Terahertz Time-Domain Spectroscopy Imaging Studies of Biomaterials

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Terahertz (THz) radiation is situated between the infrared and microwave regions in the electromagnetic spectrum with a bandwidth ranging from 0.3 to 30 THz and has numerous interesting applications in various fields, ranging from security screening, e.g., at airports, through ultrafast communications and radioastronomy, to nonionizing biomedical spectroscopy and imaging. One of the most interesting forms of THz radiation are subpicosecond in duration bursts of electromagnetic (EM) waves. These EM bursts are called THz transients, since they are typically characterized by approx. a 0.1 to 5 THz spectral range. We present our THz time-domain spectroscopy (THz-TDS) technique that has been utilized to study a variety of biomaterials ranging from gelatin-based hydrogels mimicking human skin tissue to formalin-fixed-paraffin-embedded murine pancreas and liver tumors. Our experimentally measured time-domain transients were, subsequently, analyzed using, developed by us, a maximum a-posteriori probability estimation technique to generate high-resolution, 2-dimensional maps of THz-range refractive index n and absorption coefficient α parameters, as imaging markers [1]. We also present precisely distinguishable differences in n and α markers between images of radiation-treated and unirradiated tumor samples. Once medically accepted, the THz-TDS imaging could augment *ex-vivo* histopathology tumor diagnostics and be widely used in Tissue Biobanks at cancer institutions.

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[1] Chakraborty D., Mills B. N., Cheng J., Komissarov I., Gerber S. A., and Sobolewski R., (2023) *ACS Omega* 8, 9925–9933.

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