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Recent developments at NRC Canada for Steel Microstructure Characterization and Weld Inspection

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Over the years, several topics have been explored regarding the ability of laser ultrasonics (LUS) to characterize steel microstructure both in laboratory and in industrial conditions. One important achievement is the determination of austenite grain size using LUS attenuation. The grain size evolution can be evaluated by in-situ laser-ultrasonic measurements during rapid deformation. Robust models combining deformation, recovery, recrystallization and grain growth have been developed and validated with our LUS experimental data. Another area of research is to monitor and determine in a quantitative manner the austenite fraction during phase transformation. In these recent developments, empirical models for the temperature dependent LUS velocity in austenite, ferrite and pearlite phases are established and used to evaluate austenite fraction during cooling. Comparison of dilatometry and LUS results for phase transformation of the industrial steel grade are presented and show a very good agreement. The LUS velocity approach to monitor phase fraction in industrial conditions appears to be promising. Inspection of metallic welds and metal additive materials is a booming activity in the laser ultrasonic community. Recent activities for additive material and weld inspection at NRC are presented. This paper presents an overview of recent developments at NRC, compact laser-ultrasonic head and different SAFT processing imaging, to inspect metallic welds and metal additive materials. The applications are space titanium pressure vessel, large aluminum train parts and hard coating for mining industries. Challenges and future works are discussed.