Unlike lasers at other wavelengths, they can accurately identify different molecules, even in the presence of water, making them ideal for environmental monitoring and health analysis.



The properties of the high-speed lasers make them ideal for environmental monitoring and health analysis (Image: NTU University)

Nanyang Assistant Professor, Chang Wonkeun, who led the research, said: "Our method paves the way for developing portable, powerful and fast mid-infrared laser generators that don't need well-controlled and vibration-free environments to work."

“This means we can use them in the field to help test and identify a wide variety of unknown substances on the spot, even in trace amounts, without spending extra time sending samples to labs for testing."

Potential applications for the technology include monitoring greenhouse gases like methane and detection of colorectal cancer through breath analysis.

The researchers generated the new lasers using specially-designed optical fibres with hollow cores. These fibres allowed them to produce intensely bright mid-infrared lasers in the 3-4 micrometre range, with peak power in the megawatt range – a million times more powerful than a standard light bulb.

The hollow core optical fibres also allowed them to produce high-powered mid-infrared lasers outside the controlled environment of a laboratory, as traditional methods either required disturbance-free conditions or produced lasers with insufficient intensity for accurate substance detection.

Commenting on the study results, Professor Sébastien Février from the University of Limoges, said: “Since fibres can be spliced to each other, these results pave the way towards generating mid-infrared lasers free from any moving mechanical parts.”

The ultra-fast mid-infrared lasers are approximately 1,000 times more powerful than traditional or existing methods that use solid cores.

The team of researchers used specially-designed optical fibres with hollow cores (Image: NTU Singapore)

Beyond the current iteration, there is potential for further development to generate lasers with even longer wavelengths (up to 10 micrometres), widening the range of detectable substances, including hazardous chemicals and explosives.

On future developments, Professor Février added that if the wavelength spectrum of the lasers generated can be broadened up to 10 micrometres, then: “Among the various possibilities, it is clear that the NTU team’s novel light source can be used to detect possibly hazardous compounds in the air”.

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