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Nonlinear Acoustic Characterization of Accumulated Fatigue Damage

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Abstract

Linear elastic properties of longitudinal velocity of sound, attenuation and nonlinear acoustic parameter have been measured in titanium alloy samples under cyclic loading. A small change of a few percent has been observed in the linear elastic properties of the material. On the other hand changes of hundreds of percent have been observed in the nonlinear acoustic parameter. The changes in linear and nonlinear acoustic properties are attributed to the continuously changing microstructure of the material due to fatigue. Results of the nonlinear acoustic parameter are compared with the transmission electron microscopic investigation of the microstructure changes due to fatigue. A comparison of the experimentally measured nonlinear acoustic parameter with theoretically evaluated results based on the interaction of acoustic waves with the microstructure is presented. The implication of the technique of nonlinear acoustic parameter measurements to fatigue is discussed.