

Fall 11-10-2015

# The break evolution process in composite microcomposites

Gale Holmes  
*NIST*

Follow this and additional works at: [http://dc.engconfintl.org/composites\\_all](http://dc.engconfintl.org/composites_all)



Part of the [Materials Science and Engineering Commons](#)

---

## Recommended Citation

Gale Holmes, "The break evolution process in composite microcomposites" in "Composites at Lake Louise (CALL 2015)", Dr. Jim Smay, Oklahoma State University, USA Eds, ECI Symposium Series, (2016). [http://dc.engconfintl.org/composites\\_all/56](http://dc.engconfintl.org/composites_all/56)

This Conference Proceeding is brought to you for free and open access by the Proceedings at ECI Digital Archives. It has been accepted for inclusion in Composites at Lake Louise (CALL 2015) by an authorized administrator of ECI Digital Archives. For more information, please contact [franco@bepress.com](mailto:franco@bepress.com).

## THE BREAK EVOLUTION PROCESS IN COMPOSITE MICROCOMPOSITES

Gale A. Holmes<sup>a</sup>, Edward D. McCarthy<sup>a,1</sup>, N. Alan Heckert<sup>b</sup>, Stefan D. Leigh<sup>a</sup>, Jae H. Kim<sup>a</sup>, and Jeffrey W. Gilman<sup>a</sup>

<sup>a</sup>Materials Science and Engineering Division, National Institute of Standards and Technology, Gaithersburg, MD, 20899-8541

<sup>b</sup>Statistical Engineering Division, National Institute of Standards and Technology, Gaithersburg, MD, 20899-8980

<sup>1</sup>Current Address: University of Manchester Aerospace Research Institute, Manchester, UK, M13 9PL

### 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.