Measurement and application of incoherent terahertz scattering using time-domain spectroscopy

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***Abstract*—**Measurement of incoherent rough surface scattering powers in terahertz frequency regime by means of time-domain spectroscopy has been for the first time demonstrated. Furthermore, applications of such incoherent measurements in spectroscopy and detection of chemicals are presented.

I. Introduction and background

The existence of unique signature absorption spectrum patterns for many chemicals at terahertz frequencies has promised exciting applications in non-contact safe detection of such materials [1-3]. The only viable spectroscopic mode for remote detection of chemicals involves reflection geometry. However, since the wavelength of THz radiation are comparable to the size of scatterers such as embedded internal void volumes, inhomogeneous granular features of the material and/or rough material interfaces, accuracy and scope of applications of this technique is significantly affected [4-6]. In previous work [4-5] we have shown that such scatterings are frequency dependent and significantly limit the bandwidth of detection of materials through coherent THz spectroscopy. In a different study [6], we controllably introduced increasing levels of surface roughness to interfaces of materials and showed that in addition to the aforementioned scattering effect, the coherent THz signature absorption signal of materials may also be obscured and altered.

The goal of this study is to incorporate rough surface backscattering to detect and characterize materials in off-nadir direction in THz frequencies. Rough surface backscattering is inherently of an incoherent nature; therefore it is imperatively critical to measure incoherent energies at THz frequencies. In this paper, we present the first quantitative measurement of incoherent THz scattering from rough surfaces using time-domain spectroscopy.

II. Results

Gold coated sandpapers with increasing surface roughness have been employed to measure the incoherent THz energies shown in figure 1.

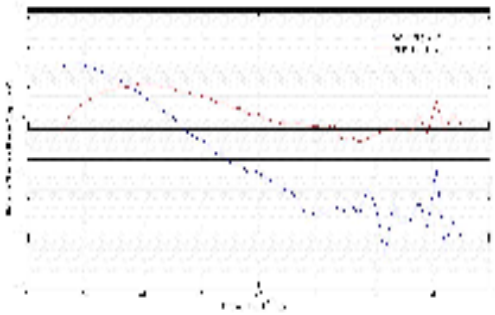

Figure 1. Relative measured spectral coherent and incoherent power reflected from gold coated P80 grit sandpaper.

Furthermore, we discuss applications of the incoherent THz power in retrieval of signature absorption peaks of materials that are diminished by rough surface scattering.

References

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