Ultrasensitive absorption and ultrasensitive and simple Raman measurements for biomedical optical spectroscopy and sensing

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Abstract: An integrated cavity is employed to perform absorption spectral measurements in highly scattering materials and to dramatically enhance the sensitivity of Raman and fluorescence measurements.

Biological optical spectroscopy and sensing (BOSS) is striving to achieve high sensitivity measurements of absorption, fluorescence and Raman spectra of biological objects, which also possess strong scattering properties, making it difficult to separate different contributions and perform accurate measurements. In this report, we introduce a novel approach to carry out ultrasensitive absorption (USA) and ultrasensitive and simple Raman (USSR) measurements using an integrated cavity \cite{1}.

In our approach, the integrated cavity, made out of a material characterized by high elastic scattering, low absorption, and low Raman cross-section serves three purposes. The first one is to efficiently utilize the excitation quanta for weak signal enhancement, the second – is to improve the capability of collecting the generated light and deliver it to the detection system, and the last but not least is to separate light absorption from light scattering effects.

One of the first successful implementations of the newly developed instrument is shown in Figure 1, where the integrated cavity is used to enhance the weak fluorescence signal specific to the presence of feces residues in water \cite{2}.

In the talk, we will describe the experimental setup and illustrate the working principle of this new instrument with experimental examples of cells and organelles USA measurements and water contaminations assessment using USSR measurements.

References: