

Public Abstract

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Graduation Term:FS 2011

Department:Mechanical & Aerospace Engineering

Degree:MS

Title:Mean Grain Size Estimation for Copper-alloy Samples Based on Attenuation Coefficient Estimates

A polycrystalline metals grain size affects its mechanical properties; therefore, the ability to effectively and easily monitor grain size during a manufacturing process is critical. Conventional destructive tests utilized for estimating grain size or mechanical properties are expensive and time consuming. Past research has shown some success in nondestructively estimating a metals mean grain size using attenuation coefficient measurements acquired from ultrasound. Within this research, a water immersion, pulse-echo mode of ultrasonic testing is employed to estimate the mean grain diameter of 5 thin copper-alloy samples using attenuation coefficient measurements. The attenuation coefficients were estimated via spectral analysis of interface reflections. The interface reflections were corrected for reflection and transmission effects, beam field diffraction, and water attenuation effects. An experimental diffraction correction approach and an inverse water attenuation filter accounted for diffraction and water attenuation, respectively. A Leave-One-Out (LOO) cross-validation algorithm was implemented to generate correlation models needed for grain diameter estimation. Models were developed as a function of ultrasonic wavelength and yielded grain diameter estimates for each sample. Estimates were seen to compare favorably with the stated grain diameters of the copper-alloy samples. This research was supported by the International Copper Association. Copper-alloy samples were supplied by the Wieland Group - Germany.