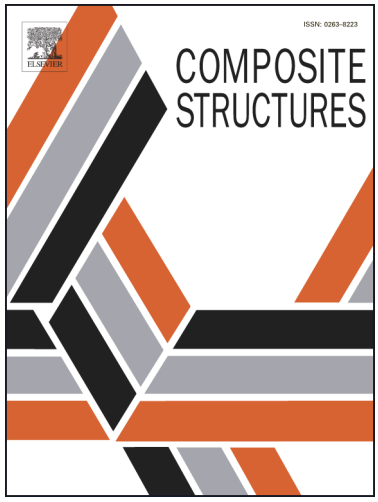

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Samit Roy, Abhishek Kumar

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Effect of Particle Size on Mixed-Mode Fracture of Nanographene Reinforced Epoxy and Mode I Delamination of its Carbon Fiber Composite

Samit Roy[a*], Abhishek Kumar[a]

[a]Department of Aerospace Engineering and Mechanics, University of Alabama, Tuscaloosa, Alabama, 35487-0280, USA

ABSTRACT

Motivated by the lack of available mixed-mode test data in the literature on graphene nanocomposites, this article aims to investigate two cases: (a) the changes in mixed-mode fracture properties of a thermoset polymer (EPON 862) reinforced with hydrogen passivated nanographene platelets (HP-NGPs) and, (b) Mode I fracture properties of EPON 862/IM7 unidirectional laminate with dispersed HP-NGPs. For case (a), mixed mode fracture experimentation was performed using an asymmetric four-point bending specimen on baseline (0 wt%), 0.1 wt% and 0.5 wt% HP-NGP reinforced EPON 862. Three different mode mix (K_{II}/K_I) ratios (0.78, 1.53, 117) were used to obtain a fracture envelop encompassing pure Mode I to Mode II. Remarkable increases in the fracture envelop both in Mode I (3 times) and Mode II (2.5 times) was observed with only 0.5 wt% of HP-NGP. For case (b), Double Cantilever Beam (DCB) experiments were used to obtain the fracture toughness of the unidirectional IM7/EPON 862 laminates with the HP-NGP reinforced matrices. Significant increase (100%) in resistance to crack propagation in DCB specimens was observed. A brittle to ductile transition at the crack tip due to a novel nanoscale size effect is postulated and verified using TEM as the reason for the toughness increase.

KEYWORDS: A. Polymer matrix composites, B. Fracture toughness, B. Delamination, Graphene

1. Introduction

Recent advances in research have paved the way for the use of polymer/fiber composites towards manufacturing lighter and more durable structures. Polymer based composites are being successfully used in many modern industries including aerospace, automobile, sporting goods, and wind turbines. A new breed of polymer composites termed as 'multifunctional' composites modified by nano particles are being currently researched for enhancing the potential of the existing polymer composites. Besides potential applications in

***Corresponding Author.** Dr. Samit Roy, Department of Aerospace Engineering and Mechanics, University of Alabama, Tuscaloosa, AL, 35487-0280, USA; Tel:+1(205) 348-5883; Email address:sroy@eng.ua.edu