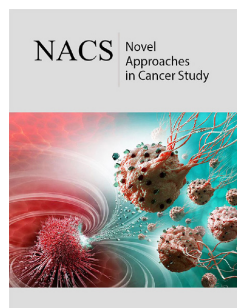


Sub-THz Spectroscopy for Fingerprinting Biological Molecules

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Mini Review

Vibrates LLC-a women owned small business organized in 2007 as a spin-off from the University of Virginia, introduces completely new, patented, fast and simple method/technology and instruments (THz spectrometers) to see signatures of molecules in liquids (including body fluids). These signatures can serve as biomarkers in medicine and other bio-industry segments, which are important for early diagnosis of cancers, mental diseases, and presence of Coronaviruses, including all new varieties. The THz frequency range is important for life science applications because of the unique ability of this radiation to interact with low energy vibrations of hydrogen bonds between atoms within biological molecules. Although hydrogen bonds are very weak compared to covalent bonds (~20 times), these weak bonds determine the three-dimensional structure of DNA, RNA, and protein molecules and are vital for all processes within biological cells. Experimental studies combined with computational Molecular Dynamic simulations demonstrated the presence of vibrational modes in absorption spectra of biological materials in THz frequency range. The frequencies and intensities of these absorption features reflect the sequence and the 3D structure of biological molecules and can serve as their specific fingerprints. All biological molecules present in body fluids contribute to fingerprints. Particularly, measurement results combined with simulations have shown that microRNAs have strong sub-THz absorption features, and the medical literature indicates the importance of specific microRNAs in regulatory pathways of all cancers and infection diseases.

Vibrates has developed and built several working sub-THz spectrometer prototypes [1] and demonstrated their use in self-research in collaboration with researchers from UVA and Martha Jefferson Hospital Health Systems in Charlottesville for detection and quantification of potential molecular biomarkers, particularly microRNA molecules. Very broad commercial applications in medicine and other life science related applications include early diseases detection and monitoring disease progression. A very simple spectrometer-Vibr-4 with software for one touch operation and cloud data transfer has been in use since 2016 [2]. This is an affordable, simple, small, light instrument that can work on batteries in hospitals or points of care. Wireless communication is used for transferring results remotely to biomedical laboratories. This is a research and application tool. Scan time 2-3min. No purging or vacuum. Can be modified for used without a computer or monitor. Corona viruses, as well as some other human viruses, consist of RNA molecules and these molecules can be identified by measuring their sub-THz absorption spectra as well. In each case, the molecular signature will be determined by the unique molecular structure making it possible to potentially identify and discriminate different varieties of viruses. We demonstrated that we were able using sub-THz spectroscopy and instrumentation developed by Vibrates to identify molecular signature of COVID-19. Using sub-THz spectroscopy will make it possible to identify and discriminate all new versions of corona virus.

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