SUB-THZ VIBRATIONAL SPECTROSCOPY FOR ANALYSIS OF OVARIAN CANCER CELLS

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Sub-THz vibrational spectroscopy utilizes wavelengths in the submillimeter-wave range (1.5-30 cm^{-1}), beyond those traditionally used for chemical and biomolecular analysis. This low energy radiation excites low-frequency internal molecular motions (vibrations) involving hydrogen bonds and other weak connections within these molecules. The ability of sub-THz spectroscopy to identify and quantify biological molecules is based on detection of signature resonance absorbance at specific frequencies between 0.05 and 1 THz, for each molecule. The long wavelengths of this radiation, mean that it can even pass through entire cells, detecting the combinations of proteins and nucleic acids that exist within the cell.

This research introduces a novel sub-THz resonance spectroscopy instrument with spectral resolution sufficient to identify individual resonance absorption peaks, for the analysis of ovarian cancer cells. In vitro cell cultures of SK-OV-3 and ES-2 cells, two human ovarian cancer subtypes, were characterized and compared with a normal non-transformed human fallopian tube epithelial cell line (FT131). A dramatic difference was observed between the THz absorption spectra of the cancer and normal cell sample materials with much higher absorption intensity and a very strong absorption peak at a frequency of $13\ \mathrm{cm}^{-1}$dominating the cancer sample spectra. Comparison of experimental spectra with molecular dynamic simulated spectroscopic signatures suggests that the high intensity spectral peak could originate from overexpressed miRNA molecules specific for ovarian cancer. Ovarian cancer cells are utilized as a proof of concept, but the sub-THz spectroscopy method is very general and could also be applied to other types of cancer.