Terahertz Waves for Non-destructive Evaluation (NDE)

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Terahertz (THz) (0.1–30x10^{12} Hz) imaging is a proven method for investigating a wide variety of materials and structures [1]. Its use has proven attractive for numerous application areas due to its non-contact and non-ionizing nature. The fact that terahertz (THz) imaging is non-destructive coupled with its ability to not only penetrate a wide variety of materials (Fig. 1), but also characterize them, yields a technique better suited for certain applications as compared to other competing technologies such as x-ray and ultrasound imaging. It has recently been demonstrated that the use of THz imaging can be advantageous in art renovation and restoration efforts [4]. The use of THz imaging for NDE purposes has also been demonstrated for use in materials and structures including fiberglass composites [5], paint coatings [6], and the foam insulation used on the space shuttle [7].

In this talk, we will discuss the power and utility of THz imaging for NDE applications. Our research group has applied this technique to a wide variety of materials spanning from composites to dielectric coatings. Our recent work has focused on developing this imaging approach such that it can provide quantitative information extracted from the imaging data. We will show how we are demonstrating this capability in measuring dielectric coating thicknesses (Fig. 2), degradation in ceramic matrix composite materials (Fig. 3) [2, 3], and artwork verification.

Fig. 1 A THz image showing the concealed objects in a laptop bag.

Fig. 2 THz imaging can be used to map coating thicknesses.

Fig. 3 THz Imaging is used to detect heat damage in CMC materials [2, 3].

2 L. Owens, Wright State University, 2012.