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U-DMA measurement and dynamic analysis of ultrasonic wave propagation in particulate composites

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Abstract

This work is dedicated to a high-precision ultrasonic testing technology for dynamic mechanical evaluation of particle reinforced composite materials. The detailed ultrasonic wave propagation due to multi-reflection and scattering waves by particles and matrix viscoelasticity, especially the mutual interactions among particles, are systematically clarified. Through a unique material evaluation method, Ultrasonic Dynamic Mechanical Analysis (U-DMA), the dynamic viscoelasticity of particulate composites with different types and contents of particles are measured directly in high frequency domain. Furthermore, based on the experiment data, the ultrasonic propagation behaviors are detailedly investigated by a newly developed time-domain finite element analysis code, Pzflex, for investigating the detailed mechanisms of particles. The results clarify that the particle interactions are playing a major role in ultrasonic wave propagation and attenuation properties, which can significantly affect the viscoelastic characteristics of developed