Laser-induced zero group velocity Lamb modes to characterize anisotropy in metals

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Composites, single crystal materials, advanced manufactured materials, and polycrystalline metals often exhibit significant grain texture inherently or from mechanical processing. This texture results in anisotropic material properties that can cause unexpected failure if unaccounted for in the design and use of the material. Ultrasonic inspection can be used to characterize this anisotropy and measure the elastic constants of the materials along different principal axes with high sensitivity and in a noncontact manner. Here, we use a laser ultrasonic technique to excite and detect zero group velocity (ZGV) Lamb wave resonances in metal plates of varying anisotropy. A laser line source is used to excite these resonances at different orientations with respect to the principal axes and the signals are detected using an interferometer. The effects of anisotropy on ZGV resonance frequencies are validated using the theory of Lamb wave propagation.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and was supported by the LLNL-LDRD Program under Project No. 23-ERD-009. The document release number is LLNL-ABS-861136.