**Overtone spectroscopy on a chip – Overview of fundamentals and important applications**

100-word abstract:

Infrared spectroscopy is very powerful tool to analyze the chemicals based on their molecular signatures. The registration of the fundamental vibrational modes that lie in the mid- and far- IR is extensively explored, however the excitation of derivatives namely high harmonics molecular vibrations overtones is still a mystery. Although the absorption cross-section of molecular transition overtones is order of magnitude smaller compared to the fundamental vibrations with same degree of freedom, the research of overtones is of high importance if just would be possible to detect them. In this work, we overview the methods to overcome the challenge in detection of molecular overtones on a chip.

250-word abstract:

Mid-infrared spectroscopy is very useful tool which is allows to obtain the chemical information about the molecular overtones and series bands of the fundamental vibrational modes. Molecular overtone bands are bands observed in the vibrational spectrum of an anharmonic oscillator along with the fundamental band arising as a result of the transition v = ±1. The intensities of the overtones are as small as 1/10 and 1/100 of the corresponding fundamental band for the 1st and 2nd overtones, respectively. Following our pioneering research on detection of overtones on glass waveguides, here we show that even the monitoring of the treatment efficiency of cancer cell is possible with overtone spectroscopy.

Cancer is the leading factor of death in the western world. Ovarian cancer, which also terms the "silent killer", is the fifth common malignancy cancer and the fifth leading cause of cancer deaths among North American women. However, the quantification and monitoring the response to therapy requires bulky and costly imaging equipment such as computed tomography (CT) and positron emission tomography (PET) scanners. Therefore, cancer patients are monitored once every several cycles of treatments to quantify their clinical response to therapy which harms inspection of the treatment efficiency.

We show a rapid fine needle aspiration test to measure the response to therapy of ovarian cancer by probing molecular overtones in the near-IR.

Using the proposed here technique, relatively fast detection of tumors response to treatment in an accurate manner, 24 hours after treatment, would be possible.