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# Microstructures evaluation of steel based on laser ultrasonics technique

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## Abstract

With the higher requirements for weight reduction and collision safety of automobiles, the development and manufacturing of high-strength steel materials have great significance for the steel industry. The mechanical properties strongly depend on its microstructure and strict process controls are generally required. Therefore, research on online monitoring of the microstructure of steel (such as grain size and phase fraction) during production processes has been widely concerned. Laser ultrasonics technique is considered very suitable for online monitoring in steel production processes (harsh environments such as high temperatures) due to its advantages of non-contact and long-distance measurements.

The use of laser ultrasonics to measure grain size of steel, or to evaluate phase transformation during heat treatment of low alloy steel has been studied in the previous literature. In addition, finite element simulation is used to assist in understanding the effect of microstructure on ultrasonic propagation. There is a lot of research on grain size measurement using ultrasonic attenuation. The purpose of this study is to evaluate the characteristics of ultrasonic wave propagation in steel with different phase fractions through experiments and finite element simulation.

In this study, we used laser ultrasonics technique to measure the sound velocity in austenitic, ferritic, and two-phase stainless steel, respectively. Then a method of laser ultrasonic finite element simulation modeling steel microstructure by the Voronoi diagram was introduced. Using the finite element simulation, we analyzed the effect of different microstructures on ultrasonic propagation.

**Keywords:** Laser ultrasonics, Microstructures, Sound velocity, Finite element simulation