Participating Institutions

University of Maribor (Faculty of Electrical Engineering and Computer Science), Slovenia

The University of Maribor was established in 1975, and is the second largest university in Slovenia. Currently the University of Maribor has 17 faculties, with about 12000 students. The Faculty of Electrical Engineering and Computer Science is a part of the University of Maribor (UM FERI) and is the leading teaching and research institution in the field of Electrical Engineering and Computer Science in Slovenia.

Graz University of Technology (TU Graz)

Graz University of Technology (TU Graz) was founded by Archduke Johann in 1811. It is one of the 5 universities in Styria, Austria, and currently comprises 7 faculties, with more than 13000 students. TU Graz combines its research into five Fields of Expertise in which researchers work in an interdisciplinary way, both with the regional economy and internationally. This unique ecosystem creates ideal conditions for scientific excellence and technology transfer.

The NATO Science for Peace and Security (SPS) Programme is an integral part of the NATO Emerging Security Challenges (ESC) Division. The SPS Programme develops and implements practical cooperation and enhances dialogue between NATO nations and partner countries through capacity-building and security-related civil science, technology and innovation. All SPS activities contribute to the Alliance's strategic objectives, have a clear link to security and respond to at least one of the SPS Key Priorities.

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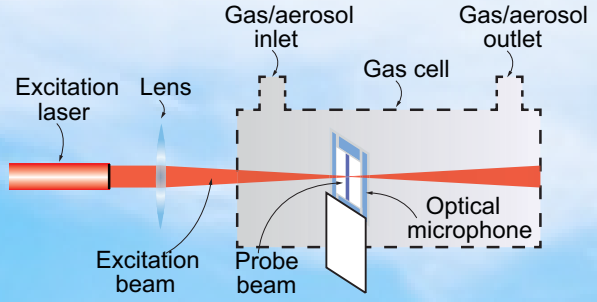
Photonic Nano Particle Sensors for Detecting CBRN events

Science for Peace and Security (SPS) Programme
Emerging Security Challenges Division

Context

The sensing of aerosols is attracting growing interest due to increasing awareness of their impact on security, human health and the environment. Aerosols are also often generated on the battlefield, during natural disasters, and radioactive material emissions. Furthermore, advancements in nanotechnologies have introduced nanoparticle engineering in different aspects of warfare and weapon systems.
Therefore, new systems for in-field/in-situ detection and characterization of aerosols, are essential for civil and military personnel health, and are relevant for the defence against CBRN agents, environmental protection, energy security, and battlefield safety.

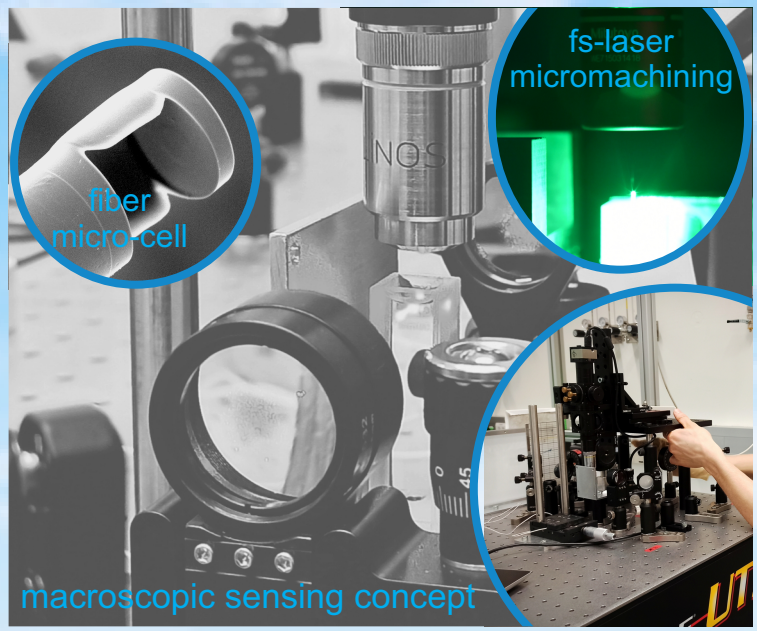


Goals

- Evaluation of new aerosol sensor concepts, based on photonic photothermal principles.
- Exploitation of absorption for various nanoparticles at different wavelengths to obtain best sensing principles.
- Miniaturization of the system.
- Ensuring sensor operation in an electromagnetically "quiet" way, in remote locations and in environments with strong electomagnetic interference at high-temperatures.
- Ensuring high nanoparticle detection sensitivity and selectivity.

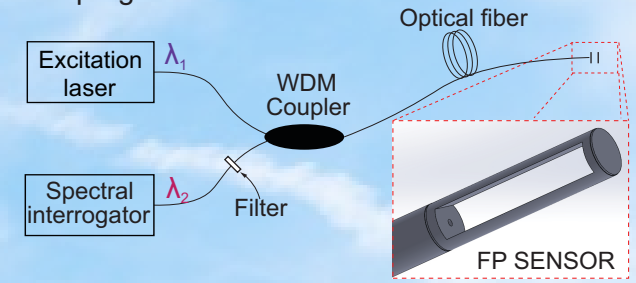
How does it work?

- Polluted air containing nanoparticles like soot enters a Fabry-Perot interferometer formed by two semireflective mirrors.
- Nanoparticles within the Fabry-Perot interferometer are heated using a high power excitation light source at a wavelength specific to the monitored nanoparticle.
- Light absorbed by nanoparticles is converted into heat, thus changing the temperature of sorrounding gas, and consequently the refractive index of the medium between the mirrors.
- Change of the refractive index is detected at a high resolution using a probe light source and by measuring the shift of the reflected spectrum.
- Different spectral interrogation techniques can be applied for reliable and cost-efficient readout of the sensor's spectral properties, which are further correlated to particle concentration.



Deliverables

- Proof of principle and establishment of a physical model.
- Manufacturing of a microscopic bulk sensing concept and tests using reference gases and aerosols.
- Manufacturing of all-fiber miniaturized gas micro-cells and demonstration of interrogation system.
- Development and characterization of a miniaturized prototype.
- Workshops, scientific conferences, scientific publications, and reports on progress.



Impact

- The project directly addresses challenges related to early and unobscured detection of airborne particles and aerosols. It is therefore of high importance for providing security and safety.
- The results of this project will advance the field of miniature, accurate and robust sensors for gas and aerosol detection.
- It will directly contribute to the protection against CBRN agents by providing a sensor system for remote and unobscured detection of gases and aerosols often hard to detect.
- It aims to enable reliable and quick detection by military and emergency personnel in the aftermath of CBRN events or industrial accidents.