Effects of Thermal Fatigue on Laser Modified H13 Die Steel

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ABSTRACT
In order to improve the wear properties of H13 die steel, the thermal fatigue properties of AISI H13 tool steel were investigated at a varied number of cycles for enhancing surface hardness. A CO2 laser system was used with a 0.09mm focused spot size on the sample surface. The peak power of 1137kW and pulse repetition frequency (PRF) of 2300Hz were the parameters controlled. The Nabertherm model of a thermal fatigue machine used consisted of the cylindrical high temperature furnace with digital control panel, controlled temperature quenching system and pneumatics control sample movement mechanism. The samples were immersed in molten aluminum and quenched in ionized water emulsion at 17oC temperature within a specific time per cycle. The quenching system was equipped with a thermocouple to control the water temperature. The testing was done on1,750 and 3,500 cycles. The treated samples was characterized for metallographic study and hardness. The metallographic study was conducted using an optical microscope for laser modified layer thickness and grain size and the hardness properties were measured using a Vickers indenter. Erosion occurred from the sample after 3500 cycles. The hardness of the laser treated layer was lowered, after a thermal fatigue test, from 650 HV0.1 to 510 HV0.1.These findings are important for designing high wear resistant surfaces through laser surface modification for applications forming semi-solid dies.

KEYWORDS: Thermal fatigue; laser surface treatment; H13 tool steel.

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