Ready to go: mobile terahertz devices

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Terahertz waves, which until now have barely found their way out of the laboratory, could soon be in use as a versatile tool. Researchers have mobilized the transmitting and receiving devices so that they can be used anywhere with ease.

Everybody knows microwaves – but what are terahertz waves? These higher-frequency waves are a real jack-of-all-trades. They can help to detect explosives or drugs without having to open a suitcase or search through items of clothing. They can reveal which substances are flowing through plastic tubes. Doctors even hope that these waves will enable them to identify skin cancer without having to perform a biopsy.

In the electromagnetic spectrum, terahertz waves are to be found between infrared radiation and microwaves. They can penetrate wood, ceramics, paper, plastic or fabrics and are not harmful to humans. On the other hand, they cannot pass through metal. This makes them a universal tool: They change when passing through gases, solid materials or liquids. Each substance leaves its specific fingerprint, be it explosives or water, heroin or blood.

So far, however, the technology has not made a breakthrough, as it is expensive and time-consuming to build the required transmitters and receivers. Now researchers at the Fraunhofer Institute for Physical Measurement Techniques IPM are making the devices mobile. To generate terahertz waves, the scientists use a femtosecond laser which emits extremely short flashes of infrared light. To illustrate: In one femtosecond, a ray of light moves forward by about the width of a hair.

The pulsed light is directed at a semiconductor, where it excites electrons which then emit terahertz waves. In conventional equipment, the laser light moves freely through the room, which makes measurement inflexible and susceptible to vibrations.

The Fraunhofer experts have taken a different approach, guiding the light through a glass fiber of a type similar to that used for transmitting data. “Our fiber-based system is so robust that we can simply plug it into a standard 240-volt socket,” says IPM expert Joachim Jonuscheit. This is not the only benefit: Until now the equipment has required a shock-proof base so that measurements are not falsified by vibrations. With the beam path inside a glass fiber, this is no longer necessary.

The advantages are obvious: The transmitters and receivers, which are about the size of beverage cans, are now attached to a flexible cable and can be positioned wherever desired. Since vibrations are no longer a problem, the device can even be deployed on the factory floor with fork-lift trucks driving around and heavy machinery vibrating. No inspection point is too difficult to access, as the glass fiber cables can bridge distances up to 25 meters.

Source: Fraunhofer-Gesellschaft