Proceedings of Symposium on Ultrasonic Electronics, Vol. 32 (2011) pp. 69-70
8-10 November, 2011

Development of High Sensitive Non ContactAir Coupled Ultrasonic Testing and Its Applications
高感度・非接触空中超音波検査法の開発と最近の応用例

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1. Introduction

We have developed non contact air coupled ultrasonic testing (here after called NAUT)using square burst waves[1]. This time we obtained high sensitive focusing air probes for NAUT. We found that the very narrow sensitive beam was obtained by focusing probes, therefore the narrow beam made the clear & sharp image pattern. in NAUT. It has many advantages such as no influence of coupling condition by conventional ultrasonic testing and the wave length in air is very short and suitable to make the desired beam [2]. We introduce its applications in NAUT.

2. Development of Image Equipment for NAUT

The image pattern equipment consists of a high sensitive square burst pulser & receiver, a preamplifier and high sensitive air probes, Fig.1 shows the system of non contact air coupled ultrasonic inspection.

Fig.1 System of non contact air coupled ultrasonic inspection

3. Example of Image Pattern

Fig.2 shows the transmission method to detect de・lamination in CFRP. The probes are 400KHz & 800KHz point focusing probes, & the element diameter φ20mm with focal length 38mm for 400KHz & 20mm for 800KHz. Its beam width is about 1.97 mm for 400KHz & 0.57mm for 800KHz in diameter.. Fig.3 shows the image pattern example of CFRP.

Fig.3(a) is a calibration image pattern of acrylic disk fiber on CFRP specimen. φ1mm disk is enough clear by 800kHz's frequency. Fig.3(b) shows the de・lamination of CFRP and

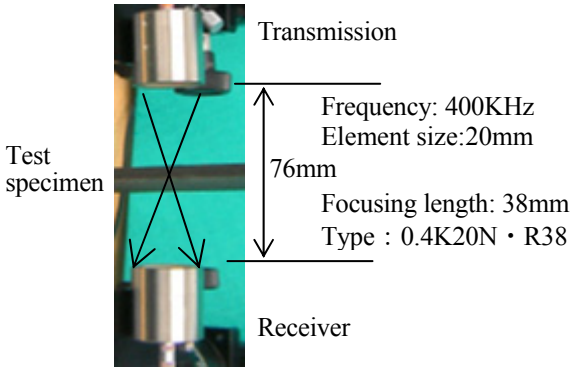
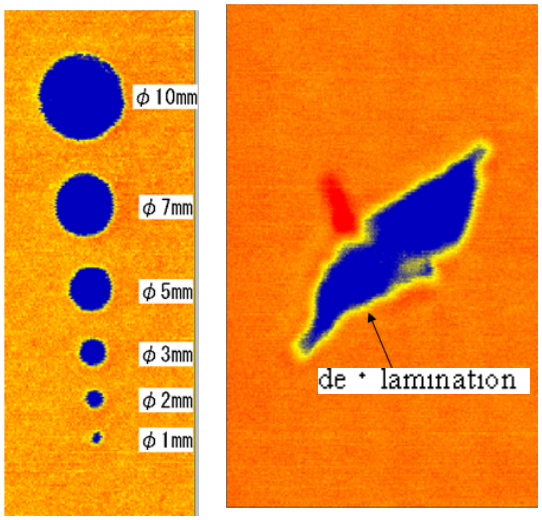


Fig.2 Transmission method



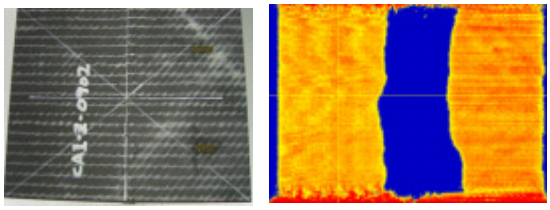
(a) Calibration of image pattern (b) De・lamination of image pattern

Fig.3 Image pattern of CFRP

the boundary is very clear. Fig.4 shows the image pattern of 10mm thick CFRP produced by VaRTM(Vacum assisted Resin Transfer Modeling). Even on 10mm thick VaRTM, the de・lamination is clearly detected.

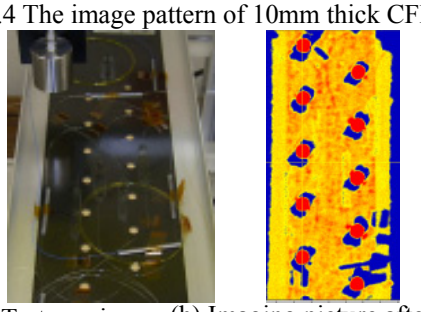
Fig. 5 shows the CFRP specimen by tension & the image picture after tension.

According to the image picture (b), it is very clear that the original defects are developing.



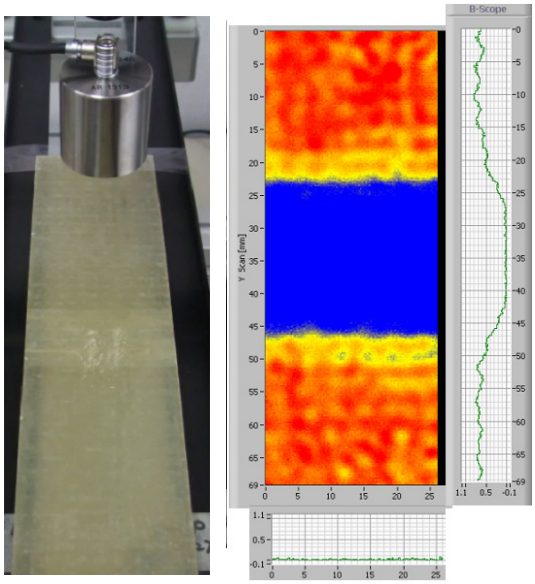
(a) VaRTM material (b) The image pattern

Fig.4 The image pattern of 10mm thick CFRP



(a) Test specimen (b) Imaging picture after tension

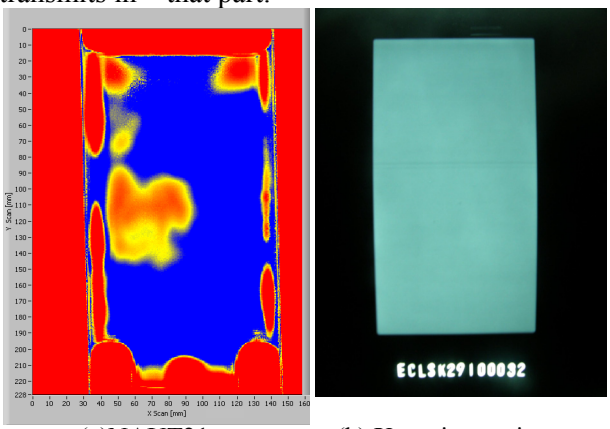
Fig.5 Test specimen & imaging picture after tension



(a) Scanning view (b) Image pattern picture

Fig.6 Example of GFRP inspection by NAUT

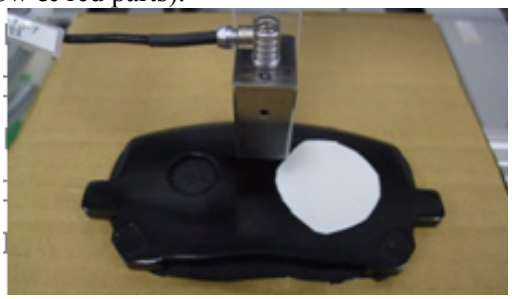
Fig.6 shows the GFRP test specimen & the image pattern picture. In the middle part of the specimen, a big de・lamination exists, no ultrasonic transmits in that part.



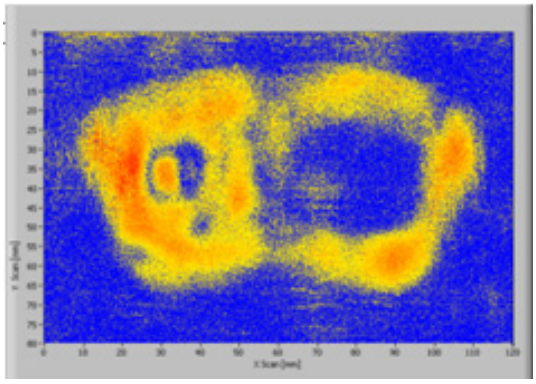
(a)NAUT21 (b) X ray inspection

Fig.7 the comparison between X ray inspection & NAUT21

Fig.7 shows the comparison between X ray inspection & NAUT21 for de・lamination in lithium ion cell battery. X ray inspection can not find any defect, but NAUT shows the big difference (no ultrasonic passes in blue part, it passes well in yellow & red parts).



(a) Test specimen and examination by NAUT21



(b) Image picture of a brake pad

Fig.8 Test specimen of a brake pad & image picture by NAUT21

Fig.8 shows the test specimen of a brake pad & its image picture by NAUT. A right white area in the specimen simulates for defect, its image picture is blue (no ultrasonic passes in this area), and the left side is mostly yellow & red, that means good pass for ultrasonic.

4. Conclusion

We have developed the non contact air coupled ultrasonic inspection system using focusing air probes .and applications are followings.

(1) This system consists of ultra high power ultrasonic pulser & receiver, pre-amplifier and high sensitive probes.

(2) Very clear & sharp image pattern is obtained by using point focusing probes in CFRP, GFRP, & lithium ion cell battery by NAUT

(3) This system with LabVIEW is available for multiple-channels .

(4) This system is available for inspection of aircrafts , automobiles, electric device & composite materials.

Reference

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