

NDE of Composites Using MBD

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Abstract

There is a practical interest among composite materials manufacturers to high-speed accurate non-destructive evaluations (NDE) technology for voids inspection when these voids are natural components of such complex structures like resin insulated layer of double-sided copper-clad laminates (Figure 1): Figure1. Resin insulated layer of double-sided copper-clad laminates an example of such a structure is schematically presented in Figure 2. The second Figure illustrates an example of a composite structure with voids Model based design (MBD) of NDE system, which is a principal solution for voids inspections in such composites [1]. This work presents a MBD approach to voids inspection based on MEMS high frequency ultrasonic transducers with dry point coupling extensions [2], finite element analysis (FEA) of waves propagation through complex structures by COMSOL [3], modern digital signal processing (DSP) and artificial intelligence (AI) tools together [4]. Some simplified MBD is demonstrated in Figure 3, which depicts simplified MBD of voids inspection. This approach is based on principal differences of patterns of acoustic responses of composites with voids and without voids to propagating acoustic waves as shown in Figure 4.

Reference

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2. Nesvijski, E., On the Problem of Application of the Conic and Exponential Wave Guiding Extensions for Ultrasonic Transducers for Materials Testing. Journal: NASTA Technical Bulletin, Philadelphia, PA, USA, 1997 (ISSN 1079-8498), Volume 3, pp. 49-56;
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4. Nesvijski E., Marasteanu M. Spectral Analysis of Acoustic Emission of Cold Cracking Asphalt, Journal: The e-Journal of Nondestructive Testing & Ultrasonics, September 2006, Vol. 11, No. 10 (ISSN: 1435-4934)

Figures used in the abstract

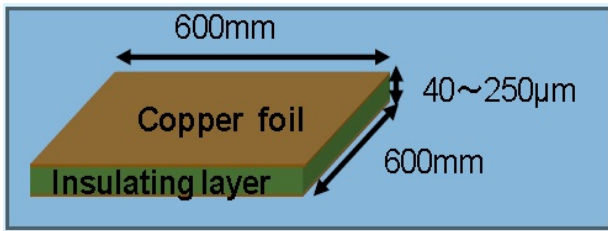


Figure 1: Resin insulated layer of double-sided copper-clad laminates.

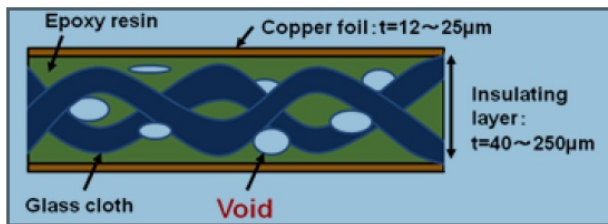


Figure 2: An example of a composite structure with voids Model based design (MBD) of NDE system.

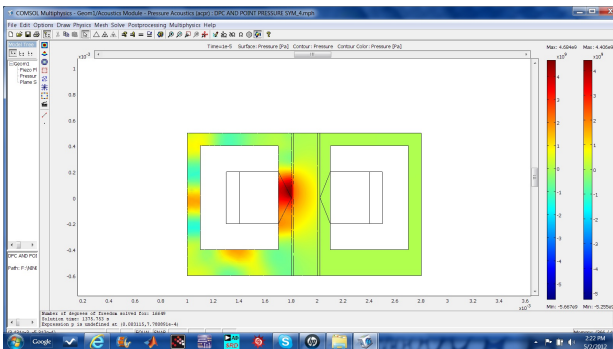


Figure 3: Simplified MBD of voids inspection.

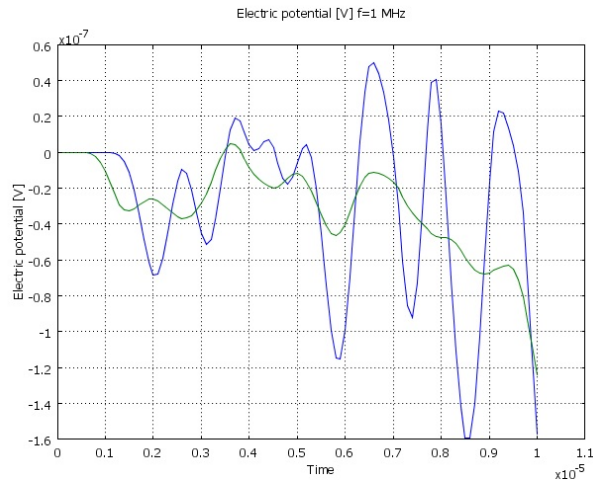


Figure 4: Patterns of acoustic responses of composites with voids (green line) and without voids (blue line) to propagating acoustic waves.