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THERMAL SHOCK BEHAVIOR OF THE COATS DEPOSITED BY PLASMA SPRAYING OF THE Al_2O_3

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ABSTRACT

For the coats made by using the Al_2O_3 powder (type Metco 101) on a martesitic stainless steel substrate, the thermal shock testing conditions consist in: fast heating to 800℃ (or 500℃) (10s) and water cooling without maintaining to maximum temperature.

After 22 cycles to a maximum temperature of 800℃ we noticed the appearance of a pattern fine cracks, which is developed along the next 20 cycles but with no scorching.

For a maximum temperature of the 500℃ of the thermal shock, after 205 cycles we not observed the appearance of the scorches on the coats surface.

KEYWORDS

Thermal shock, Al_2O_3 coatings, plasma deposition

1. INTRODUCTION

Compared to other coating methods, plasma spraying is unique in that the high temperatures (~ 10.000 K) and specific energy densities achieved in thermal gas plasmas enable the melting of any material which has a stable molten phase. Plasma spraying of materials such as ceramics and non-metallic, which have high melting points, has there fore become well established as a commercial process. Such coatings are increasingly used in aerospace, automobile, textile, medical, printing and electrical industries to impart proprieties such as corrosion resistance, thermal resistance, wear resistance, etc [1,2].

This paper describes the results of tests conducted to determine the thermal shock behavior of the coats deposited by plasma spraying of the Al_2O_3.

2. EXPERIMENTAL PART

2.1. Experimental conditions at the Al_2O_3 coatings spraying in plasma

The substrate is the martensitic stainless steel Z12CNDV12.

The powder used is Metco 101, with 97% Al_2O_3 and 2% TiO_2 and particle size between 30 and 75 μm.

The coatings have been made using a plasma generator GPPR-400 equipment. There have been working using the following parameters:

- intensity of the current at the generator: 500 A;
- voltage: 70 V;
- spraying distance: 50 mm;
- plasma gas flow: 36,6 l/h;
- coating thickness: 0,3 mm.

2.2. Thermal shock testing

For the coats made by using Metco 101 powder on a martensitic stainless steel substrate, the thermal shock testing consist in: fast heating to 800°C or 500°C (10 s) and water cooling (600°C/s) without maintaining to maximum temperature.

3. RESULTS AND DISCUSION

Some results of the experimental determination are shown in table1.

Table 1. Results of the thermal shock determination

Cod sample	The number of thermal cycles	The maximum temperature cycle [°C]	Cooling medium	Observation
19	50	800	water	The appearance of scorches
21	62	800	water	The appearance of scorches
29	65	800	water	The appearance of scorches
Medium		59		
35	205	500	water	No cracks, No scorches

Figure 1 shows some images for the the coats made using Metco 101 powder, in a different moments of the determination.

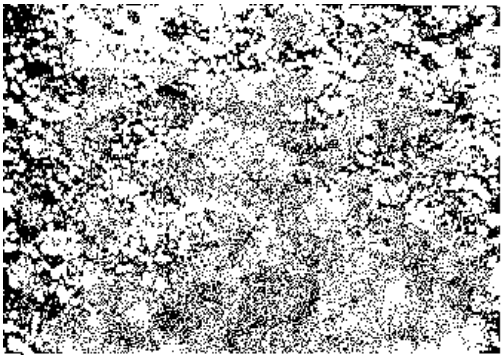
After 22 cycles to a maximum temperature of 800°C, we noticed the appearance of the pattern fine cracks, which is developed along the next 20 cycles but with no scorching.

For a maximum temperature of the thermal shock of 500°C, after 205 cycles we not observed the scorches appearance on the coats surface.

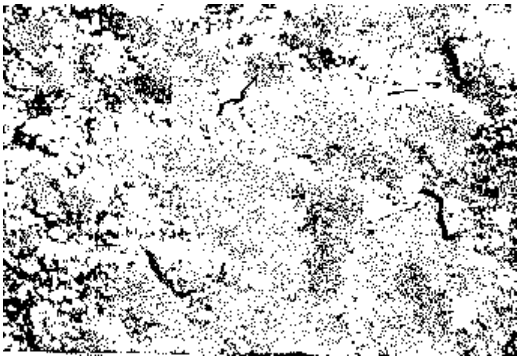
4. CONCLUSIONS

- for a maximum temperature of the thermal shock of 800°C, after 22 cycles, it is observed the appearance of a fine cracks;
- along the next 20 cycles to a maximum temperature of the thermal shock of 800°C, a pattern fine cracks is developed but with no scorching;
- after 205 cycles for a maximum temperature of the thermal shock of 500°C, we not observed the scorches appearance on the coats surface;
- the coats deposited by plasma spraying of the Metco 101 showed a good thermal shock resistance.

Figure 1. Images for the coats made by using the Metco 101 powder at the thermal shock

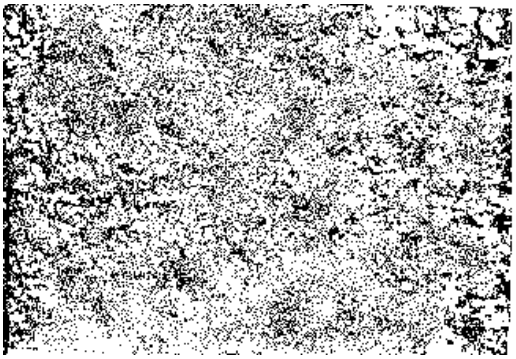


Sample 21, 70x, Initial state

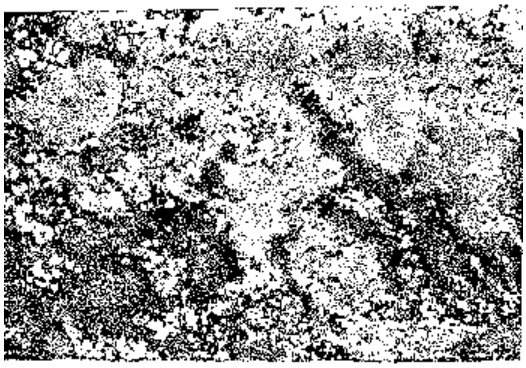


Sample 21, 70x, 800^{0}C/water/ 22 cycles.

Sample 21,70x, 800^{0}C/ water/ 66 cycles

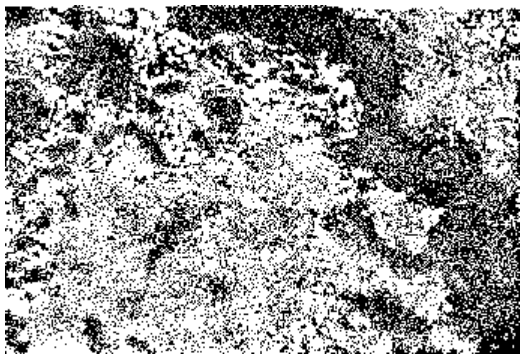


Sample 29, 70x, initial state



Sample 29,70x , 800^{0}C/water/ 22 cycles Crack

Sample 29, 70x, 800^{0}C/water/44 cycles Cracks



Sample 29, 70x, 800^{0}C/water/ 44 cycles cycles Cracks

Sample 35, 70x, 500^{0}C/ water/ 104 Means cracks

Sample 29,70x,800°C/water/44 cycles Cracks

Sample 35, 70x, 500°C/water/182 cicluri Network fine cracks

5. REFERENCES

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