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Title:Development of a compact terahertz time-domain spectrometer for the measurement of the optical properties of biological tissues

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Abstract:Terahertz spectrometers and imaging systems are currently being evaluated as biomedical tools for skin burn assessment. These systems show promise, but due to their size and weight, they have restricted portability, and are impractical for military and battlefield settings where space is limited. In this study, we developed and tested the performance of a compact, light, and portable THz time-domain spectroscopy (THz-TDS) device. Optical properties were collected with this system from 0.1 to 1.6 THz for water, ethanol, and several ex vivo porcine tissues (muscle, adipose, skin). For all samples tested, we found that the index of refraction ( $n$ ) decreases with frequency, while the absorption coefficient ( $ua$ ) increases with frequency. Muscle, adipose, and frozen/thawed skin samples exhibited comparable  $n$  values ranging between 2.5 and 2.0, whereas the  $n$  values for freshly harvested skin were roughly 40% lower. Additionally, we found that the freshly harvested samples exhibited higher  $ua$  values than the frozen/thawed skin samples. Overall, for all liquids and tissues tested, we found that our system measured optical property values that were consistent with those reported in the literature. These results suggest that our compact THz spectrometer performed comparable to its larger counterparts, and therefore may be a useful and practical tool for skin health assessment.

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