Tribological study of Ni-Cr-5Al_2O_3 thermal spray coating: A comparison of different post processing techniques

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We utilized different post-processing techniques comprising of vacuum annealing, microwave-sintering and thermo-mechanical processing to homogenize the microstructure of high-velocity oxy-flame (HVOF) Ni-Cr-5Al_2O_3 coatings. Non-homogeneous microstructure including splats and elemental segregation leads to their premature failure. Post-processing of HVOF coatings is utilized to remove structural non-homogeneities. Vacuum annealing and microwave-sintering minimized elemental segregation with partial removal of splat boundaries. In contrast, thermal and strain-fields during thermo-mechanical processing resulted in significant microstructural refinement with complete elemental homogenization. All processed coatings showed improvement in degradation resistance compared to as-sprayed coatings. Thermo-mechanical processed coating showed highest resistance both in erosion as well as erosion-corrosion.

Key words: Thermal-spray coatings; post-processing; vacuum annealing; microwave sintering, thermo-mechanical processing.

Introduction

Thermal spray coatings are widely considered for addressing erosion-corrosion problems in structural components in marine environments [1]. The degradation resistance of coatings was evaluated using slurry erosion, corrosion and erosion-corrosion studies in 3.5 wt.% NaCl solution.

Experimental details

Ni-Cr-5Al_2O_3 thermal spray coatings were developed using high velocity oxy flame spray technique on SS316 substrate.

Table 1:
Thermo mechanical processing parameters

Parameters	Value
Rotational Speed (RPM)	388
Feed rate (mm/min)	20
Depth of cut (mm)	0.25

Table 2:
Slurry erosion and erosion-corrosion test parameters

Parameters	Value
Impact Angle (degree)	30, 90
Sand particle concentration (ppm)	5000
Constant velocity (m/s)	20
Sand particle size (µm)	75-150
Test duration (hr)	2

Results and discussion

The elemental segregation was minimized along with partial removal of the splat boundaries through vacuum annealing and microwave sintering. Erosion rate of stationary friction processed sample is comparatively 1.5-4 times lower than that of the annealed samples and 3-5 times lower than as sprayed sample in both slurry erosion and erosion corrosion. Thermo-mechanical processed coating exhibited maximum resistance both in erosion as well as erosion-corrosion which is attributed to its higher strength as well as superior corrosion resistance.

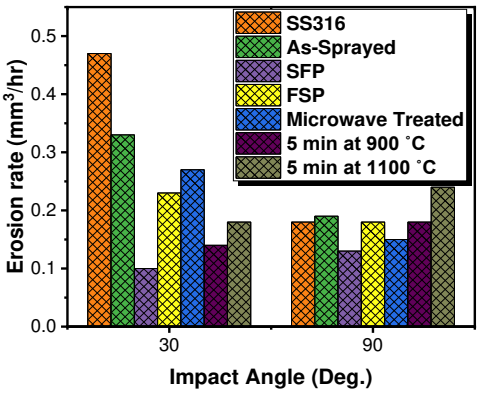

Figure 1**:** Erosion rate as a function of impingement angle

References

[1] R. Bhagat, Deposition of Nickel–Aluminum Bronze Powder byCold Gas-Dynamic Spray Method on 2618 Al for DevelopingWear Resistant Coating, in Proceedings of 1st UTSC, 1997,(1997)