Micromechanical Models for Predicting Failure and Fracture in Composite Materials

Traditionally homogenization has been used to predict the thermo-mechanical, thermal and other transport properties of composite materials and heterogeneous material systems. Recent advances in computational methods have enabled to simulate progressive failure including crack propagation. In this talk simulation of failure and fracture of various materials systems such as textile composite materials and cellular materials including functionally graded foams are presented. The challenges in predicting failure in the presence of large stress gradients in the microstructure will be discussed, and a method in which currently available phenomenological criteria could be modified to accommodate stress gradient effects will be presented. Effects of thermal stresses on the failure of fiber composites will be discussed and an efficient method of modifying the phenomenological failure criteria will be presented. Calculation of thermal stresses in Integrated Thermal Protection Systems will be used as an example to demonstrate stress gradient effects.