

WEAR OF DIRECTED ENERGY DEPOSITED H13 STEEL AS A FUNCTION OF ITS GRADED MICROSTRUCTURE

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ABSTRACT

Due to the high hardness and corrosion resistance, H13 steel has been widely used as the die materials. However, the high hardness and low ductility of H13 make it difficult to be machined by conventional subtractive processes. Recently, laser additive manufacturing (AM), including selective laser melted (SLM) and directed energy deposited (DED) of H13 is gaining widely attention for the high freedom in component design, such as conform channel cooling system and the repair of worn mold [1]. In this work, a special attention was paid to the graded microstructure and wear behavior of DED processed H13 Steel with focus on parameters optimization and intrinsic heat treatment. The parameter optimization results show that the size of molten pool decreases with the increase of scanning speed. The width, depth and height of the molten pool decrease from 3318 μm, 686 μm, and 546 μm to 1888 μm, 188 μm, 92 μm, respectively, as the scanning speed increases from 2.5 mm/s to 10 mm/s. When the laser power increases from 2000 W to 3500 W, the size of molten pool also increases gradually. Based on that, a finite elemental (FE) model was established to analysis the thermal behavior during the DED process. Then, the hardness and wear behavior in the different region (Top, bottom and matrix) of DED processed H13 steel single-wall sample by 100 layers are determined. Compared with the bottom and matrix of DED processed H13 steel, the top place exhibits obvious higher hardness of 811 HV and lower coefficient of friction (COF) of 0.38. According to the microstructure and FE analyses, the induced graded structure by intrinsic heat treatment during DED process controls the microstructure precipitation strengthen effect and hence its wear performance.

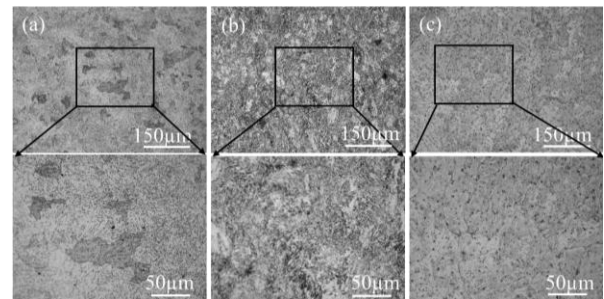


Fig.1 Microstructure at (a) matrix (b) bottom (c) top place

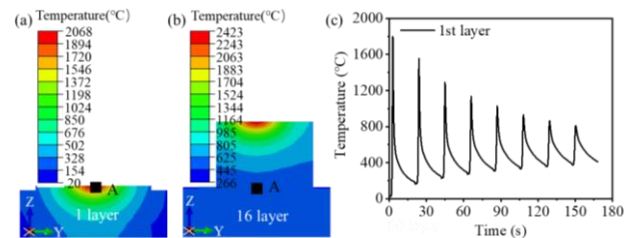


Figure. 2 Temperature counter of simulation at (a) 1st layer, (b) 16th layer; (c) Temperature history in the point A.

Table 1 Wear rate and average coefficient of friction (COF)

Position	Wear rate (mg/mm)	Average COF
Top	6.8×10^{-5}	0.38
Bottom	2.8×10^{-4}	0.46
Matrix	$5,5 \times 10^{-4}$	0.45

REFERENCES

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