Inner Defect Shape Visualization Method based on Terahertz Imaging

D.-H Han[1,2], and L.-H Kang[1,2,3*]

[1] Department of Mechatronics Engineering,
[2] LANL-CBNU Engineering Institute-Korea,
[3] Department of Flexible and Printable Electronics,
Jeonbuk National University, 567 Baekje-daero, Deokjin-gu, Jeonju 54896, Republic of Korea

*Corresponding author: reon.kang@jbnu.ac.kr

1. Introduction

Recently, terahertz (THz) imaging technology has become one of the most promising techniques for non-destructive testing (NDT) because THz waves are not harmful to biological tissue and they can provide high spatial resolution due to their shorter wavelengths. The visualization methods of the THz imaging are focused on the 2D visualization method to check the size and the locations of the defect as summarized in Table 1.

In this study, we proposed a 3D visualization method of the inner defect shapes that are simulated with Teflon film in the GFRP.

Table 1 Summary of existing THz imaging method for 2D plate samples

Author	Imaging type	Sample type	Scan size(mm)
D.-H, H.et al. [1]	2D image	9 layers paper	22 × 44
R.-S., A.et al. [2]	2D image	9 layers paper	22 × 44
Z., J.et al. [3]	2D image	2 layers CFRP	100 × 100

2. Scanning and THz imaging method

We employed a commercial fiber-coupled THz spectroscopy system (TERA K15, MenloSystems Corp.) to visualize the hidden defects in the GFRP. The GFRP sample was raster-scanned using motorized x–y moving stages with a 0.25 mm step resolution. Each scanned THz waveform contained 2,400 data points, corresponding to one waveform per pixel.

The THz waveform captured by using reflection geometry to obtain the depth and thickness of the GFRP sample. The scanning and imaging were performed in the time-domain as follows four following steps: (i) propagating the THz wave to the GFRP sample at each pixel; (ii) recording a reflected THz waveform corresponding to the x and y coordination of the scanning section; (iii) extracting the eco peaks on the interface of the defect from the THz waveform; (iv) assigning the peak threshold value of the defect to eliminate the noise elements; (v) reshaping the defect value as 3D matrix; (vi) rendering the defect in 3D plot.

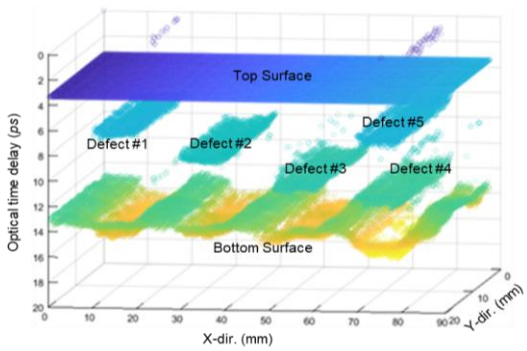

Fig.1 Inner defect visualization results

3. Results

In this study, the inner defect visualization method was proposed. The measured THz waveform that includes the peak time information at the interface of the defect in GFRP using the reflection scanning method. As a result, the inner defect shape was extracted then the 3D image was successfully rendered by analyzing the peak time information.

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References

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