328 Nd-YAG Laser Cladding of Chrome Carbide Cermets

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INTRODUCTION

In the recent past years the developments in the surface modifications against erosion / corrosion have undertaken new dynamic turn in the laser cladding of hard materials [1]-[2]. The unrelenting demand of low erosion, high wear resistance and increased hardness with low thermal effects have forced the manufacturers to adopt / develop innovative techniques which could meet this demand. This led to the selective use of cladding of composite powder materials by laser technology. Usually the laser cladding process produces efficient coating with upto a maximum of 50% hard metal carbide content, whereas coating containing greater content of metal carbide are produced by liquid phase sintering [2]. In this case the hard metal carbide gets dissolved in the molten liquid metal acting as a binder thus producing the desired structure. In this paper based upon this techniques we demonstrate the feasibility of direct generation of hard coating of composite materials by using the Nd-YAG laser.

CLADDING PROCEDURE

In this process, a molten pool of the pasted or blown powder with a complex three dimensional shape is formed on the substrate, by the laser beam interaction with the powder material. The basic principle could be compared to a process of layered coating. In this case the powder material such as cermet i.e. hard metal carbide (Cr_3C_2) with other alloying element (NiCr) is delivered into the laser beam, thereby it get melted and deposited onto the substrate. Usually this process is accomplished by locally melting the substrate or the alloying element with the laser beam while simultaneously adding the cermet powder. The coating can be achieved through layer by layer scanning in the horizontal direction.

EXPERIMENTAL RESULTS AND DISCUSSION

The laser cladding experiments were performed with a pulsed Nd-YAG laser provided with the beam bending optics etc. The beam was focussed by a lens of focal length f=80mm. For the laser cladding of chrome carbide cermets with an average grain size of about 30um, two cases i.e. [Cr_3C_2(70%)-NiCr(30%)] and [Cr_3C_2(50%)-NiCr(50%)] were investigated. The powder with a premixed ratio was fed by a powder feeder and laser cladded onto the mild-steel, SU304 and Cr-Ni substrates. The results are summarized as below:

For the microscopical observations, various samples were cut, polished and finally etched in a 5% nital solution. The microstructures were examined using the optical microscope. The microhardness measurement were done using a Matsuzawa microhardness tester. The results [Fig.1A/B] indicate that, the cladded surface appears to be good but contains several cracks due to

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the thermal stresses generated by the different alloying element during the solidification process. Its further critical evalution yields that, clad surface with higher metal carbide contents exhibits large number of cracks but with increased microhardness value [Fig.1A-c]. On the otherhand the cladding with low value of the metal carbide contents indicate reduced cracks but considerably lower microhardness value [Fig.1B-c]. In the latter case the hard metal carbide seems to be get dissolved in the melt.

CONCLUSION

In conclusion, our results indicate that the laser cladding of chrome carbide cermet with 70% of metal carbide content exhibits more cracks and higher hardness compared to the 50% of metal carbide contents with less cracks but reduced hardness.

REFERENCES

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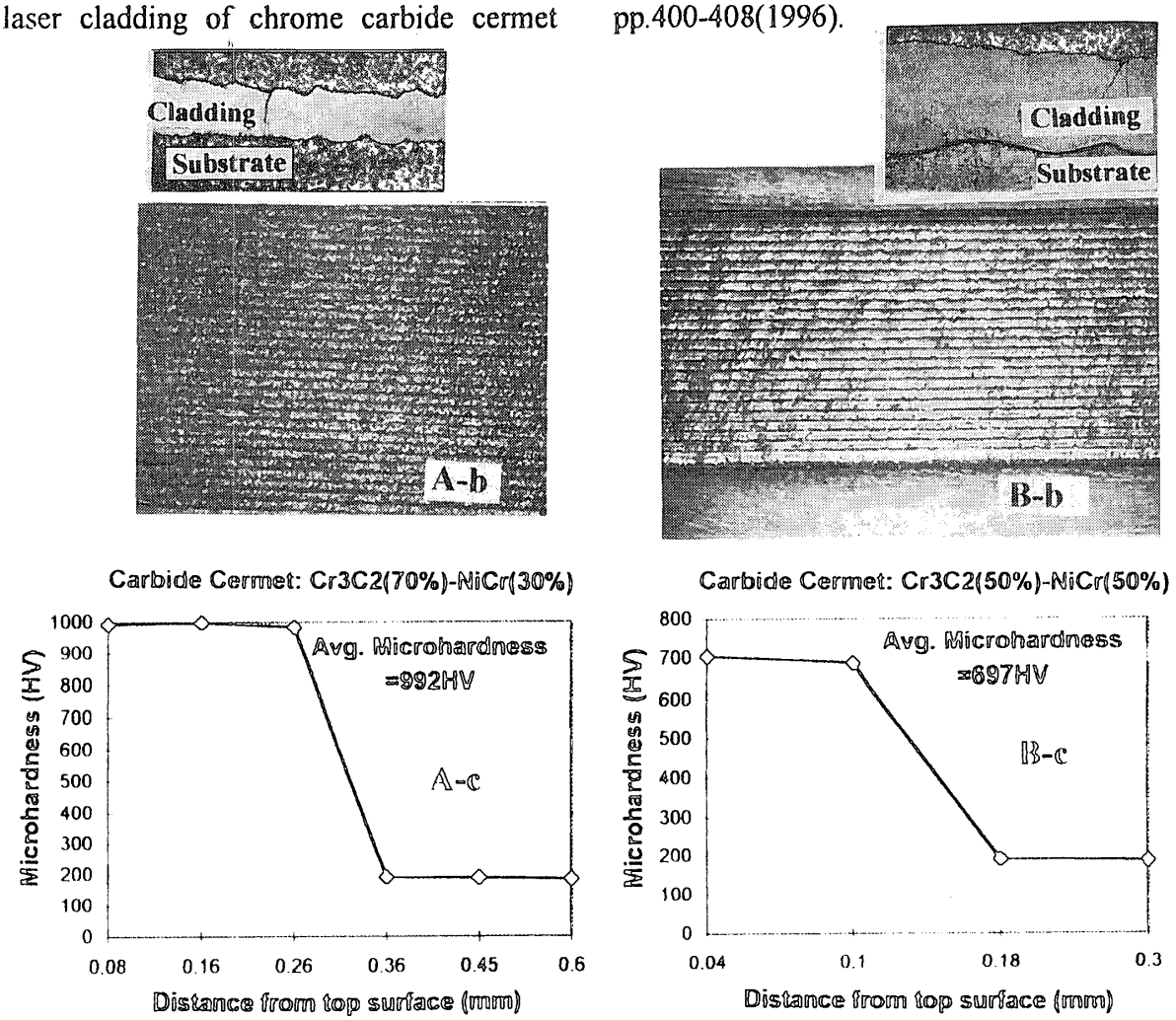

Fig.1 Bead appearance and microhardness profiles in (HV) for load=500gf of laser cladded sample with pulsed Nd-YAG laser. Base:SUS304;Cladding:Cr3C2/NiCr [A]:Pavg. = 200W; pulse width=10msec.; proc. speed=0.3 m/m;PRR=40Hz [B]:Pavg.=50W;pulse width= 4msec.; proc.speed(V)=0.1m/m; PRR=50Hz.