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THE BREAK EVOLUTION PROCESS IN COMPOSITE MICROCOMPOSITES

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Abstract

The mechanical integrity of a structural composite is strongly affected by the strength and toughness of the fiber–matrix interface/interphase (Norwood, 1994), with interfacial shear strength (IFSS) considered the best quantifying metric. Because the IFSS outputs are used in unidirectional (UD) composite failure models (CFMs) to predict strength and failure behavior, where the interaction between fibers can be important, the validity of extrapolating from test results based upon the repeated failure of a single isolated fiber has often been questioned. In this presentation, the spatial distributions of fiber breaks in a single fiber fragmentation test (SFFT) specimen, such as used in IFSS measurements, and a 2-D array of glass fibers (i.e., multi-fiber fragmentation test (MFFT) specimen) are compared. In both cases, the break locations in the fibers were found to evolve to a uniform distribution, thereby confirming that the ordered fragment lengths from the repeated fracture process conforms for both SFFT and MFFT specimens to a cumulative distribution function (CDF) derived by Whitworth (1887) and cited by others (Read, 1988; Pyke, 1988; Holst, 1980). The array break density, however, was observed to be less than the break density in isolated fibers, and break locations across array fibers were found to be highly coordinated and mostly aligned. The implication of these results on predictions arising from UD-CFMs will be discussed.