Summary of Research

Grant Title: "An Investigation of Theories of Failure for Ceramic Matrix Composites."

Type of Report: Final Report

Name of Principal Investigator: John H. Hemann

Period Covered by the Report: 6/15/93 to 7/21/95

Name and address of grantee's institution:

Cleveland State University
1983 E. 24th Street
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Grant Number: NCC 3-306

John H. Hemann
12/22/95

Research Results: The grant funds were primarily used to support a graduate student who worked on-site at NASA-Lewis. Amy Brewer assisted in setting up an acoustic emissions laboratory and, in particular, developed software to collect and reduce acoustic emission data. She wrote her master thesis using this research.
A copy of the abstract to the thesis is attached: a copy of the thesis is on file at NASA-Lewis in the NDE group.

Final Property Inventory: No equipment was furnished or acquired under this grant.

New Technology: No new technology was developed or patented under this grant.

AN INVESTIGATION OF ACOUSTIC EMISSION TECHNIQUES FOR THE DISCRIMINATION OF DAMAGE MECHANISMS IN CERAMIC MATRIX COMPOSITES

AMY R. BREWER

ABSTRACT

In order to further advance the understanding of the mechanical behavior of ceramic matrix composites (CMCs), acoustic emission (AE) techniques were implemented to monitor and identify damage mechanisms in CMCs under tensile loading.

In addition to real-time AE monitoring techniques, a data acquisition system was developed and implemented in order to capture AE waveforms resulting from stress-induced damage. Waveforms were inspected for multiple events, separated in distinct events, and then analyzed to determine waveform characteristics in the time and frequency domains. Waveform characteristics included peak amplitude, event duration, MARSE, energy, and dominant and centroidal frequency. In addition to conventional methods for determining a damage discrimination criteria, a study of the distribution and correlation the waveform characteristics was performed to aid in the determination of a damage discrimination criteria. The damage discrimination criteria was tested for "uniqueness", i.e., the effectiveness of the criteria to identify and monitor damage independent of the stress-strain relationship. Insitu radiography was used to substantiate the damage accumulation.

A simulation test was also performed over the loading history to study the changes in the waveform characteristics of the system response from a constant excitation.

This thesis demonstrates the usé of waveform analysis to study the AE activity resulting from stress-induced damage in CMCs in conjunction with other nondestructive evaluation techniques to investigate the mechanical behavior of CMCs.