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Antin, Kim-Niklas; Santos, Telmo G.; Vilaça, Pedro

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K-N. Antin, T. Santos, P. Vilaça

Detection of damage in unidirectional carbon fiber composite rods using eddy current probes

Introduction

Carbon fiber composites are high performance materials, but they are very sensitive to damage. Therefore, the condition of composite structures needs monitoring to assure safe operation. However, critical flaws need to be detectable in order to develop a meaningful non-destructive testing method.

Methods

Detection of fiber damage in pultruded UD CFRP products was shown to be difficult using commercial eddy current probes. However, a suitable probe concept and geometry for damage detection was found. The probe is a differential planar eddy current probe as shown in Fig. 1 and complete test setup in Fig. 2. The probe was traversed along the specimen and the impedance of the coils was recorded.

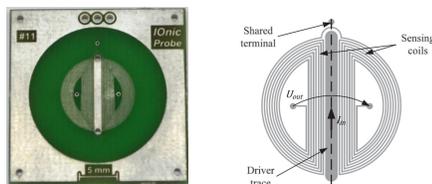


Fig. 1. Probe geometry and structure

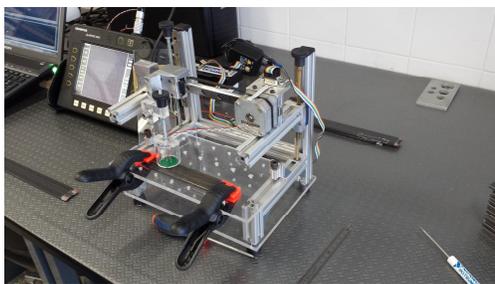


Fig. 2. Test setup with traversing probe and DAQ

Results

The tested flaw types include notches, holes, slots, voids, damage from impact, fiber breakage from flexural loading and thermal degradation. Distributed damage, such as fiber breakage due to bending, proved to be difficult to detect (Fig.3). Volumetric flaws, however, showed a clear signal (Fig.4).

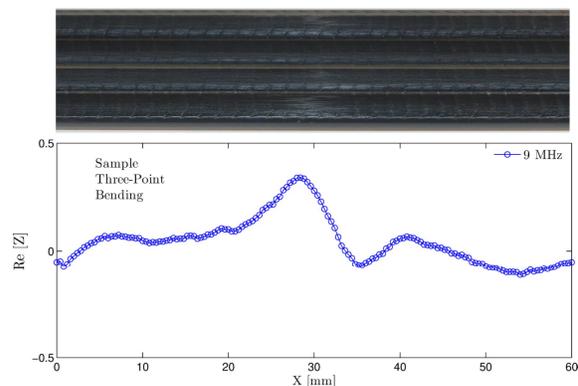


Fig. 3. Broken fibers shown in the impedance signal

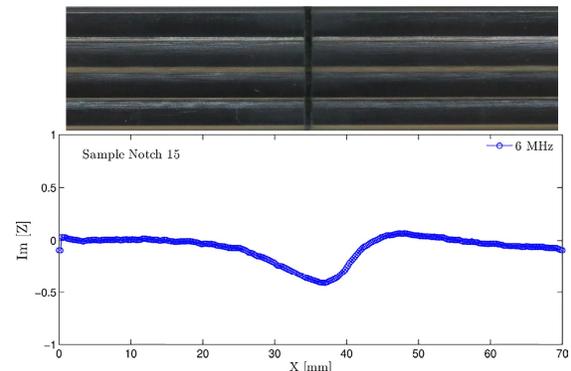


Fig. 4. A machined notch is easy to detect

Conclusions

Damage detection of unidirectionally reinforced carbon fiber composites using eddy currents is possible with the advanced probe concept tested. However, planar and distributed damage is still a challenge for eddy current testing.