Laser surface hardening of 11% Cr ferritic stainless steel and its sensitisation behaviour

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Abstract: 11% Cr ferritic stainless steel conforming to EN 1.4003 standard was surface hardened by a continuous-wave fibre laser beam. Both single-pass and multi-pass laser hardening was investigated. Different laser parameters were compared and their influence on hardness, microstructure, geometry of the hardened zone and sensitisation was investigated, especially for overlapping passes. The experiments showed that a surface hardness which is double that of the base material hardness was obtainable via martensitic phase transformation and high cooling rate, in spite of the low carbon and nitrogen content. This behaviour could be predicted from the chemical composition using the Kaltenhauser Ferrite Factor. Hardening at higher power levels gives more coarse-grained lath martensite but does not increase the hardness. Sensitisation was not a problem in single-pass hardening. However, the production of overlapping tracks could be detrimental to corrosion resistance in 11% Cr steel due to the formation of chromium carbides and nitrides.

Keywords: laser surface hardening, ferritic stainless steel, sensitisation