State the objective of the project

The main goal of this project is to develop and test the multiple-modality platform for innovative cancer diagnostics. The aim of the research is to prove that changes in metabolism and epigenic changes occurring in response to the growing process of tumorigenesis may be determined by optical methods, including methods of Raman spectroscopy and imaging, SERS, IR spectroscopy, techniques of AFM, SNOM, femtosecond spectroscopy. As part of the study the multiple-modality platform RISAF will be designed (Raman-IR-SERS-SNOM-AFM- femtosecond spectroscopy,) to analyze cells and tissues: normal and malignant human brain and the human breast tissues, the results for human tissues they will be compared with results for cell line of normal and malignant, which can be considered as model systems. Morphology and biochemistry of cells and tissues will be analyzed for systems in-vitro and in-vivo. RISAF platform 'will improve' research on epigenics and metabolomics of tumors and allows the answers to many questions unexplained so far by monitoring biochemistry / morphology / nanomechanisms / systems dynamics of living cells. We will also provide information on the vibrational properties of living cells and intracellular processes occurring on a scale from 10^{-15} to 10^{-9} sec for normal and malignant cells as well as about the location of anticancer drugs used in chemotherapy and phototherapy of cancer. Aim of the study will be achieved through the use of spectacular spatio-temporal resolution (nm / 10-15 s), sensitivity (10^{-14} M) and specificity offered by the platform RISAF. The sensitivity up to 10^{-14} M will be achieved through the use of nanoparticles and SERS technique.

Description of the research

Implementation of the objectives set out in paragraphs above will be held by applying multivariate RISAF platform enabling imaging and femtosecond spectroscopy, which can open up new possibilities in the field of cancer biology specifically identification of metabolome changes and epigenic changes accompanying the development of cancer and help to revolutionize cancer diagnosis and treatment. The platform connects the possibilities posed by technology and Raman imaging and Raman spectroscopy, IR spectroscopy, SERS, AFM, SNOM, femtosecond spectroscopy. The analysis will be carried out for the epithelial cell lines of breast (MCF10A, MCF-7 and MDA-MB-231) and brain (U87 MG), tissues of the human brain (gliomas), and breast (ductal carcinoma and lobular carcinoma). The cells and tissues will be used to identify and distinguish between normal and cancerous structures.

Reasons for choosing the research topic

Global statistics clearly show that about 30% of cancers could be cured if you have been diagnosed at an earlier stage. Currently used clinical methods of diagnosis and imaging are very expensive, elaborate, time consuming and often imperfect because of the limited sensitivity, specificity and spatial resolution. By using multivariate RISAF platform we would like to shift the threshold of cancerous changes identification and localization, we will apply spectacular spatio-temporal resolution up to (nm / 10^{-15} s) and sensitivity up to 10^{-14} M.