

Terahertz Imaging

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ABSTRACT. The methods, instrumentation, and application of time domain terahertz imaging (a.k.a. THz or T-Ray Imaging) for non-destructive evaluation (NDE) and security are discussed.

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OCIS Codes: 320.7080 Ultrafast devices, 110.6880 Three-dimensional image acquisition

1. Introduction

Terahertz (THz or T-Ray) imaging is being adopted for non-destructive evaluation (NDE) applications in aerospace and other government and industrial settings [1-3]. NASA is currently employing THz reflection NDE to examine the space shuttle external tank sprayed on foam insulation (SOFI) for voids and disbonds. Homeland security applications such as the inspection of personnel[2], the detection of concealed explosives[2], biological agents, chemical weapons, flammables, metallic and non-metallic weapons are the subject of active investigation. We report the development and applications of a high speed large area time domain terahertz non destructive evaluation imaging systems such as the Picomatrix QA1000 T-Ray non-destructive evaluation (NDE) imager.

2. Instrumentation and Applications

As an example of one application being developed, we demonstrate the location and identification of delaminations and water intrusion in advanced composite materials used in ground based radome panels, shelters and towers using T-Ray imaging. Radomes encase radar antennae in order to protect them from them from wind, rain, snow, hail, dust or other interference which could damage the radar or hinder its operation. Radome composite panels are typically sandwich type structures of dielectric materials, for example woven material (fiberglass, GORE) surface layers and a foam or honeycomb core. Exposure to the elements can damage the radome, leading to delaminations and water intrusion which degrade radar performance. We have used the QA1000 T-Ray imager to demonstrate detection of delamination and water intrusion, Figure 1. Water is much more absorptive than the inner core foam, and water intrusion is indicated by a dark shadowing in the back surface reflection. The method is non-contact with a working distance of 30 cm. demonstrated, and has millimeter lateral resolution which finely locates the features and defects within the panels. Additional applications in aerospace NDE and security imaging will be discussed.

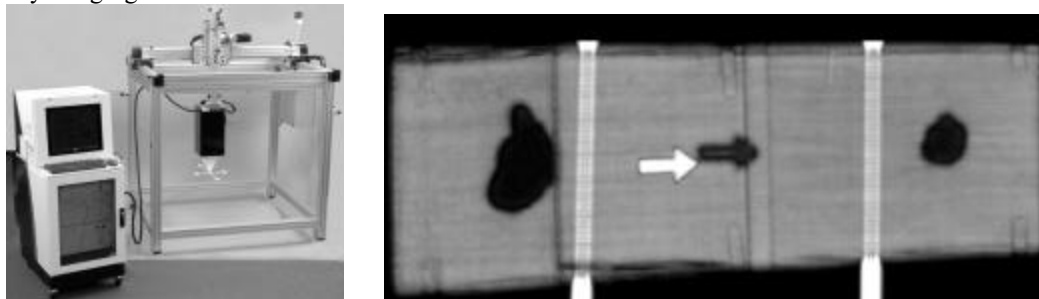


Figure 1 Left: QA1000 high speed large area T-Ray non-destructive evaluation imager configured in Reflection Geometry. T-Ray images of radome section with water intrusion under front surface shell, 2 mm steps, power integrate 0.150 THz to 0.5 THz, 320 ps window. Black shadows strongly indicate the presence of water intrusion in the back surface reflection image.

3. References

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