

Probe and a method for detecting fiber orientation defect

Highly accurate detection of fiber waviness and misorientation for carbon fiber reinforced plastics

Summary

CFRP (Carbon Fiber Reinforced Plastic) is a lightweight, high-strength, high-rigidity material that is used in a wide variety of products such as golf club shafts or aircraft fuselage. CFRP is manufactured by stacking multiple sheets of carbon fibers aligned in one direction and heating & pressurizing them. In such laminates, the orientation of the carbon fibers is important, and if the orientation angle deviates from the design, the mechanical properties cannot be expected. In order to ensure the mechanical properties, carbon fiber misalignment can be detected by eddy current testing. However, while it is possible to detect the orientation and fiber waviness as a tendency, there is no inspection method that is accurate enough to guarantee the mechanical properties of CFRP laminates.

This invention is able to provide a probe and a method capable to detect defects such as orientation angle and fiber waviness with high accuracy of a carbon fiber in a hardened layer. This invention comprises a sensor for detecting an induced electromotive force caused by an eddy current formed by a uniform excitation coil.

Effect

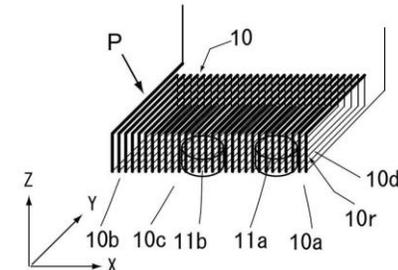
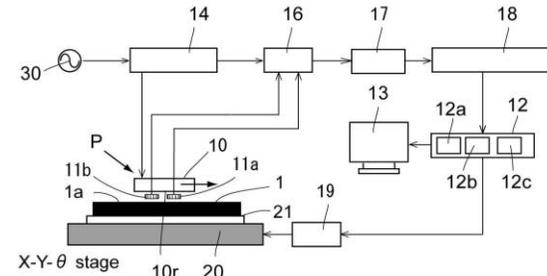
Able to detect orientation deviation of ± 3 degrees or more and fiber waviness of ± 2 degrees or more with an accuracy of about 1deg.

Application

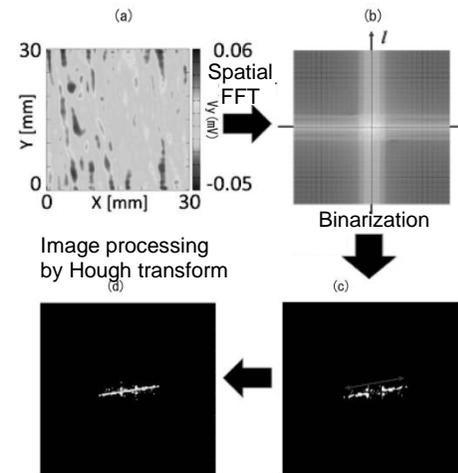
- Quality inspection of carbon fiber reinforced plastics

Patent Data Sheet

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- 1.Laminate 10.Uniform excitation coil 10a.Beginning of winding 10b.End of winding 10c. Middle part 10d.Lower edge 10r.Excitation surface 11a/b.Detection sensor 12.Computer 12a.Spatial FFT image processor 12b.Orientation misalignment angle arithmetic unit 12c.Waviness arithmetic unit 13.Monitor 14.Function synthesizer 16.Differential amplifier 17.Lock-in amplifier 18.A/D converter 30.Power supply P.Uniformly excited differential probe



【Up left】 Configuration of the entire detection system

【Up right】 Diagram of the uniform excitation coil

【Down left】

(a) Contour diagram of macroscopic misalignment

(b) Spatial FFT processing

(c) Binarization diagram

(d) Analyzed image by Hough transform

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