In-situ grain size measurement during dynamic recrystallization and hot rolling simulations by laser ultrasonics

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The real-time grain size measurement has recently been realized by laser ultrasonics in the hot-rolling process [1]. This enables quality control, the possibility of direct feedback to the process control system, as well as feedback to the set-up calculation which is performed before each transfer bar is sent through the finishing mill to be rolled. The gauge provides novel insights into how the material behaves during production. This is especially useful for low-alloyed steels that phase transform at cooling to room temperature making it difficult to use traditional metallographic methods to estimate prior austenite grain structure. However, the grain size gauge is currently only installed at one position in the mill, thus, providing measurements at a single point in the process. To better understand how material behaves during the whole process the GLUS® testbed at Swerim, which is the combination of the thermo-mechanical simulator GLEEBLE and laser ultrasonics (LUS) can be used. The method provides a unique possibility to explore and validate alloying concepts on a smaller scale to increase the understanding of how material properties evolve during for example annealing or hot-rolling processes. In this work, this is demonstrated for an austenitic stainless steel making it possible to confirm LUS measurements with room temperature observations. Thermomechanical simulations are made corresponding to a 6-stand finishing mill, with different deformation strategies reaching the same total deformation. Grain structure is monitored with laser ultrasonics on 316L. In addition, we will present the results from grain size measurement during the deformation showing the capability of GLUS to capture the microstructure evolution such as dynamic recrystallization. References [1] Malmström M, Jansson A, Hutchinson B, Lönnqvist J, Gillgren L, Bäcke L, et al. Laser-Ultrasound-Based Grain Size Gauge for the Hot Strip Mill. Applied Sciences 2022;12:10048. https://doi.org/10.3390/app121910048.