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Real-time Monitoring and Prediction of Martensite Formation and Hardening Depth during Laser Heat Treatment

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Abstract

An automated real-time thermal monitoring system is developed to monitor the thermal dynamics of the Laser Heat Treatment (LHT) process online. The infrared imaging system captures the cooling rate, heating rate and peak temperature in real-time. LHT experiments are conducted with thermal monitoring to understand and correlate microstructures, hardness and hardening depth. Single-track laser heat treated samples of AISI 1020 low carbon steel are examined to evaluate the observed thermal history with different input process parameters. Microstructural characteristics such as martensite formation and phase transformations are studied based on the real-time values of the cooling rate, heating rate and peak temperature. Moreover, the hardness and hardened depth are also correlated with the substrate's thermal dynamics to identify a suitable feedback signal for closed-loop control of the depth. Finally,

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