

Nondestructive detection of incipient thermal damage in glass fiber reinforced epoxy composite using the ultrasonic propagation imaging

ABSTRACT

Incipient thermal damage (ITD) in polymer-matrix composites could cause substantial loss of material properties and it is notoriously difficult to be detected using nondestructive evaluation (NDE) techniques. The emerging ultrasonic propagation imaging (UPI) could be the solution for the detection problem and its detection probability for ITD was studied in this work. Glass fiber reinforced epoxy plate specimens insulted at temperatures ranging between 1.1 and 1.7 times of the glass transition temperature (T_g) for duration ranging between 5 and 30 min were inspected. The results in the form of statistically thresholded anomaly maps showed clear detection of ITD for specimens insulted at 1.4 and 1.7 times of T_g for 30 and 5 min, respectively, and partial detection for specimens insulted at 1.3 and 1.5 times of T_g for 30 and 10 min, respectively. Finally, an insulting duration-temperature plot with distinguished ITD undetectable, partially detectable, and fully detectable zones was estimated for references of future works.

Keyword: Matrix degradation; Heat damage; Acoustic wavefield imaging; Threshold analysis; Laser ultrasound imaging