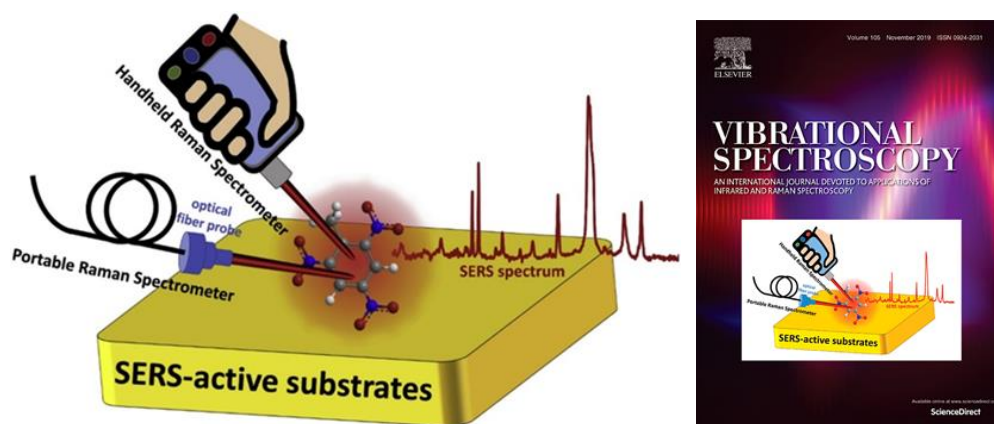


## Elaboration of manufacturing technology of SERS platforms on functionalized by etching GaN substrates as sensors for examination of medical and biological molecules (Grant NCN 2015/19/B/ST8/02004)

At the Institute of High Pressure Physics of Polish Academy of Sciences a new generation of platforms based on photo-etched epitaxial GaN layers was elaborated. They are used for SERS (Surface Enhanced Raman Spectroscopy) measurements allowing trace detection and identification of organic molecules.

Within the limits of the this grant detailed study were performed of nano-structures of hetero-epitaxial GaN after single and two-stage etching procedures and the influence of the type of nano-structure on enhancement factor (EF) of Raman scattering was established. One-to-one correlation was shown between the characteristic etch features (such as pits and nano-pillars) and the position of hot-spots where the EF reaches the highest value. The optimized GaN platforms were used for examination of drugs (fentanyl), spores of bacteria and different explosives. The latter analytes were examined using portable Raman equipment (see the image below), that opens the possibility of in-field SERS measurements.



Graphical Abstract placed by the Editor on the title page and taken from our publication (M. Liszewska et al., „Evaluation of selected SERS substrates for trace detection of explosive materials using portable Raman systems“, *Vibrational Spectroscopy* 100 (2019) 79).

A method to deposit the DNA of cancer cells on the nano-structured GaN platforms and covered by nano-particles of gold was elaborated. Subsequently, using SERS the identification of the gene mutation of cancer cells was done. This achievement opens the possibility of performing examination of cancer cells in the clinical practice and may result progress in early recognition of tumour diseases. All experiments performed in the framework of this grant showed the usefulness of nano-structured GaN platforms for identification of threats dangerous for human health and life, i.e. the CBE threats (Chemical, Biological, Explosives).

Apart from the practical applications of SERS measurements and the elaboration of optimized technology of GaN-based platforms, the predicted theoretically enhancement of scattered Raman beam on semiconductor (nan-structured GaN) without plasmonic metal layer was experimentally confirmed.