Abstract

Damping in Metal Matrix Composites -An Overview

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Measurements of damping in metal matrix composites (MMC) have been conducted in flexural and extensional modes over a wide spectrum of frequency (1Hz - 80Hz) and strain amplitude (10^{-7}- 10^{-3} in/in) with various test techniques. Dynamic response of MMC can be described in terms of strain amplitude independent and dependent damping behavior. At very low strain amplitudes ($\sim 5x10^{-5}$), damping is nearly independent of strain amplitude level, but varies with frequency showing a Zener relaxation peak. The total composite damping can be calculated from the modulus or strain energy weighted rule of mixtures. Average damping capacity (Ψ) of MMC is generally less than the Ψ value for matrix alloy because reinforcing fibers and whiskers have inherently very low damping. Beyond a critical strain amplitude level, the damping capacity of composite increases with increasing strain amplitude. This strain amplitude dependent response can be explained in terms of the Granato-Lucke theory which is based on a dislocation breakaway model. Also discussed are the efforts to improve damping in MMC by modifying the microstructural characteristics of fiber, matrix, and interfaces.† With enhanced damping contribution from MMC structural materials, the degree of additional passive and active controls required may be reduced for large precision space structures.

† S. P. Rawal, J. H. Armstrong and M. S. Misra, "Interfaces and Damping in Metal Matrix Composites," Final Report No. MCR-86-684, prepared for Office of Naval Research, Arlington, VA.
M. S. Misra, S. P. Rawal and J. H. Armstrong, "Damping Characteristics of Metal Matrix Composites," Technical Report No. MCR-8-634, prepared for Office of Naval Research, Arlington, VA.