Ultrasonic Attenuation and Backscattering in Duplex Alloys for Materials Characterization

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It is well known that the microstructure can affect a propagating ultrasonic beam. For example, the sound velocity is significantly affected by crystallographic texture. In addition, during flaw detection, the microstructure can backscatter energy, creating noise which can mask signals from small flaws. Furthermore, a flaw signal can be attenuated by absorption and scattering of energy. These effects can have deleterious effects on flaw detection and characterization. However, due to the link between backscattered grain noise, attenuation and the microstructure, measurement of these ultrasonic quantities can be used as accurate materials characterization methodologies if appropriate models exist. Theoretical predictions of attenuation have been made successfully in the past in materials consisting of texture free, equiaxed grains. However, there is a lack of adequate models describing the attenuation and backscattering in duplex alloys with texture such as commonly used steels and titanium alloys. The multiple scattering, which controls the attenuation, is of particular interest. In this paper, we will present theoretical predictions and experimental measurements of attenuation and backscattering in duplex alloys, with the practical goal of producing a theory to quantify material properties when coupled with appropriate ultrasonic measurements.

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