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Improved model of rapid cooling in the process of laser or small-scale induction hardening

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The paper presents and discusses an enhanced version of modeling laser or small-scale induction hardening. The process is characterized by a rapid cooling rate, reaching several hundred or over one thousand degrees Celsius per second. Most heat from the heated spot is transferred through conduction rather than convection, penetrating deep into the material's interior. Consequently, determining the surface hardness based on the continuous cooling transform (CCT) diagram is challenging. Typically, the cooling curves in the CCT diagram are only available for rates of around tens of degrees Celsius per second. To address this issue, the paper introduces a model that utilizes optimization procedures supplemented by calibration through specific measurements to estimate the resulting hardness. The methodology is demonstrated through an illustrative example, and the obtained results are compared.

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