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Post Test Analysis of Inconel-625 (HVOF) Coating Using SEM and EDS after Exposure to Erosion-Corrosion Test

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In many industrial applications including oil and gas production petrochemical fields, the behaviour of a material surfaces is of major importance. The appropriate selection of bulk materials and coating of equipment components is an important factor for the economic success of these industries. Moreover, the need to minimize cost and enhance reliability of rotating and stationary fluid machinery equipment that are subjected to highly erosive and corrosive environment is mandatory. In many cases the surfaces are exposed to more than deterioration mechanism such as wear and corrosion at the same time, where the probability of material failure is increased [1].

Thermal spraying, of which high velocity oxygen fuel (HVOF) is considered, is one of the most useful techniques available in producing coatings which protects machinery components against wear and corrosion. Presently, thermal spray coating is becoming a part of each industrial technology such as marine, medical, petroleum, steel, textile and printing [2]. Materials, either in powder or wire form, are melted and propelled onto a metallic substrate surface to form a coating. Regardless of the type of spray equipment and coating material, thermal spraying projects molten or semi-molten particles onto the substrate material. As the particles impact the surface, they are flattened and form thin splats or lamellae. The splats adhere to the substrate and to each other. The flattened particles then build up and form the coating [3].

The present study describes the microscopy and microanalysis characterization of Inconel-625 powder thermally sprayed by HVOF coating process after exposure to sever erosion-corrosion tests. The post test analysis is performed using Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS). The SEM investigations and X-ray linescan of the specimen surfaces showed that the metal removal was concentrated around the non-melted or semi-molten particles in the coating and the dark areas in the bright Ni-rich matrix of the coating is mainly Cr-Nb oxide inclusions (Figure 1). This was also shown in the EDS analysis where the peak of Cr_2O_3 was highest in the dark inclusions regions (Figure 2). EDS analysis of the deposited coating also showed that the amount of oxygen available in the coating varied across the coating thickness. The amount of Oxygen in the interior and edge of the coating appear to be lower than the center of the coating. This is might be due to the slow cooling rate in the center of the coating compared to the interior and edge. Also, presence of Al_2O_3 and Si_2O_3 in the interface is due to surface preparation (Figure 3).

References
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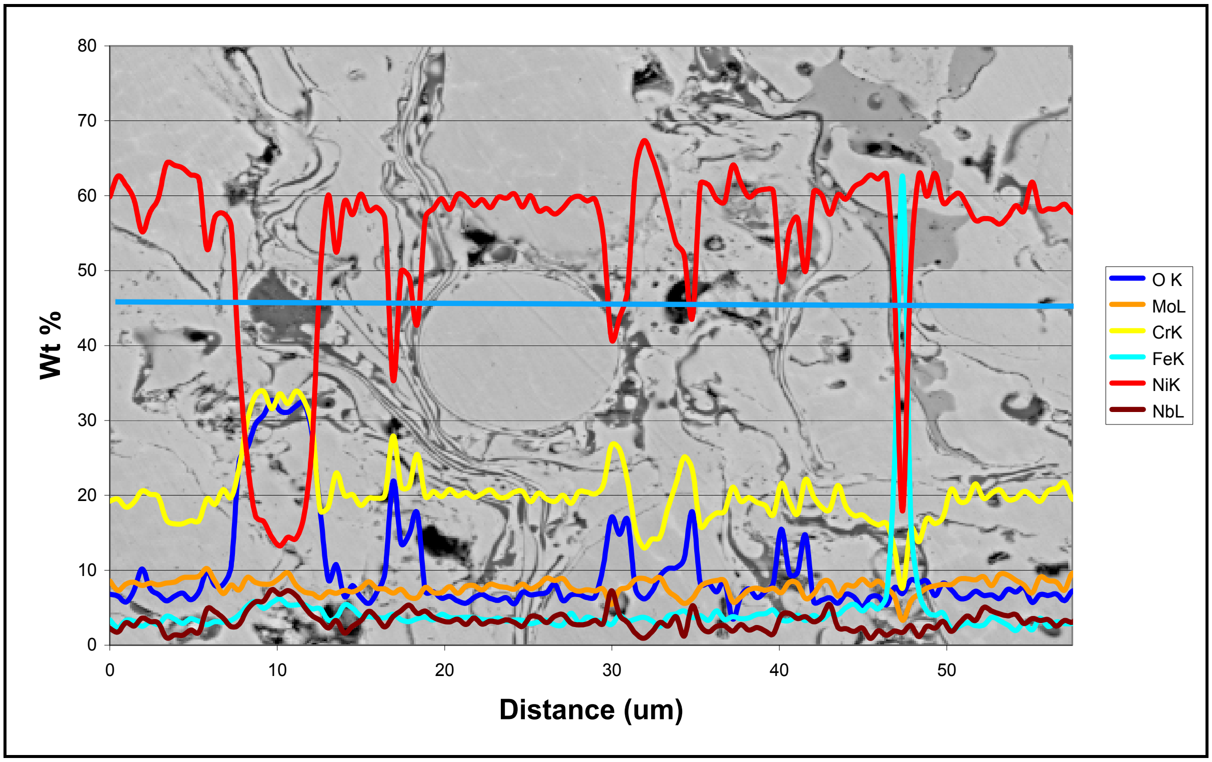

FIG. 1. X-ray linescan of the coating cross section at 2000X Magnification. Bottom: Backscattered electron image. Top: Line scan showing elemental composition of various phases across 60µm width of the coating.

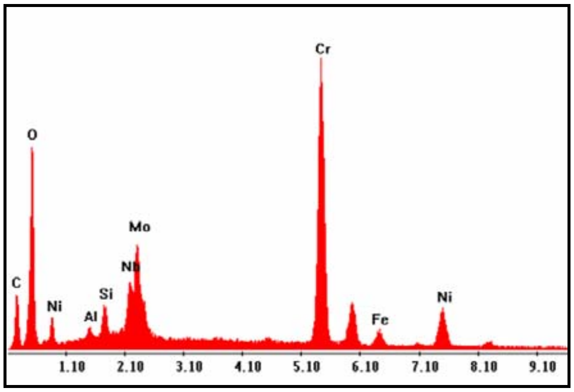

FIG. 2. EDS X-ray Spectrum of dark inclusions

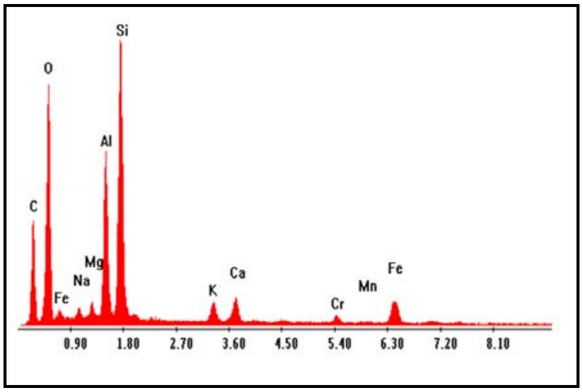

FIG. 3. EDS X-ray Spectrum of interface