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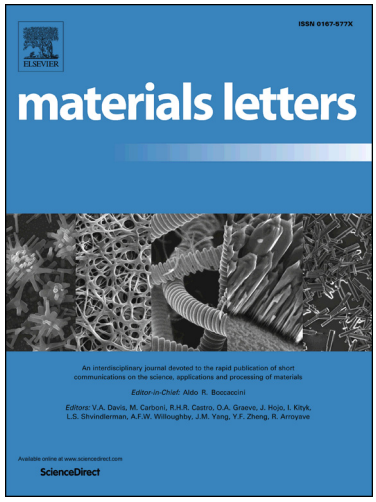

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A novel approach to direct preparation of complete lath martensite microstructure in tool steel by selective laser melting

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Abstract

A direct preparation of complete lath martensite microstructure (transformation rate δ > 99%) in tool steel was successfully realized using selective laser melting (SLM) in conjunction with laser remelting (LR) technique. Ultrafine lath martensite with a high percentage of low-angle grain boundaries (LAGBs) (46.12%) was formed. This unique microstructure contributed to the prominent effect of dislocation rearrangement and entanglement within the substructure of martensite, leading to a significant improvement of mechanical properties. An ultrahigh microhardness of ~765.1 $HV_{0.3}$ was obtained, which is much higher than the previously reported values of as-built SLM hardened steel such as H13 and maraging steel.

Keywords: Selective laser melting (SLM); Phase transformation; Microstructure; Grain boundaries; Microhardness