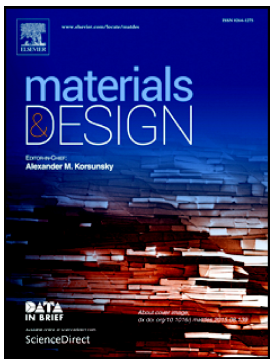

Near–fiber effects of UV irradiation on the fiber–matrix interphase: A combined experimental and numerical investigation

Libin K. Babu, Kunal Mishra, Raman P. Singh

PII: S0264-1275(18)30581-1
DOI: doi:10.1016/j.matdes.2018.07.050
Reference: JMADE 7283

To appear in: *Materials & Design*

Received date: 11 May 2018
Revised date: 21 July 2018
Accepted date: 23 July 2018

Please cite this article as: Libin K. Babu, Kunal Mishra, Raman P. Singh , Near–fiber effects of UV irradiation on the fiber–matrix interphase: A combined experimental and numerical investigation. Jmade (2018), doi:10.1016/j.matdes.2018.07.050

Near–fiber effects of UV irradiation on the fiber–matrix interphase: A combined experimental and numerical investigation

Libin K. Babu[a], Kunal Mishra[a], Raman P. Singh[a,b,*]

[a]*School of Mechanical and Aerospace Engineering*
Oklahoma State University
Stillwater, OK 74078, USA
[b]*School of Material Science and Engineering*
Oklahoma State University
Tulsa, OK 74106, USA

Abstract

Characterization of the interphase region in carbon fiber reinforced polymer (CFRP) is challenging because of the length scale involved. The interpretation of measured load-displacement curves using indentation is affected by the lack of analytical solutions that account for the fiber constraint effect. A combination of AFM (Atomic Force Microscopy) based indentation and FE (Finite Element) simulations showed a gradient in the elastic modulus of the interphase evaluated along a radial line from the fiber. 3D FEA (Finite Element Analysis) indicated that fiber constraint effect is significant in the region less than 40nm away from the fiber. Nonetheless, the apparent rise in elastic modulus due to fiber constraint is limited when compared to the gradient in the elastic modulus of the interphase. Additionally, this technique is used to demonstrate that UV irradiation causes a rapid decrease in the modulus of the region near the fiber due to photocatalytic degradation of carbon fiber but subsequently increases due to high cross-linking. Whereas, the modulus of the matrix at 8 mm away from the fiber decreased by 32% after 24h of UV irradiation. This indicates that the response of epoxy to UV irradiation is influenced by the proximity to the reinforcement.

Keywords: Carbon fiber composites, Interphase, fiber–constraint, UV

*Corresponding author –Tel: +1 405.744.5140; Email: raman.singh@okstate.edu