EFFECT OF PARAMETERS ON MICRO SHAPE AND ORGANIZATION OF TIC/CO-BASED COATING ON H13 STEEL SURFACE PREPARED BY LASER CLADDING

Thi Hong Nga Pham[1], Van Thuc Nguyen[1,2*], Ngoc Thien Tran[1], and Truong Thinh Nguyen[1]

[1]Faculty of Mechanical Engineering, University of Technology and Education Ho Chi Minh City, Vietnam
[2]Department of Mechanical Engineering, National Kaohsiung University of Science and Technology, Kaohsiung 807, Taiwan

[*]Corresponding author: nguyenvanthuc1510@gmail.com

1. Introduction

In recent decades, Laser Cladding (LC) is seen as an advanced method in improving quality of material surface that is developed rapidly and has avantage in repairing and recovering the surface of large-size parts [1,2]. Melting alloy layer of metal platform is a rapidly developed technology in recent years that intends to enhance corrosion resistance of material. In which, Co-based self-fluxing alloy's coating can improve antioxidant ability and wear resistance of material, and adds simple carbides such as WC, B4C, SiC, Cr2C3, TiC… which have thermal endurance to Co alloy [3~7] can enhance mechanical properties effectively at high temperature.

2. Materials

H13 steel was selected for the experiment, with main components showed in Table 1, steel sample of 100mm x 30mm x 10mm. Before testing, sample's surface is cleaned by sandpaper, rinse with alcohol and acetone, and then dried by oven. Self-melting Co50 alloy powders have chemical components listed in Table 2, particle size ~ 53 μm; TiC powder with 99.5% purity and ~ 10 μm in particle size. The process is that test sample is coated by pre-placed powder layer which used homemade binder, then apply LC to melt it. Pre-placed powder layers include Co50 alloy powder layer and 20%TiC + Co50 composite powder layer (% by weight), with ~ 1 mm thickness. Those pre-placed powder layers on H13 steel surface are then dried by oven for 8 hours, before being melted away by LC.

Laser cladding Co50 coating and Co50 composite coating are made at Kunming University of Science and Technology (China) with LC on the type of GS-6000 TFL transverse-flow CO2 with the main parameters: the laser power 3.3 ~ 3.9 kW, scanning speed 350 ~ 400 mm / min, the distance from the laser head to the based steel surface 50 mm, flow of Ar protective coating 8 L / h.

Table 1 Chemical composition (% by weight) of H13 steel used in experiments

Element	C	Si	Mn	Cr	Mo	V	Fe
% by weight	0.43	1.17	0.48	4.79	1.38	0.94	bal.

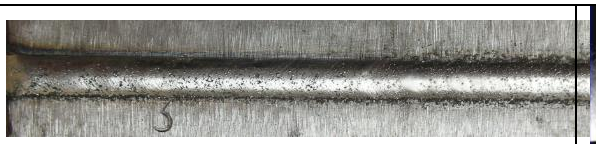
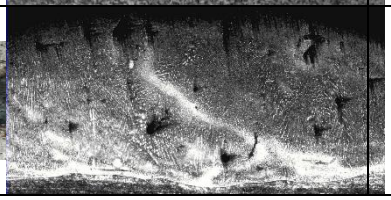
Table 2 Chemical composition (% by weight) of Co50 alloy powder used in the experiments

Element	C	W	Si	Cr	Mo	Fe	Co	Ni
% by weight	0.6	3.0	3.5	20.0	5.1	5.0	bal.	14.0

3. Results

Table 3. Surface morphology

Coating	Surface morphology	Macrograph of the coating from the transversecross-section	Laser power density P_w/ kW.s.cm^{-2}
A1			14.37
A2			12.57

A3			11.18
A4			10.06
B1			15.68
B2			13.72
B3			12.19
B4			10.97

4. Conclusions

Laser cladding Co50 alloy coating and Co50 composite coatings doped with 10, 20 and 30 wt. % TiC particles were prepared on the H13 steel surface. The effects of TiC content on phase composition, microstructure and micro-hardness of the coatings were studied. The results indicated that, TiC/Co composite coatings with the content of TiC less than 20% showed good metallurgical bonding characteristics with the substrate surface. Co-based with 20%TiC composite coating exhibits good comprehensive properties, fully meet the requirements of production.

References

[1] Candel J J, Amigó V, Ramos J A, et al.. Sliding wear resistance of TiCp reinforced titanium composite coating produced by laser cladding. *Surface and Coatings Technology*, 2010, 204(20): 3161-3166.

[2] Chen J Y, Conlon K, Xue L, et al.. Experimental study of residual stresses in laser clad AISI P20 tool steel on pre-hardened wrought P20 substrate. *Materials Science and Engineering*, 2010, 527(27-28): 7265-7273.

[3] Grum J, Slabe J M. A comparison of tool-repair methods using CO2 laser surfacing and arc surfacing. *Applied Surface Science*, 2003, 208-209: 424-431.

[4] Hardro J P. Development of materials for the rapid manufacture of die cast tooling. *United States - Newport: Graduate University of Rhode Island*, 2001.

[5] Zhao Y M, Wang J L, Mou J W. Microstructures and properties of Co-based alloy coatings prepared on surface of H13 steel. *China Welding*, 2010, 19(3): 41-44.