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COMPUTATIONAL SIMULATION of COMPOSITE BEHAVIOR

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Work was performed under this grant to simulate composite behavior under two broad areas - development of a novel technique for composite microfracture evaluation and development of micromechanics and macromechanics equations for simulating ceramic matrix composite behavior.

Composite microfracture technique developed here is based on the concept of global strain energy release rate. Step-by-step procedures were outlined to evaluate composite microfracture. The technique can predict microfracture initiation/propagation, predict the "structural fracture toughness", and establish the hierarchy of fracture modes. Both unidirectional and cross-ply metal-matrix composite laminates were evaluated for microfracture, subjected to thermal and mechanical loads. Five NASA reports were published as shown in the bibliography and several presentations were made at the technical conferences/symposia.

Work was also performed to develop simplified micromechanics and macromechanics for ceramic matrix composites. A novel fiber sub-structuring technique was developed, which divides the fiber into several "slices" and applies the micromechanics equation at the "slice" level, which are then integrated upwards to get the ply and the laminate properties. It allows for a more accurate representation of interfacial conditions such as partial interface bond etc. It also predicts the stress-strain behavior of a composite up to failure by taking into account material properties dependence upon temperature as well as stress redistribution that occurs due to damage initiation and propagation. A computer code CEMCAN (Ceramic Matrix Composites Analyzer) which includes all these capabilities has been developed as a part of this research activity. The work is summarized in the NASA reports as shown in the bibliography section. The CEMCAN computer code is available through COSMIC (NASA's software technology transfer center) at The University of Georgia, 382 East Broad Street, Athens, GA 30602-4272, USA. Their phone number is (706) 542-3265 and the Fax number is (706) 542-4807.

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