# Microstructure evolution after single pass laser heat-treatments of steel

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**Abstract**

Surface hardening of steel with ferrite and pearlite initial microstructure was carried out through laser heat-treatments (LHT). The aim is to investigate the phase transformations during the rapid heating and cooling cycles associated to LHT. Laser heat treatment of the test samples was conducted using a 6kW YLS-6000 IPG laser integrated with 4-axis CNC motion control system. The laser spot size was calibrated using a PRIMES BM60+ laser beam profiler. The laser power delivered to the workpiece was verified using a 10K-W-BB-45-V3 laser power meter from OPHIR Photonics. All test parameters were held constant for all laser heat treatment procedures to isolate the effect of substrate chemistry and initial microstructure on the resulting phase transformations. Specimens for microstructural observation were cut in the same plane previously described. The procedure was the standard grinding and polishing to 1 $\mu$m diamond paste. The specimens were etched with Nital 2 vol. percent for four seconds. The observation was performed in a Keyence optical microscope model VHX-5000, under bright field illumination mode. Electron backscatter diffraction (EBSD) measurements were performed on a FEI Quanta TM 450-FEG-SEM. The images and maps were taken along the centerline of the laser heat treatment pass. The microstructure shows the well documented distinctive contrast between the hardened layer (mainly martensitic) and the base material. The microstructure reveals a clear transition zone, which is sharper as the carbon content increases.

**Keywords:** Laser heat treatment, fast heating, austenite, martensite, modeling

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