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GUIDED WAVES IN A FIBER-REINFORCED COMPOSITE MATERIAL WITH INTERFACE LAYERS

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ABSTRACT

The mechanical response and failure of high-temperature fiber-reinforced materials are critically dependent on the mechanical properties of the interface (interphase) layers between the fibers and the matrix. Even though considerable amount of work has recently been done on the fracture of these materials, characterization of interface properties and their influence on deformation and failure is found to be a challenging problem. Guided ultrasonic waves provide a powerful tool to obtain the mechanical properties of the interface layers and the quality of the bond between the fiber and the matrix. In this paper, we present a model study of dispersion characteristics of both axisymmetric (n = 0) and nonaxisymmetric (n = 1) guided waves in a SiC fiber reinforced glass matrix. Here n stands for the circumferential wavenumber. It is assumed that the fiber has two surrounding layers separating it from the matrix: a thin layer of carbon and then a thin layer of TiB_2. Surrounding matrix is a glass cylinder. Comparison of dispersion characteristics with and without the interface layers shows mode dispersion curves come very close at certain frequency-wavenumber values as if they cross. This phenomenon is often characterized as "pinching" and is found to be very sensitive to the interface (interphase) properties. Examination of the mode shapes at these points reveals mode interchanges. It is argued that careful study of the pinch effect can be used to obtain mechanical properties of the interface (interphase).