Effect of tungsten carbide partial dissolution on the microstructure evolution of a laser clad surface

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ABSTRACT

Laser surface modification has been a way to promote wear resistance in dies and molds application. Previously, researchers have succeeded in enhancing surface properties through laser surface modification. The addition of particles in laser cladding process enhanced the surface properties by strengthening the modified AISI H13 tool steel structure. Controlled parameter was laser power, pulse repetition frequency (PRF) and scanning speed with a range of 1.7–2.5 kW, 30–70 Hz and 10.5–24.5 mm s−1 respectively. The powder addition executed by a preplaced method. The grain size and hardness properties of treated samples were characterized using scanning electron microscope (SEM) and hardness Vickers indenter respectively. Surface roughness was characterized using roughness tester. From the findings, tungsten carbide (WC) particles were dissolved homogenously within refined substrate grain structure at higher laser energy. Higher laser scanning speed contributed in uniform particles distribution. The grain refinement with W element in modified layer resulted in maximum hardness of 660 HV. Rapid solidification during laser processing produced metastable phase formation grain refinement, and a higher fraction of grain boundary which resulted in grain boundary strengthening, grain refinement and metastable phase formation. In this paper laser cladding of AISI H13 tool steel with micron size WC particles addition for enhanced surface properties was investigated. These findings are important to design high precision modification of die surface for high temperature forming process.

KEYWORDS

Laser cladding; Tungsten carbide particle; Carbide dissolution; Grain refinement; Nd:YAG laser; Phase transformation

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