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Laser Emissivity Coefficient and Laser Differential Speed Effect on Coating of HAZ of Components

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Abstract

In the industry, physical deposition was a commonly used coating technique of materials. This was known for its ability to addition of layers of material had no voids or impurities. The method has been innovated used a vacuum chamber to ensured selective depositions. A challenge in the industry was the improvement and requirement of high-speed processes has led to deterioration of the material when coated. In this research, the laser differential speed at a constant emissivity was studied and the effects of HAZ after experiment at a microscope. Therefore, materials, although they had no void, deteriorated in the combinatorial process. In this research, laser and other conventional techniques were studied to reduce the HAZ on the material. The method involved using literature and new parameters to test the optimum values of laser emissivity and laser differential speed on the HAZ. Given that HAZ had a macroscopic observation, a microscope was used to study the properties. The conclusion of laser differential speed had a positive correlation on HAZ, and laser emissivity had the lowest on the affected components. The HAZ was stable in the upper levels of the laser differential speed to ensure the absence of voids for physical vapor deposition process.

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Introduction

Studies showed the HAZ was the most challenging in the development of durable materials. This material corroded over time when coating degradation. Therefore, it lost its performance after additive manufacturing of physical deposition methods. The HAZ effect occurred in literature when the laser was not adequately absorbed at the surface layer. There were many causes of HAZ; lack of viscosity of the surface, insufficient absorption due to reflective out surface and absence of precision in the material preparation and processing. Therefore, researchers used alternative low-strength materials that were unable to meet the performance. In most situations, material would need recoating and additive manufacturing after use over time.

This was not cost effective to the manufacturer, and the consumer would need to find exact specifications of additional components' requirements. Most components according to ISO standards could be outdated and lack a supplier after years of use. This research had the aim of effectively designing a laser process to ensure the lowest HAZ on the material. The research objective was to study commonly used parameters and present a specification of new settings and the effects on the surface of the material. The study would compare and determine the appropriateness of the final material to the industry and level of corrosion absorption. The laser differential speed according to literature was the difference from the longitudinal speed to the lateral speed. While the emissivity was the variation of laser wave and the materials density.

Materials and Methods

The research obtained two ingot materials from a supplier. These materials were of diameter 20 mm and height 40 mm. These were used for experimental testing of HAZ up to physical deposition coating experiment. The effect was to determine the degree of the HAZ and suggest improvement. According to literature the emissivity was used and had a significant amount. Therefore, this was kept constant, and the laser Differential Speed varied in the experiment. The optimal laser emissivity, E_O was derived from the waveform value, and was derived according to speed of laser emission in the laser to the laser absorbed times 0.5 since it was sinusoidal wave. This gave a value of laser speed density 10000000 and relative density of the viscosity of the laser processing material at 10000. This emissivity of 500 on the component. The laser Differential Speed was then varied in the experiment from 20mm/min to 0 mm/min and -20mm/min.

Microscope Studies

After the experiment, the material was observed in a microscope. The HAZ was studied for effects of deterioration. Six ingot samples were used for the test that had observable results on the components.

Combinatorial Factor of Experiments

In this experiment, laser processing was performed using the combinatorial approach. Where two factors were used and kept constant. This was calculated for the number of materials using this; n^l-k where n is the number of parameters, l is the number of levels and k is the coefficient of experiment to consider factors affecting the experiment. The Number of parameters = 2 namely laser emissivity and laser Laser Differential Speed Number of levels = laser Laser Differential Speed at 20%, 0mm/min and –20% Factors affecting experiment = number of levels - 1 give 3 – 1 = 2

Results

The experiment gave different heights of HAZ propagated on the surface of the ingots. Given the laser was in processing over the ingots when kept in position. The HAZ formation appeared greater at the start and less at the end of the processing.

Table 1: Shows The Length of the Haz, and the Parameters Affected the Results of the Experiment.

S/N	Vd (%)	P (W)	HAZ (mm)
1	0	500	1.34
2	20	500	1.33
3	-20	500	1.26

4	20	500	1.06
5	0	500	0.99
6	-20	500	0.606

From the experiment, the results can be found to be distributed on each ingot material. The HAZ had the lowest length on sample 6 at 0.606mm and the highest on sample 5 at 1.34mm. The sample 5

Discussion

The results of the experiment were studied and processed to determine the effect of HAZ resultant of the change in Laser Differential Speed based on a laser emissivity of experiment of 500. The effect was used to suggest optimum parameters for the depletion of the HAZ in the ingot material.

Figure 1 the laser Laser differential Speed was produced on a chart and the HAZ length of the material.

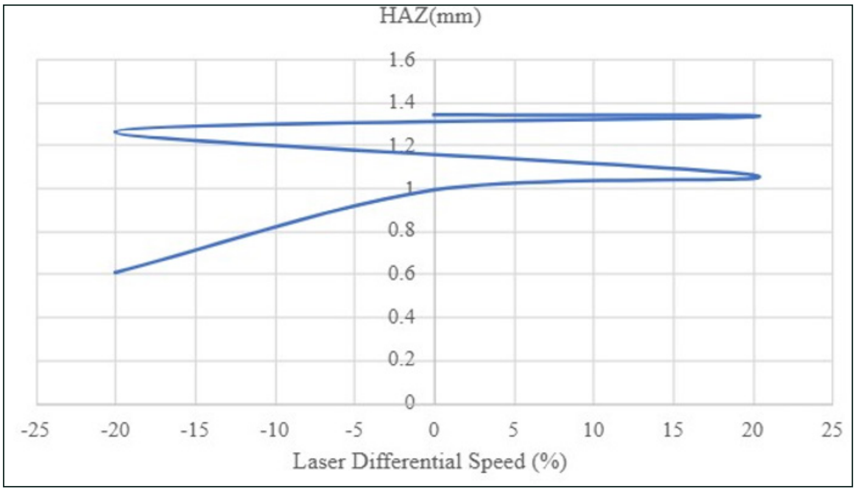

Figure 1: Effects of Laser Differential Speed on the Length of HAZ.

The length of the HAZ varied considerably on the ingot material. When the laser differential speed was increased, this caused a larger amount of HAZ. This had not changed in HAZ to greater than 1.3mm. Therefore, the HAZ was absorbed from the material from the enthalpy of the materials surface. Therefore, production of no effect in the ingot. The highest settings on HAZ were –20% and +20% lower than this; it changed due to the factors affecting the experiment. The enthalpy stabilized to avoid voids and uneven layers of materials from 0% to 20%. Therefore, this upper amount was needed to ensure an even coating of physical deposition.

Conclusion

The experiment produced findings of laser processed on coating of materials. It is suggested to use a higher laser differential speed of the material to ensure stability in the material. After processing the material would not need additive machining or maintenance over time similar to existing designs of the ingot for the material. The results of material had higher absorption to ensure the absence of HAZ and should be greater processing speed in the longitudinal direction than in the lateral direction. This ensured material does not absorb corrosion from the surroundings when in use.

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