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Submillimeter wave spectroscopy of biological macromolecules

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The recently emergence of submillimeter-wave or terahertz (THz) spectroscopy of biological molecules has demonstrated the capability to detect low-frequency internal molecular vibrations involving the weakest hydrogen bonds of the DNA base pairs and/or non-bonded interactions. These multiple bonds, although having only $\sim 5\%$ of the strength of covalent bonds, stabilize the structure of bio-polymers, by holding the two strands of the DNA double helix together, or polypeptides together in different secondary structure conformations. There will be a review of THz-frequency transmission (absorption) results for biological materials obtained from Fourier Transform Infrared (FTIR) spectroscopy during the last few years[1,2]. Multiple resonances, due to low frequency vibrational modes within biological macromolecules, have been unambiguously demonstrated in qualitative agreement with theoretical prediction, thereby confirming the fundamental physical nature of observed resonance features. The discovery of resonance character of interaction between THz radiation and biological materials opens many possible applications for THz spectroscopy technique in biological sensing and biomedicine using multiple resonances as distinctive spectral fingerprints. However, many issues still require investigation. Kinetics of interactions with radiation at THz has not been studied and vibrational lifetimes have not been measured directly as a function of frequency. The strength of resonant modes of bio-molecules in aqueous environment and strong dependence of spectra on molecular orientation need explanation. Vibrational modes have not been assigned to specific motions within molecules. THz spectroscopy of bio-polymers makes it only in first steps. 1. T. Globus, D. Woolard, M. Bykhovskaia, B. Gelmont, L. Werbos, A. Samuels. International Journal of High Speed Electronics and Systems (IJHSES), **13**, No. 4, 903-936 (2003). 2. T. Globus, T. Khromova, D. Woolard and B. Gelmont. Proceedings of SPIE Vol. 5268-2, 10-18 (2004)