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Investigation of hot corrosion resistance of bare and Ni-20%Cr coated superalloy 825 to Na₂SO₄-60%V₂O₅ environment at 900°C

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Abstract

The present study aims to compare the hot corrosion resistance of bare and Ni-20%Cr coated Ni-Fe based superalloy 825 in Na₂SO₄-60%V₂O₅ molten salt environment at 900°C. Superalloy 825 was thermal spray coated with Ni-20%Cr by high-velocity oxy-fuel (HVOF) coating process. During hot corrosion study, weight measurement was done at the end of each cycle to obtain the corrosion kinetics by thermogravimetric technique. Surface morphology study, surface chemical analysis and phase identification of the corrosion products were carried out using scanning electron microscope, energy dispersive spectroscopy and X-ray diffraction. Cross-sectional analysis was performed on the hot corroded specimens to determine oxide layer thickness and depth of corrosion attack. Elemental distributions on the cross-sectioned hot corroded specimens were studied using X-ray mapping analysis. The Ni-20%Cr coated specimen showed better corrosion resistance than the bare specimen. Spallation and cracking of scale was observed on the uncoated specimen with progress of corrosion reaction.

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Keywords: Ni-based superalloy 825; Thermal spray coating, Hot corrosion, Thermogravimetric analysis.

1. Introduction

Alloy 825 is a titanium stabilized nickel-iron based superalloy. It is a candidate material for a wide spectrum of applications; superheaters in waste heat incinerators, nuclear power plants, chemical plant and equipment, nuclear fuel processing, petrochemicals, oil and gas. The alloy has superior resistance to stress corrosion cracking and

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pitting and crevice corrosions (Arivarasu et al. (2017); Aytekin et al. (2013) and Pan et al. (2000)). Hot corrosion is a severe problem in high-temperature applications such as boilers, superheaters, gas turbines, marine engines, and waste incinerators. Na_2SO_4 , V_2O_5 , K_2SO_4 , KCl and NaCl salts play an important role in high-temperature corrosion. The materials are subjected to hot corrosion at elevated temperature due to the presence of deposits of the salts on the components. At elevated temperatures, the material gets oxidized to form an oxide layer on the surface. Salts which are in the molten state come in contact with surface of the specimen through the pores and cracks in the oxide layer. Reaction of the salts with the oxide scale leads to spalling of scales. Consequently superalloys require a coating to protect them from molten salt corrosion at high temperatures (Sidhu et al. (2005) and Singh et al. (2007)). Nowadays, various thermal spray coating processes such as plasma, flame spray, detonation gun, cold spray, and high-velocity oxy-fuel (HVOF) are used to protect the superalloy materials from high-temperature oxidation and corrosion. HVOF coating process possesses low porosity, compactness, good bonding strength, higher hardness, wear, and corrosion resistance. Metallic powders Ni-20%Cr, NiCrBSi, cermet coating Cr_3C_2 -25%NiCr and satellite coating are used for oxidation and hot corrosion resistance applications (Reddy et al. (2018); Singh et al. (2006); Sidhu et al. (2006); Zhang et al. (2002)).

Lopez et al. (2014) evaluated the hot corrosion behavior on low alloy ferritic steel with and without Ni-50%Cr HVOF coating in (CO_2 + air) environment at 550 and 600°C. The authors reported that coated steel shows better corrosion resistance than uncoated one. The uncoated sample suffered severe corrosion in (CO_2 + air) environment. In contrast no corrosion was observed in the coated sample due to the formation of the Cr_2O_3 layer. Niraj Bala et al. (2010) deposited Ni-50%Cr coating on the boiler grade steels using cold spray technique. Coated samples showed excellent performance in Na_2SO_4 -60% V_2O_5 environment at test temperature of 900°C. The formation of NiO and Cr_2O_3 oxide scales resulted in protection of the substrate material from the molten salt environment. Chatha et al. (2012) investigated the hot corrosion performance on uncoated, and Ni-20%Cr and Cr_3C_2 -25%NiCr HVOF coated T91 boiler steel in Na_2SO_4 -60% V_2O_5 molten salt environment at 750°C. Ni-20%Cr coating provided better corrosion resistance than Cr_3C_2 -25%NiCr coating and uncoated steel due to the formation of stable Cr_2O_3 oxide layer.

Studies on hot corrosion behavior of the uncoated and thermal spray coated superalloy 825 are not available in the published literature. This was the driving force for the present study. In this work, cyclic hot corrosion resistance of uncoated and Ni-20%Cr coated superalloy 825 is studied in the Na_2SO_4 -60% V_2O_5 salt environment at 900°C for 50 cycles. Using thermogravimetric studies, corrosion kinetics of the hot corroded specimen was established. Surface morphology, surface chemical analysis and phase identification of the corrosion products were characterized by scanning electron microscope/energy dispersive spectroscopy (SEM/EDS) and X-ray diffraction (XRD). Cross-sectional analysis was performed on the hot corroded specimen to evaluate the depth of corrosion attack and oxide scale thickness. Distribution of different corrosion products in the surface region was studied using the X-ray mapping technique.

2. Experimental procedure

2.1. Substrate Material

Ni-based superalloy 825 was used for the study. Specimens with dimension 20×10×5 mm were cut using wire electrical discharge machining (WEDM). The chemical composition of the superalloy 825 is given in Table.1

Table1. The chemical composition of Ni-based superalloy 825

Material	Ni	Fe	Cr	Mo	Cu	Ti	C	Mn	Al	Others
Inconel 825	38.15	29.8	22.27	3.93	2.37	0.71	0.036	0.47	0.13	Co-0.20, Nb-0.20, S-0.18, W-0.28

2.2. Coating

Thermal spray coating method (HVOF) was used to deposit Ni-20%Cr powder on the substrate material. The surface of the substrate material was prepared by emery paper polishing and grit blasting. This was followed by

acetone cleaning to remove the impurities and oxide layer from the substrate. The coating was performed at Spraymet Coating Industries, Bangalore. Ni-20%Cr powder with particle size 240 mesh with 64 μm was sprayed by HVOF technique with hydrogen gas as the fuel. Coating parameters are listed in Table. 2.

Table 2: Process parameters for the HVOF coating

Parameters	Values	Units
Oxygen pressure	11 -11.72	Bar
Oxygen flow rate	14-16	Lpm
Hydrogen pressure	8-9	Bar
Hydrogen flow rate	26-30	Lpm
Powder feed	80-100	g/min
Powder particle size	64	μm
Powder flow rate	7-15	Lpm
Spray distance	230	Mm

2.3. Hot corrosion study

The hot corrosion study was performed on the uncoated, and Ni-20%Cr coated superalloy 825 in Na_2SO_4 -60% V_2O_5 molten salt environment at 900°C. During the hot corrosion study weight of the specimen was monitored using an electronic weight balance which has accuracy 0.1 mg. The dimensions of the specimens were measured using a digital Vernier caliper to calculate the surface area. The cyclic hot corrosion study was performed for a total of 50 cycles; each cycle consists of 1h heating to 900°C followed by 20 minutes of cooling to room temperature. A eutectic salt mixture Na_2SO_4 -60% V_2O_5 is applied on the uncoated and coated specimen in the range of 3-5 mg/cm^2 coverage using wire camel brush. Samples were kept in an alumina boat with 99.99% purity and loaded are into the furnace for heating and cooling. During hot corrosion study, the weight change occurs due to cyclic heating and cooling process. The weight of the specimen with the boat was measured at the end of each cycle to determine the corrosion kinetics.

2.4. Characterization technique

The surface morphology, chemical composition of the surface and phase occurring on the corrosion products were studied by scanning electron microscope (SEM), energy dispersive spectroscopy (EDS) and X-ray diffraction (XRD). The corrosion kinetics was determined by thermogravimetric analysis. Cross-sectional study was performed on the hot corroded samples to determine the depth of attack, oxide layer thickness and chemical composition of the corrosion products using optical microscopy (OM) and SEM/EDS. The hot corroded samples were cross-sectioned by slow speed diamond saw cutter. The samples were prepared using emery papers of 220, 400, 600, 800 and 1200 grit sizes and alumina disc polishing.

3. Results

3.1 Visual examination

The macro images of hot corroded bare and Ni-20%Cr coated superalloy 825 samples exposed to Na_2SO_4 -60% V_2O_5 molten salt environment at 900°C are shown in Fig. 1.1 & 1.2. During hot corrosion study, color change and oxide scale spallation were observed in uncoated superalloy 825 specimens. After the 3rd cycle, white particles appeared on the top surface and scales started to spall. The color changed to brown at the end of the 8th cycle. More white particles were seen on the specimen at the end of the 15th cycle. Intensity of spalling increased with increase in the number of cycles. Extensive spalling occurred by the end of the 50th cycle.

In case of Ni-20%Cr coated specimen, after a few cycles the color of the specimen changed to dark brown; after the 30th cycle the color changed to grey. No spallation of scales was observed in the case of coated samples. This indicates that the coating provided good protection in the hot corrosion environment.

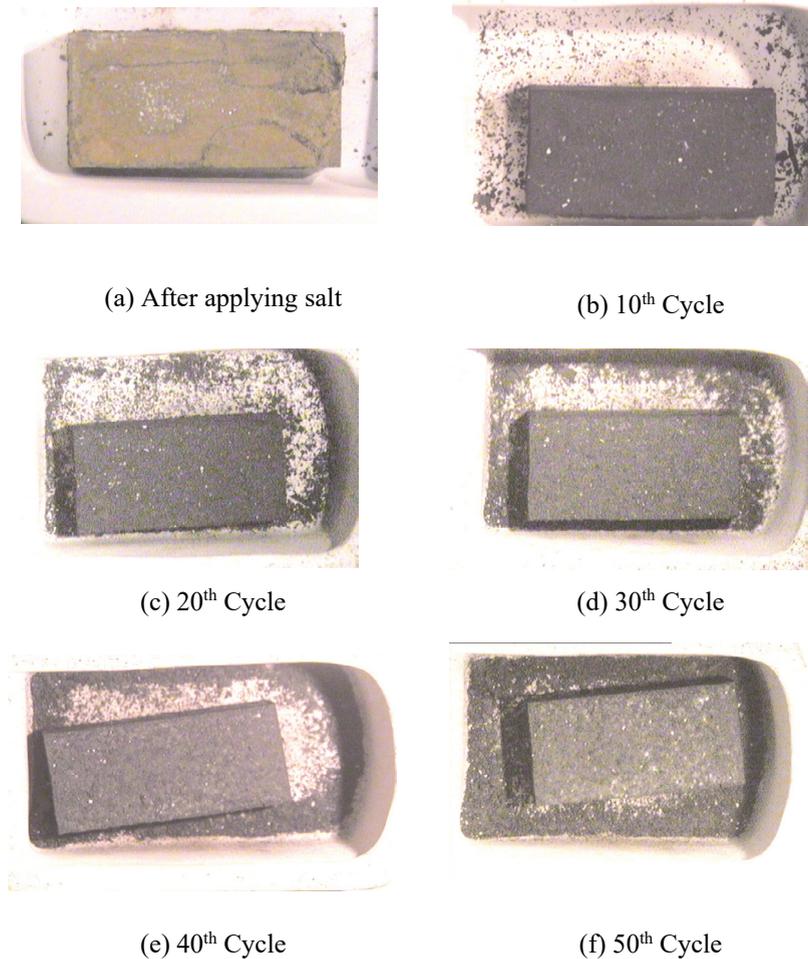


Fig. 1.1 Macro images of uncoated hot corroded superalloy 825 after exposed in molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C 50 cycles.

3.2 Thermogravimetric study

Figure. 2 shows the result of thermogravimetric study for the uncoated and coated superalloy 825 specimens. In the figure, weight gain per unit area was plotted against number of cycles. It is seen from the figure that the uncoated specimen had poor corrosion resistance. It showed a rapid weight gain upto the 24th cycle (about 7.197 mg/cm²). Thereafter, it was mostly a case of weight loss happening. The steep weight loss in the 30th and 35th cycles was due to the spallation and sputtering of oxide scales. A net weight gain of about 0.776 mg/cm² was observed in the uncoated sample at the end of 50th cycle.

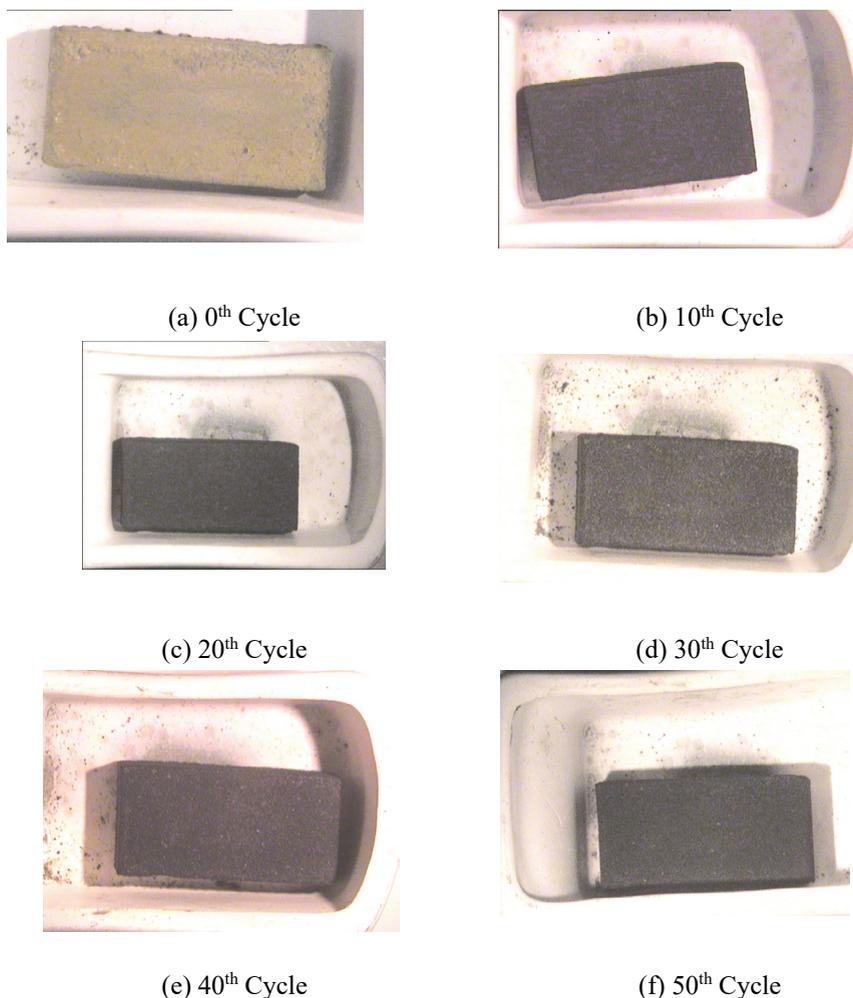


Fig. 1.2 Macro images of hot corroded Ni-Cr20% coated superalloy 825 after exposed in molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C 50 cycles.

The corrosion kinetics of superalloy 825 coated with Ni-20%Cr is shown in Fig. 3. Upto 3rd cycle relatively high weight gain was observed (about 0.0062 mg/cm^2). Thereafter weight gain occurred at a slow rate till the end of 50th cycle (about 3.134 mg/cm^2). Weight gain was due to the formation of the oxide layer. No spallation was observed in the coated specimen, as can be seen from the macro images in Fig. 1.2. The corrosion kinetics of Ni-20%Cr coated specimen followed a parabolic law; coated specimen showed less weight gain and better corrosion resistance than the uncoated one.

The uncoated specimen showed accelerated hot corrosion, as manifested by the steep weight gain during the first 24 cycles; thereafter weight loss was observed. The drop in the weight after the 24th cycle was due to the spalling and sputtering and falling away of the oxide scale from the boat. The spalling could be noted in the thermogravimetric chart during 31-35 and 36-39 cycles. Spalling is believed to be due to the excessive thermal stresses developed in the oxide scale as account of the difference in the coefficient of thermal expansion of the oxide and substrate.

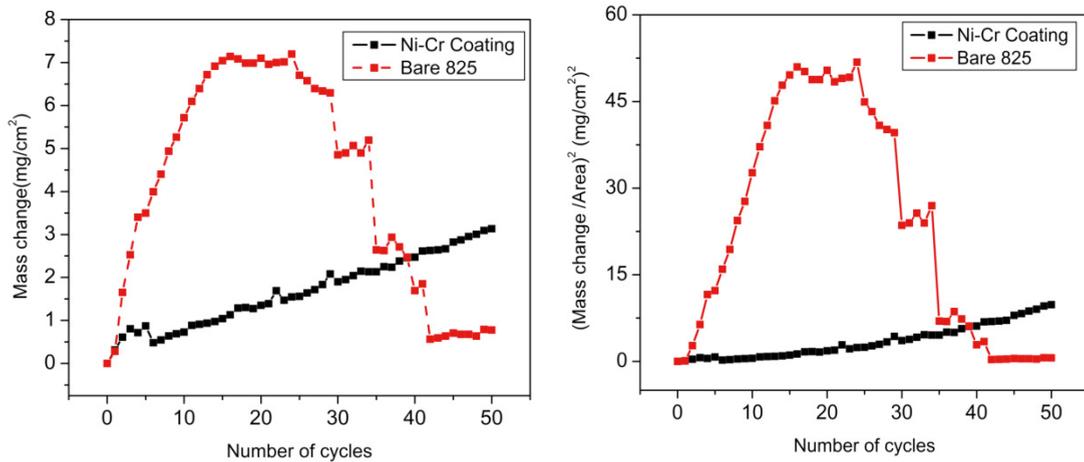


Fig 2: Thermogravimetric analysis of hot corroded bare and HVOF sprayed superalloy Inconel 825, (a) Weight gain/ Unit area vs. Number of cycles; (b) (Weight gain/Unit area)² vs. Number of cycles

Cumulative weight gain and parabolic rate constant values are listed in Table. 3. The corrosion kinetics of the uncoated and coated specimen is calculated using $(\Delta W/A)^2 = K_p \times t$

Where,

“K_p” represents parabolic rate constant,

“t” represents the number of cycles,

$\Delta W/A$ is a weight gain per unit area.

Table.3 Cumulative weight gain and Parabolic rate value of bare and HVOF sprayed super alloy after subjected to hot corrosion

S.No	Substrate	Cumulative weight gain per unit area (mg/cm ²)	K _p (10 ⁻⁹ g ² cm ⁻⁴ s ⁻¹)
1	Bare 825	7.197 (after 24 cycles)	14.38 (upto 24 th cycle)
2	Ni-20Cr coated 825	03.13 (after 50 cycles)	2.72 (upto 50 th cycle)

3.3 XRD Analysis

Figure. 3 shows the X-ray diffraction patterns of the uncoated and Ni-20%Cr coated Nickel based alloy 825 after exposure to the molten salt atmosphere at 900°C for 50 cycles. In the hot corroded bare superalloy 825, the corrosion products observed were NiO, Cr₂O₃, FeCr₂O₄, NiCr₂O₄, and Fe₂O₃. In the coated samples the major phases observed were NiO, Cr₂O₃ and NiCr₂O₄. An important observation is that Fe₂O₃ is not present at the surface of the coated samples; its present clearly noticed on uncoated samples.

3.4 SEM/EDS analysis

The surface morphology and compositional analysis of uncoated and coated superalloy 825 are depicted in Fig. 4 and Fig. 5 respectively. In bare superalloy fragile oxide scales and cracks are observed on the surface. The surface structure shows splat oxide scales when viewed at a higher magnification of 10,000X. The EDS analyses were performed on two different zones. Both regions show substantial at the presence of Ni, Cr, Fe, and O This indicates occurrence of oxides of nickel, chromium, and iron. In both regions Fe was high, due to the porous nature of Fe₂O₃ the corrosive species reach and react with substrate material, increasing the corrosion rate.

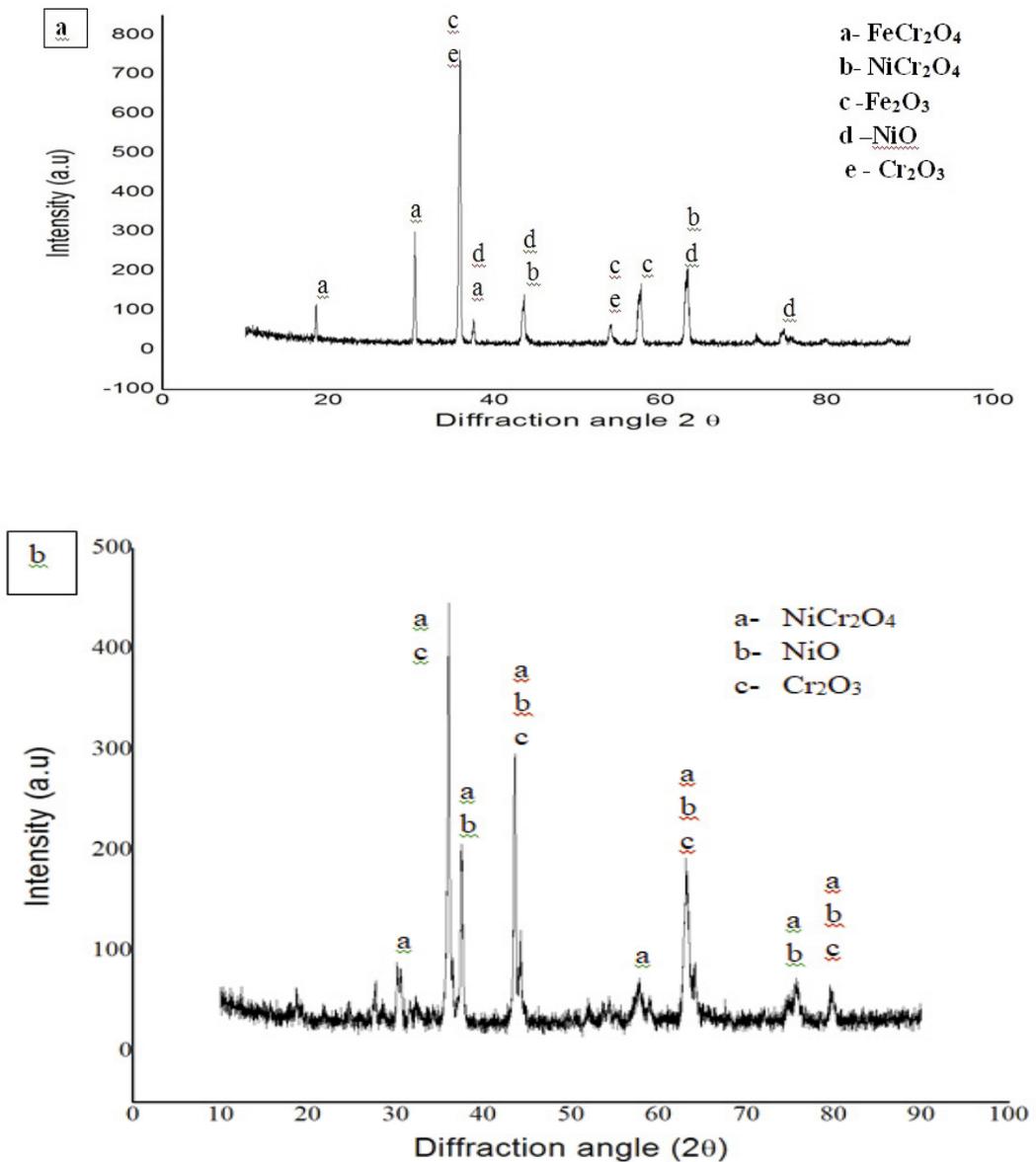


Fig 3: XRD analysis of hot corroded superalloy Inconel 825 after exposure to molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C . (a) Uncoated 825; (b) Ni-20%Cr Coated 825.

An irregular rough surface morphology was observed on the Ni-20%Cr coated superalloy after exposed with molten salt which is displayed in Fig. 5. The EDS analysis revealed that the surface of the coated superalloy is rich in Ni, Cr and O. This indicates the presence of NiO and Cr_2O_3 layers. Other corrosive elements such as Na and V are observed on the top scale. A minor amount of Fe was observed.

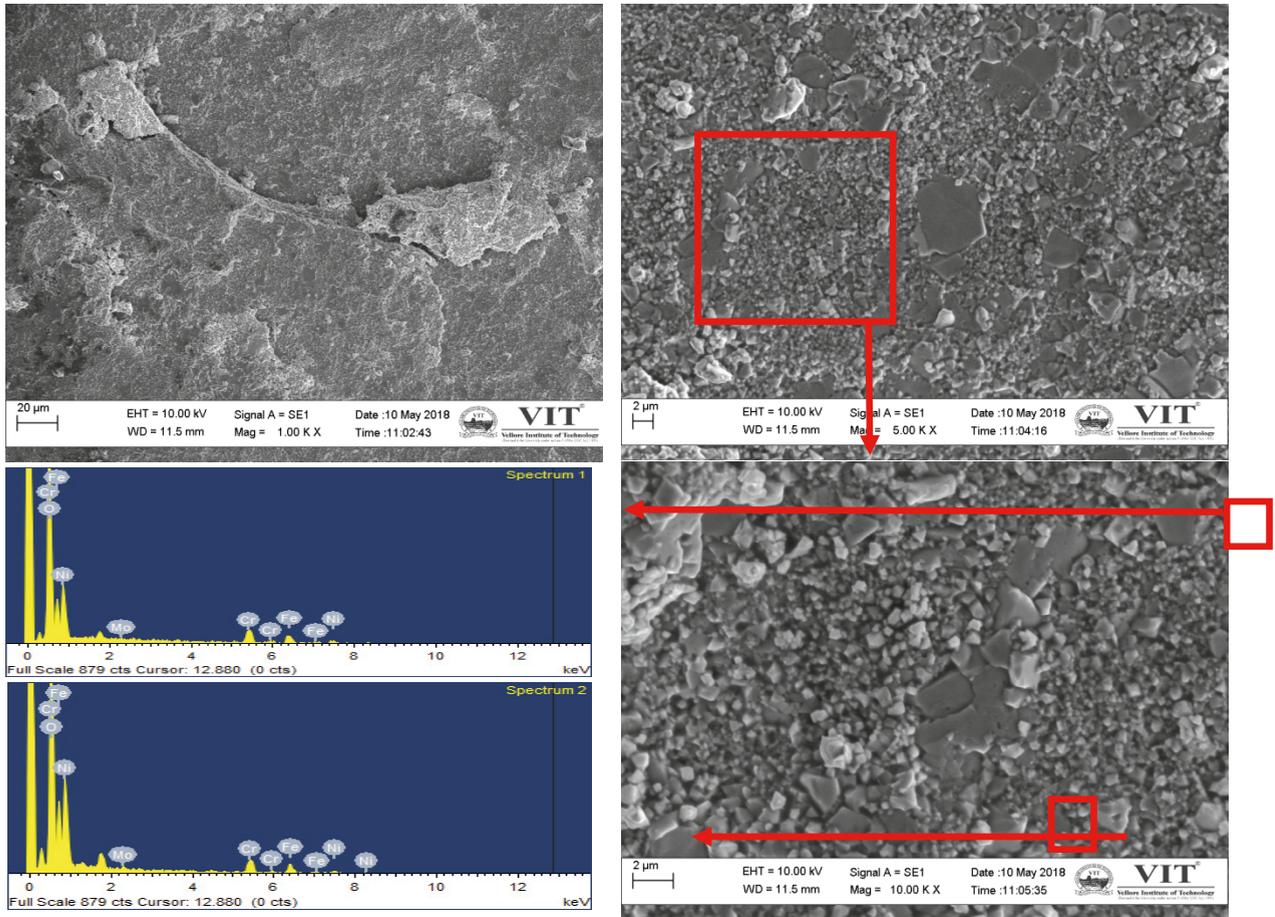


Fig 4: SEM/EDAX analysis of uncoated superalloy Inconel 825 after subjected to cyclic hot corrosion in molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C .

3.5 Cross-sectional analysis

The cross-sectional morphology of uncoated and coated hot corroded superalloy after exposing it to molten salt at 900°C for 50 cycles is shown in Fig. 6. The mirror polished hot corroded sample cross section was examined with an optical microscope to get information on the oxide scale thickness, presence of cracks, and depth of attack. The cross-section was also examined using SEM/EDS for elemental analysis. It was observed that oxide scales formed on the surface of the uncoated specimens were much thicker compared to those on HVOF coated specimen. The thickness of the oxide layer is measured on the uncoated and coated specimen was $63.09\mu\text{m}$ and $8.64\mu\text{m}$ respectively.

The EDS point analysis on the cross section of the hot corroded uncoated super alloy 825 is shown in Fig. 7. Ni, Fe, V, and O in a higher amount, and a small amount of Cr (5.76%) were observed in the top layer (point 1). This indicates the presence of substantial amounts of NiO and Fe_2O_3 . Vanadium (15.46%) is present in the top layer of the uncoated specimen which suggests that this element diffused into the oxide scale contributing to increased corrosion of the uncoated material. At points 2, 3 and 4, Ni, Cr and Fe were found to be rich. The amount of O decreased with increasing depth of analysis. A high level of V (13.27%) was observed at point 4. This indicates the diffusion of V from molten salt into the superalloy.

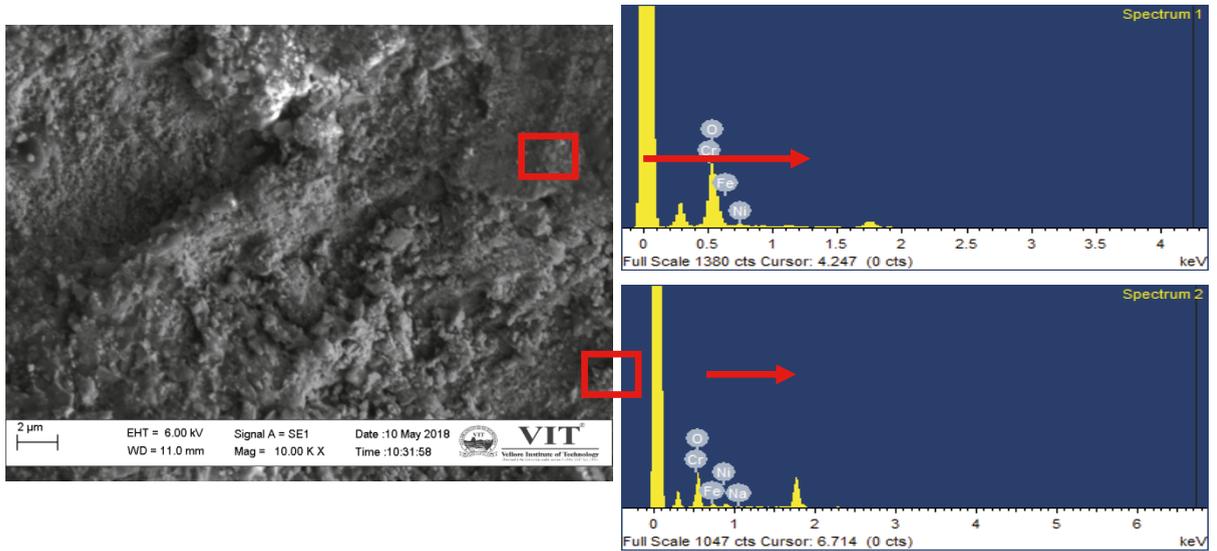


Fig 5: SEM/EDS analysis of superalloy Inconel 825 Ni-20%Cr coated after subjected to cyclic hot corrosion in molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C

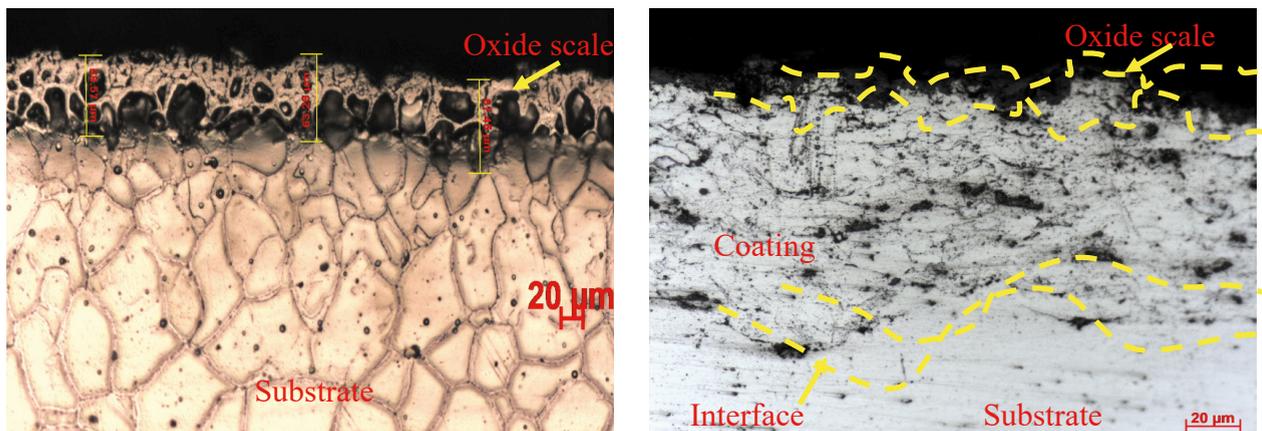


Fig. 6 Cross-sectional optical microscope image of Ni-based superalloy after exposed with Na_2SO_4 -60% V_2O_5 environment at 900°C for 50 cycles. (a) Bare 825; (b) Ni-20Cr Coated Superalloy

Cross-sectional EDS point analysis of the Ni-20%Cr coated superalloy after exposure to molten salt at 900°C is shown in Fig. 8. The top layer (point 1) contains a high percentage of O and Cr; some amount of Ni was observed. Small amounts of S (3.19%) and Na (0.81%) were present at point 1. At points 2 and 3 Ni was found to be above 75%, and Cr about 20%. The EDS analysis of point 4 is taken at the substrate near to the coating substrate interface; here a small percentage of O was observed. Corrosion products were not observed in the coating zone. Migration of Cr has occurred outward through the coating with the result Cr is as high as 38% close to the external surface. The fact that essentially Cr and O are present very close to the outside surface shows that it is essentially a chromium oxide layer at the surface of the corroded sample. Oxygen has not penetrated to locations 2, 3, as its level is essentially the same at points 2, 3 and 4.

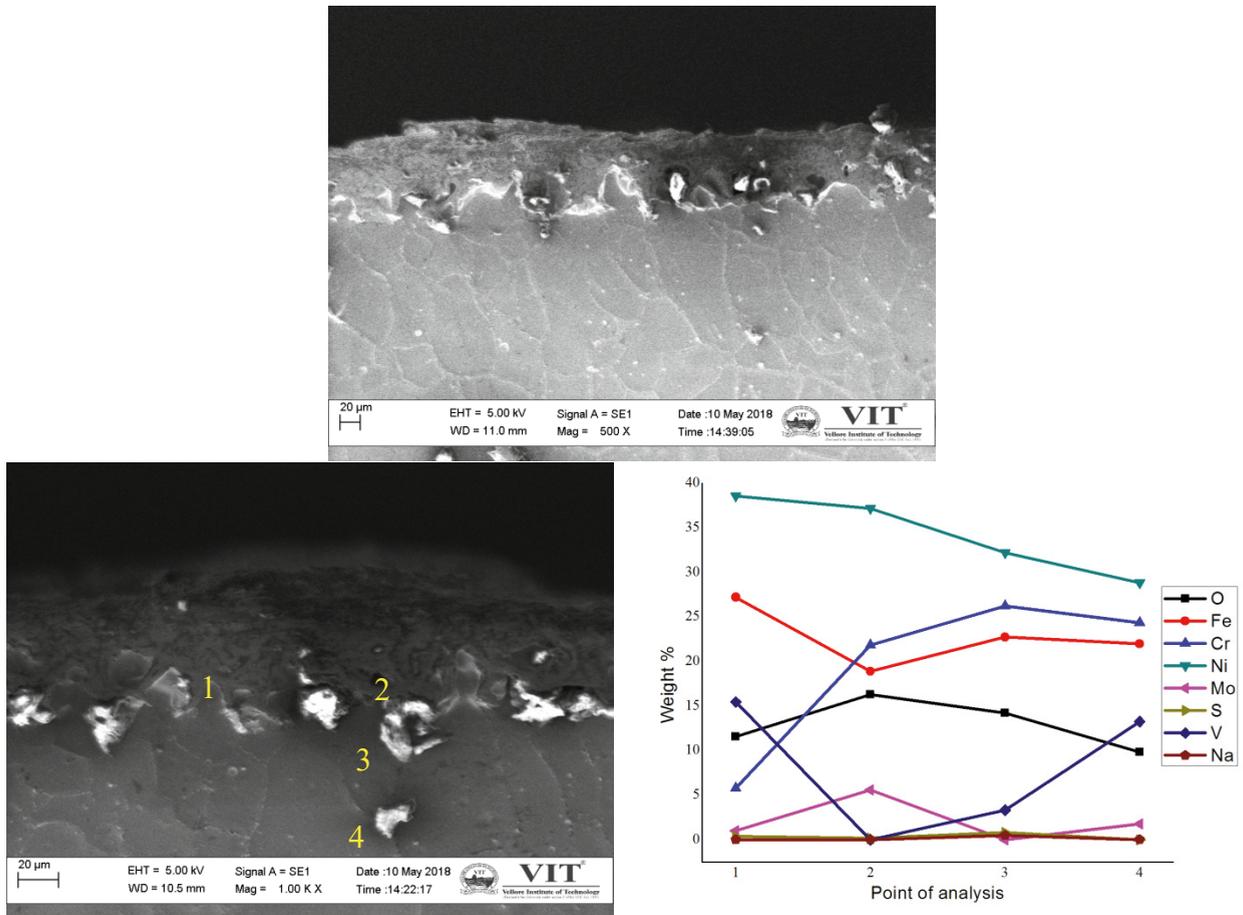


Fig. 7 Cross-sectional EDS point analysis of uncoated superalloy 825 after subjected to cyclic hot corrosion in molten salt of Na_2SO_4 -60% V_2O_5 environment at 900°C after 50 cycles.

3.6 X-ray mapping analysis

Elemental distribution of the alloying elements was found out using X-ray mapping analysis on cross section of hot corroded uncoated and coated superalloy samples after exposure to salt environment for 50 cycles. Fig. 9 shows the elemental map of the hot corroded bare superalloy. Alloying elements O, Ni, Cr, and Fe are distributed evenly on the cross-section. The corrosive elements such as V, Na and S were also observed. The distribution of V is high which increases the corrosion rate; promoting continuous oxide scale formation is formed on the uncoated specimen.

The BSE image of hot corroded Ni-20%Cr coated superalloy shows dense and adherent scale. Thin oxide scale is observed on the top surface of the coating. The elemental mapping of hot corroded HVOF sprayed superalloy specimen is shown in Fig. 10. It could be observed that vanadium is absent in the coated sample.

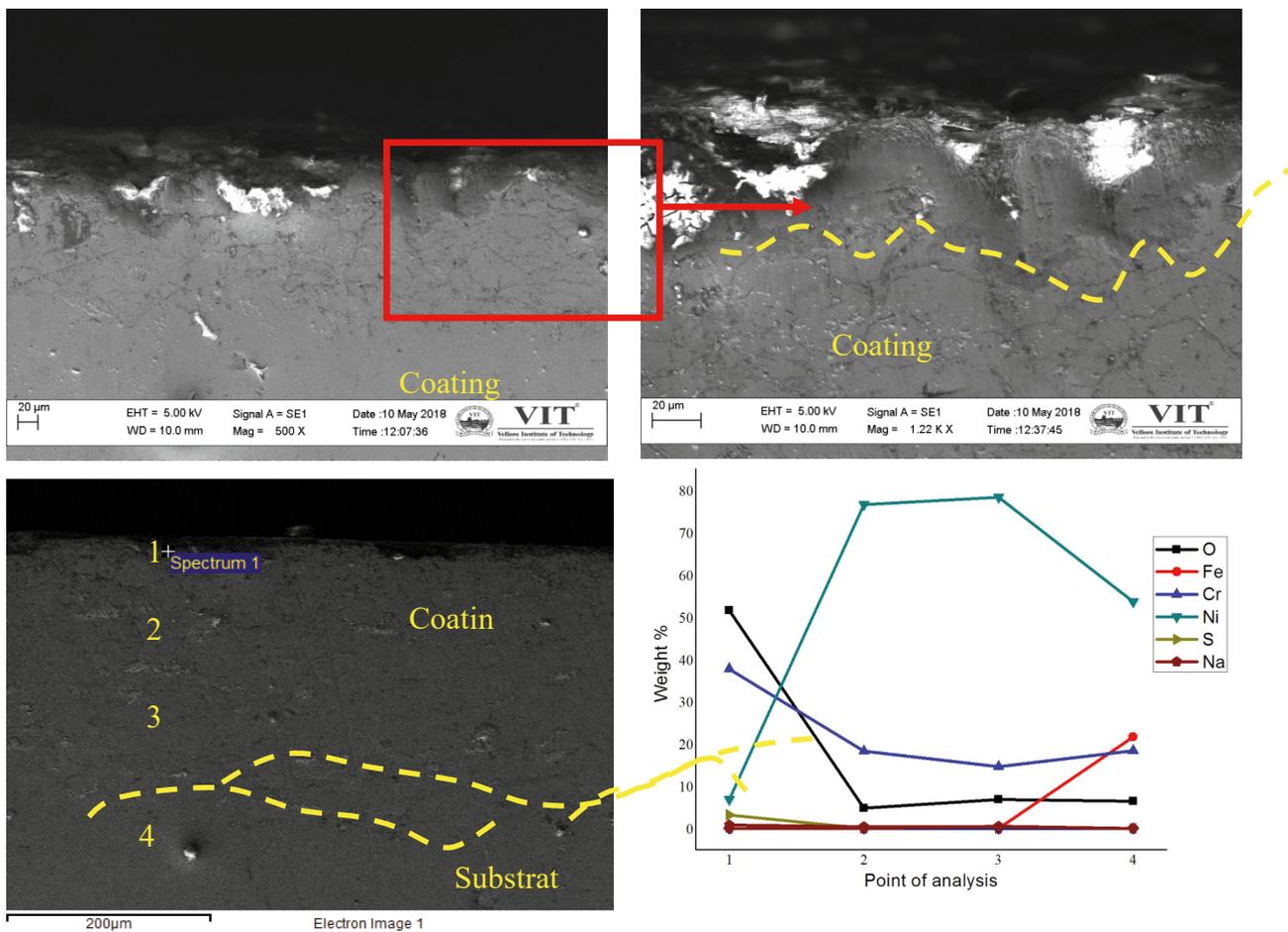


Fig.8 Cross sectional EDS point analysis of Ni-20%Cr coated superalloy 825 after subjected to cyclic hot corrosion in molten salt of Na₂SO₄-60% V₂O₅ environment at 900°C after 50 cycles.

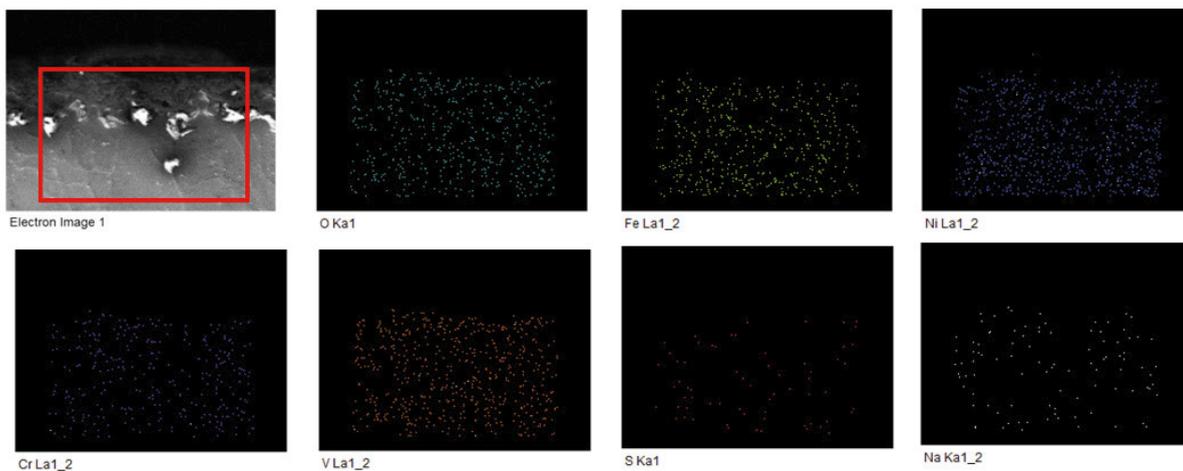


Fig 9: The X-ray mapping analysis of uncoated superalloy Inconel 825 after subjected hot corrosion in Na₂SO₄-60%V₂O₅ in 900°C after 50 cycles.

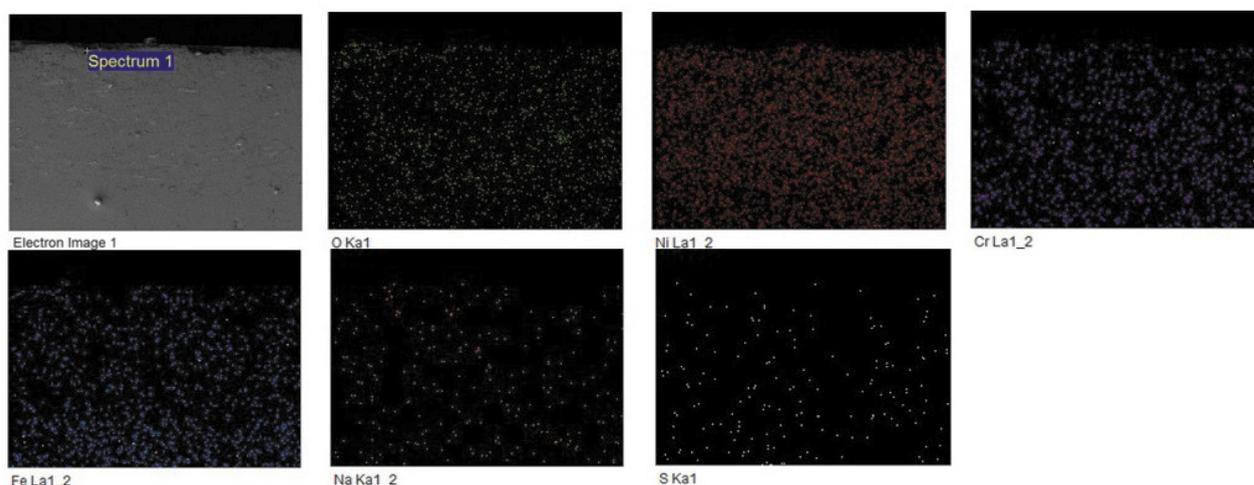


Fig10. X-ray mapping analysis of HVOF sprayed Ni-20Cr coated super alloy Inconel 825 after subjected hot corrosion in Na_2SO_4 -60% V_2O_5 in 900°C after 50 cycles.

4. Discussion

Hot corrosion study was carried out on uncoated and Ni-20%Cr coated superalloy 825 in Na_2SO_4 -60% V_2O_5 molten salt environment at 900°C for 50 cycles. During the hot corrosion study, the bare and coated specimens got corroded and oxide layers formed on the specimen surface. Subsequently oxide spallation occurs which is clearly observed from the macro images. In bare specimen, it could be observed that aggressive hot corrosion took place and there is a steady weight gain up-to the 24th cycle. In the following cycles there was drastic weight loss. This could be attributed to the severe spallation and sputtering of the oxide scale. During cooling phase of the 25th cycle, it was observed that the oxide scale sputtered outside the ceramic boat holding the specimen; this is believed to be due to the excessive thermal stresses developed in the oxide scale. The difference in coefficient of thermal expansion of oxide scale and the substrate is expected to induce cracks in the oxide scales by stress generation Chatha et al. (2012). The sputtered oxides during the cooling cycle could not be retained in the boat during the weight measurements and hence the drastic drop in the weight in thermogravimetric chart between the 25th and 26th cycle. In the following cycles, it could be observed that there is weight gain suggesting that the corrosion reaction resumed. The thermogravimetric chart gives a good indication of sputtering away of the scale during the study.

The HVOF sprayed Ni-20%Cr coated superalloy samples show a lower weight gain compared to the uncoated specimens; there was no spallation of the oxides nor sputtering. This shows that a strong adherent protective oxide layer was formed on the HVOF coated samples and explains the high resistance to hot corrosion of the coated sample in the Na_2SO_4 -60% V_2O_5 environment at 900°C .

The thermogravimetric analysis shows the corrosion kinetics of the bare and coated specimens. The overall weight gain at the end of 24 cycles of the uncoated sample was found to be 7.197 mg/cm^2 , whereas it was found to be 3.134 mg/cm^2 for the HVOF coated sample at the end of 50th cycle. The corrosion rate of the uncoated and coated superalloy value is found to be $14.388 \times 10^{-9} \text{ g}^2 \text{ cm}^{-4} \text{ s}^{-1}$ (24 cycles) and $2.727 \times 10^{-9} \text{ g}^2 \text{ cm}^{-4} \text{ s}^{-1}$ (50 cycles).

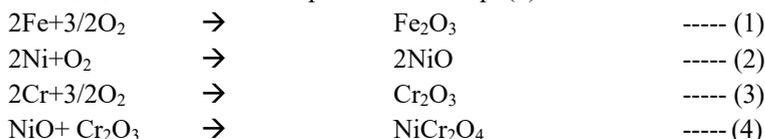
The various corrosion products formed on the uncoated and HVOF coated samples were analysed with the SEM/EDS in combination with the XRD results. In the XRD plots reaction products such as NiO, Cr_2O_3 , FeCr_2O_4 , NiCr_2O_4 and Fe_2O_3 were identified on hot corroded uncoated superalloy. In contrast, in the HVOF coated samples NiO, Cr_2O_3 and NiCr_2O_4 were observed. From the cross sectional SEM/EDS point analysis of the uncoated sample in Fig. 7 it could be observed that the Fe content is more at the surface. The high weight % Fe present in the

substrate material reacts with oxygen to form Fe_2O_3 . The XRD plots in Fig. 3(a) shows intensive peaks for Fe_2O_3 ; this in combination with the EDS point analysis in Fig. 7 reveals that considerable amount of iron oxide is formed on the uncoated sample; it is known that Fe_2O_3 is not at all protective in nature. Nickel oxide was found to be present but not particularly protective. All these observations can be used to conclude that there was absence of protective layer in case of uncoated specimen.

In the point analysis of the HVOF coated sample (Fig. 8) the Fe content at the surface was found to be nil; further there was a presence of a considerable amount (40%) of chromium. Further, the XRD pattern of the HVOF coated sample (Fig. 3b) shows strong peaks for Cr_2O_3 . It can be concluded that a strong protective oxide layer formed on the HVOF coated samples leading to high resistance to hot corrosion at 900°C .

Eutectic mixture of Na_2SO_4 -60% V_2O_5 molten salts combined at 900°C to form Na_2VO_3 which has a lower melting point of 610°C ; this is much less than our test temperature (Sidhu et al. (2006)). In the uncoated samples, during the cyclic hot corrosion studies cracks and pores formed on the Fe_2O_3 rich oxide layer. The molten salts could diffuse into the cracks and pores and reach the substrate causing accelerated degradation. Due to the difference in coefficient of thermal expansion of the oxide layer and the substrate; spalling and sputtering took place. Spallation and dissolution of oxide scales are the important events in the hot corrosion damage (Arivarasu et al. (2017)).

In the case of the HVOF coated samples, the protective oxide scales formed on the coating are mainly Cr_2O_3 , NiCr_2O_4 and NiO , as was shown from the XRD pattern. These oxide layers are formed due to nickel and chromium oxide present in the coating as shown by Eqn (2&3). The strong, adherent and protective Cr_2O_3 and NiCr_2O_4 oxide scales protect the specimen from attack by the molten salt. The spinel oxide NiCr_2O_4 observed in the sample also provides corrosion resistance to the coated superalloy 825 (Kamal et al. (2010)). The spinel oxide is formed by the combination of NiO and Cr_2O_3 oxide scales as explained in the eqn (4).



The cross-sectional image of bare material clearly explained the formation of the thick oxide layer after exposure to the molten salt environment at 900°C . The thickness of the oxide layer is about ($63.09 \mu\text{m}$) and was measured using image analysis software in the optical microscope. This indicates higher corrosion resulting from the formation of the Fe_2O_3 layer. In the coated specimen, a very thin oxide layer was observed in the range of $8.36 \mu\text{m}$ thickness made up of the protective oxide layer Cr_2O_3 (Bala et al. (2010)). The Cr_2O_3 layer is stable and does not allow the oxygen to react with the substrate material. The NiO phase has some porosity and less protective than Cr_2O_3 . This may allow the oxygen and other corrosive elements to move through. The elemental mapping analysis of hot corroded uncoated super alloy 825 (Fig. 8) shows high level of Cr, Ni, Fe, and O, indicating the formation of NiO , Cr_2O_3 and Fe_2O_3 .

The EDS point analysis and the X-ray mappings of the uncoated samples suggest that the corrosive element vanadium diffused considerably into the oxide scale resulting in aggressive hot corrosion. The porous iron oxide layer resulted in the penetration of the vanadium to the substrate. On the other hand, with the Ni-20%Cr HVOF coating, the elemental mapping analysis (Fig. 9) shows the presence of high levels of Ni, Cr and O and the absence of vanadium. Presence of the oxides Cr_2O_3 , NiCr_2O_4 and NiO in the form of continuous protective layer and the absence of vanadium in to the oxide layer, explain the observed high resistance to corrosion.

5. Conclusions

The following conclusions could be drawn from the experimental investigations carried out on the cyclic hot corrosion of uncoated and Ni-20%Cr HVOF coated superalloy 825 in Na_2SO_4 -60% V_2O_5 molten salt environment at 900°C .

- The coating provides better resistance to corrosion due to the formation of a stable protective scale consisting of Cr_2O_3 and NiO and NiCr_2O_4 . XRD, EDS and X ray mapping analysis confirmed the formation of these phases.
- Sputtering and spallation were observed on uncoated specimen owing to the formation of the nonprotective Fe_2O_3 rich oxide layer-
- At the end of 24th cycle, weight gain for the uncoated samples was found to be 3.71 times higher than the HVOF coated samples.
- The corrosion rate (K_p) was $14.388 \times 10^{-9} \text{ g}^2 \text{ cm}^{-4} \text{ s}^{-1}$ for the uncoated sample for the 24 cycles and $2.727 \times 10^{-9} \text{ g}^2 \text{ cm}^{-4} \text{ s}^{-1}$ for the coated sample for the 50 cycle.

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