From a

Drugs, explosives, chemical

The police discover a secret laboratory. Now they need to work out what substances are involved: Is it a drug laboratory? Or are explosives perhaps being made here? Contact with an unknown substance could be fatal in such cases. The officers present therefore need to identify the substances they have found from a safe distance. Is this possible?

safe distance

weapons: Determining hazardous substances at arm's length

On dangerous terrain

The police, military, fire service, and rescue services are frequently faced with situations where they encounter unknown substances: a secret laboratory, a leak in a tanker, or the discovery of an unidentified powder. Rapid identification of the substance is essential to making a decision on how to proceed. Yet to do this, contact with the substance must be avoided as far as possible, as under these circumstances, an unknown substance could potentially be a hazardous substance.

Raman spectroscopy can solve this problem: A laser beam is directed at the substance to be determined. The light interacts with the substance and is modified in a unique way. Analyzing the scattered light enables the substance to be uniquely determined. This all happens in a matter of seconds. To find out what happens in detail, take a look at the info box on the following page.

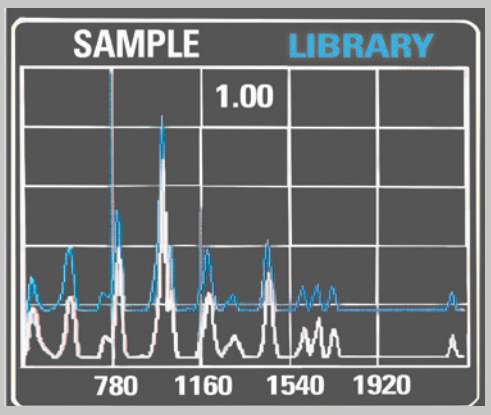
New Raman spectrometer for defense and security applications

Mira DS is the name of the new Raman handheld spectrometer specially for the defense and security sector. Hardly any bigger than a smartphone and equipped with a practical touchscreen, it is easy to operate with one hand – even when wearing gloves. This enables, for example, drug squad officers, explosives experts, and the military to identify illegal substances and explosives in a matter of seconds directly on site.

The spectrometer even identifies substances through transparent packaging such as plastic bags or glass bottles. With its certification to IP67 and in accordance with US military standard MIL-STD-810G, it is also particularly robust and suitable for use in dangerous environments.

Info

In Raman spectroscopy, light of a single wavelength is shone on a substance to be analyzed. This means that each photon, i.e., light particle, in this beam is carrying the same amount of energy. When they hit the substance, the light particles are scattered among by atoms and molecules that make up the substance. In doing so, they give off energy to the particles. Their own energy therefore decreases and their wavelength changes accordingly. Following scattering, the photons feature numerous different wavelengths. With the aid of a detector that captures the scattered light, the new wavelengths of the scattered photons are analyzed and an inventory taken to determine how many photons of each wavelength there are. The graphical representation of this information is the Raman spectrum. By comparing the recorded spectrum with a spectral database, the sample can be uniquely identified.



Superposition of the Raman spectrum for a sample (white) and the corresponding spectrum from the spectral database.

Equipped for all samples

The Mira DS identifies substances by comparing the measured spectra with its integrated spectral database. This includes the spectra of thousands of substances, including drugs, explosives, and other hazardous substances. Five measuring attachments, which can be exchanged in just a few steps, make the instrument particularly flexible: depending on the sample, the right attachment can be mounted to ensure optimum measurement. The universal attachment and the right-angle attachment (Figure 1) are included with the Mira DS as standard. All other attachments can be purchased additionally as required.

Safety on the streets and in the laboratory

There are situations where a protective suit and keeping at arm's length are not enough to guarantee safety. This is the case, for example, when suspected explosives are found. To analyze such substances, the strength of the laser can be reduced to prevent detonation. The possibility to set a scan delay gives the user enough time to position the Mira DS and get out of the hazardous area before the sample is measured. Thanks to the interface with the HazMasterG3 app, further information about the substance can be called up on a smartphone once it has been identified.

The identification of potential hazardous substances on site by means of Raman spectroscopy also means greater safety for employees in forensic laboratories. Handling unknown substances is an extremely delicate matter. If the substance has already been identified using Raman spectroscopy, this makes it easier to ensure that the sample is handled correctly during the wet chemical analysis to determine its exact composition.

Figure 1. The right-angle attachment enables measurements to be conducted on surfaces.

Universal attachment

The universal attachment has three different focal lengths for the measurement in direct contact, through a plastic bag, or through a glass vessel.

Right-angle attachment

The substance is placed on a surface with the Mira DS next to it and the right-angle attachment resting on the sample. This attachment is ideal, for example, for determining the content of a bag on the hood of a patrol car (Figure 1).

Stand-off attachment

The stand-off attachment enables measurement from a distance of up to 1.5 m. It is therefore ideal if it would be particularly risky to approach the sample.

Ball probe attachment

With the ball probe attachment (Figure 2), the user no longer has to worry about the focal length. To take the measurement, the ball probe is simply brought into direct contact with the liquid or powder. Its stainless-steel design makes it easy to clean.

Vial attachment

The vial attachment is particularly suited to measurements in laboratories. The sample is placed in the attachment along with the vial and determined.

Identification of blended and trace substances

The identification of street drugs is made more difficult by the fact they hardly ever appear in their pure form. The cuts can contain a whole host of different substances. This has an effect on the Raman spectrum, which is a superposition of the spectra of all of the substances contained in the mixture. With the aid of Orbital Raster Scanning (ORS) and the latest software, Mira DS identifies the individual components of such mixtures.

If only very small amounts of a suspicious substance are present, the measuring sensitivity can be increased by means of *Surface Enhanced Raman Scattering* (SERS) in such a way that even traces can be reliably determined. The SERS substrate kits needed for this are available directly from Metrohm.

Versatile use

The Mira DS is handy, highly robust, and with its extensive spectral database, is able to detect thousands of substances. It is therefore ideally equipped for all conceivable applications – from routine security checks at airports to serious cases encountered by the police, drug squad, and rescue services.

Do you want to find out more about the Mira DS? Visit our website at **www.metrohm.com/mira-DS**.

Figure 2. With the ball probe attachment, substances can be measured in direct contact with the probe, meaning that the user no longer has to maintain a certain distance.