The Investigation of Microstructures and Properties of X40CrMoV5-1 Hot Work Tool Steel after Laser Alloying

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Abstract

Investigations include alloying the X40CrMoV5-1 hot-work tool steel surface layer with the tungsten carbide, using the high power diode laser (HPDL). The structural mechanism was determined of surface layers development, effect was studied of alloying parameters, and thickness of paste layer applied onto the steel surface on structure refinement and influence of these factors on the mechanical properties of surface layer, and especially on its hardness, abrasive wear resistance, and microharness. Martensite twining occurs in some locations, retained austenite, and very fine precipitations of the M_6C and M_7C_3 type carbides are observed as broken network on dendrite boundaries, as well as the high-dispersive ones inside of certain grains. The fine grained martensite structure is responsible for hardness increase of the alloyed layer. The dependence is presented of micro-hardness change on the laser beam effect on the treated surface, and especially the hardness increase in the alloyed layer. The tribological wear relationships were determined for laser treated surface layers, determining friction coefficient, and wear trace shape developed due to the abrasive wear of the investigated surfaces. The X40CrMoV5-1 conventionally heat treated steel was used as reference material. The outcome of the research is an investigation and proving the structural mechanisms accompanying laser remelting and alloying.

Materials Processing for Properties and Performance (MP^3) Vol. 3
Edited by K.A. Khor, R. V. Ramanujan, C. P. Ooi and J. H. Zhao
Institute of Materials East Asia, 2004