Mechanical behavior of MWCNT reinforced GFRP composites under fatigue constant amplitude loadings with the presence of artificial notches

I. Lazaridou*, N.D. Alexopoulos
Department of Financial Engineering, University of the Aegean, Chios, Greece
A. Vairis, M. Petoussis
Department of Mechanical Engineering, Crete Institute of Technology, Heraklion, Greece

The present work investigates the effect of artificial surface notches on glass fiber reinforced polymers (GFRP) under constant amplitude fatigue loadings and for various nano-reinforced matrices. Different concentrations of Multi-Wall Carbon Nanotubes (MWCNTs) were added to the resin before the vacuum assisted resin infusion (VARI) of the composites [1]. Three different MWCNT nanocomposites were manufactured that had concentrations namely 0.5, 0.75 and 3.0 % MWCNTs [2]. Typical tensile coupons according to ASTM D3039 were machined from the composite plates that had 10 plies of unidirectional S-glass fabric. The artificial surface notches were introduced by a precise saw cut and the notch depth was measured with image analysis (Figure 1a). Two regions of the specimen were monitored by the electrical resistance change method; the so-called "healthy" region and the "notched" region that had the presence of the artificial notch. On the opposite flat surface of the coupon, strain gauges were attached and the readings of strain gauges and electrical resistance were continuously recorded during the progressive fatigue cycles.

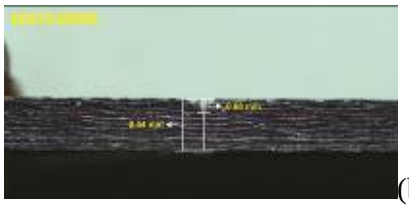
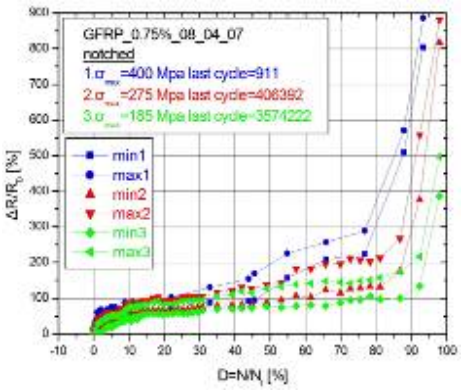
(a)  (b)  (c) 

Figure 1: (a) Photograph of the composite's cross section along with the artificial surface notch, (b) testing set-up with electrical resistance and strain gauges and (c) electrical resistance results of 0.75%wp MWCNTs composite over fatigue life.

Fatigue tests were performed in an MTS 100 kN loading frame with constant stress ratio of R = 0.1. Three different fatigue maximum stress levels were selected so as to address all fatigue regimes. It was found (Figure 1c) that a sudden increase takes place on the transition of stage III of the fatigue mechanism. This sudden increase point in the resistance change was applied maximum stress as well as MWCNT concentration (different material) dependant.

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* Ilona Lazaridou, email: lazaridou.ilona@gmail.com