Contribution ID : **208** Type : **Poster**

Novel techniques with ATR apparatus at THz frequencies

Thursday, 25 November 2021 18:46 (1)

A new method is presented which extends the capabilities of attenuated total reflection (ATR) apparatus to a partial reflection/partial transmission mode, which also delivers the complex dielectric values of samples. The technique involves placing a mirror at a known distance from the sample/crystal interface to reflect the transmitted portion of the incident signal back to the detector. The attenuation of this signal reflected is dependent on the absorption coefficient of the sample.
The method is well suited to biological samples in the terahertz radiation frequency band range 1.0 THz to 2.0 THz, with a diamond crystal ATR.
The 2.0 THz range biological data is poorly represented in literature, since most THz data on biological tissues has 1.2 to 1.5 THz as the upper limit. A demonstration of the technique was performed using water and water based gel at the Australian Synchrotron FIR/THz beamline.
At frequencies of 3.0 to 5.0 THz, a paradoxical region was noted where the total reflectance of the signal reflected at the initial crystal/sample interface plus the signal reflected from the mirror was less than the reflected at the initial crystal/sample interface alone. The destructive interference is in the region where the effective path length of the transmitted signal through the sample is in the region of 1.3 λ to 1.7 λ. Significance and potential uses of this region are still being investigated.
Since many cancers have higher water content than normal tissue, the extension of the ATR apparatus capacity promises to establish a new diagnostic modality.

Level of Expertise

Early Career <5 Years

Presenter Gender

Man

Pronouns

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Do you wish to take part in the Student Poster Slam

Condition of submission

Yes

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Session Classification : Poster Session

Track Classification : Instruments & Techniques