|  | **Feedstock materials** | **Substrate** | **Thermal process** | **Electrolyte** | **Testing temperature range** | **Testing** | **Thermochemical properties** | **Electrochemical and mechanical properties** | **Remarks** | | **Reference** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | SHS9172 | Ferritic stainless steel/Nimonic alloy 263/Iron based alloy (SAN25) | HVOF | Molten salt (NaCl,Na2SO4,KCl) with gas synthetic air + 10% H2O | 575,625OC | Corrosion test for 168hours. | Powder particle size – 53+15 µm. |  | Good corrosion resistance. Slight coating layer detachment observed at some places. CJS spray coating thickness – 250 µm, no cracking showed due to high particle velocity. DJ spray coating thickness – 430 µm | | (Oksa, Tuurna and Varis 2013) |
| 2 | Diamolley 4006 | Stainless steel (SS) 304 | HOVF | Modified geothermal fluid | Autoclave at 170OC |  | Corrosion rate – 31.1659 mm year-1 | In the geothermal environment, Diamalloy 4006 behave as a sacrificial anode. | Corrosion rate 25.3897 mm/year-1 | | (Morales -Hernandez et al. 2014) |
| 3 | Diamalloy 4006 | Ferritic stainless steel/Nimonic alloy 263/Iron based alloy (SAN25) | HVOF | Molten salt (NaCl,Na2SO4,KCl) with gas synthetic air + 10% H2O | 575,625OC | Corrosion test for 168hours. | Powder particle size – 53+11 µm. | DJ coating layer covered with the dark/partly yellow deposit layers. | Excellent corrosion resistance. Corrosion experienced 100 µm coating thickness.  CJS spray coating thickness – 280 µm  DJ spray coating thickness – 210 µm | | (Oksa, Tuurna and Varis 2013) |
| 4 | Pyro paint 634 -BN (refractory coating) | Mild carbon steel (MCS) | Brushing, dipping or spray gun | - | - | - |  |  | Coating temperature limit 850OC | | (Azhar 2016) |
| 5 | YSZ (NiCrAlY bond coat) | Ni based super alloy | Air plasma spraying (Amdry 962 used as a bond coat) | Molten salt (V2O5) | 910OC | Specimen inspected 6,12,18,30 hours in furnace. | Coating thickness – 200 ± 13 µm  Bond coating thickness – 110 ± 10 µm | Powder particle size – 50 – 60 nm  Morphology – semi spherical  The bond coating suffered by the internal cracks and oxidation. | YSZ coating dispatched from the base material in 30 Hours. | | (Loghman-Estarki, Razavi and Jamali 2016) |
| 6 | YSZ | Ni alloy substrate (Inconel 713LC) | Atmospheric plasma spraying (CoNiCrAlY used as a bond coat) | Molten salt (LiCl-Li2O) | 650OC | Sample immersion on the molten salt 24 to 168 hours. |  |  | YSZ no coating thickness variation with the immersion time.  YSZ shows high corrosion resistance. | | (Lee and Baik 2009) |
| 7 | YSZ | Stainless steel (SS) type 316L | Plasma spray process | Molten LiCl-KCl | 873K | In furnace 873 K for 5, 100, 250 and 500 hours. |  |  | At 100, 500 hours the weight loss was 0.3%  YSZ shows better corrosion resistance | | (Shankar et al. 2008) |
| 8 | YSZ |  |  | 50wt %Na2SO4 and 50wt %V2O5 mixture on the substrate  Air | 1100OC | Hot corrosion test in the electrical furnace for 4h at 1100OC (1 cycle) total 10 cycles done. |  | Salts crystals form and growth on the substrate surface.  Coating surface spallation and delamination observed. |  | | (Habibi Yang and Guo 2014) |
| 9 | YSZ |  | Plasma sprayed coating | Calcia-magnesia-alumino-silicate(CMAS) (molten) | 1320OC | TBC/CMAS interactions performed at 1320OC for 24 and 72h in a muffle furnace. | Powder particle size 15 -45 µm.  Porosity 1.6% | Large amount of the CMAS penetrate into the YSZ coating and cracks, pores appeared. |  | | (Fan et al. 2019) |
| 10 | YSZ |  | Mechanically pressing | Na2SO4 + V2O5 (Molten salt) | 1000OC | Corrosion test 4 cycles. One cycle for 25 h. |  | Fully degraded after testing time. |  | | (Chen et al. 2019) |
| 11 | Al2O3 | Ni alloy substrate (Inconel 713LC) | Atmospheric plasma spraying (CoNiCrAlY used as a bond coat) | Molten salt (LiCl-Li2O) | 650OC | Sample immersion on the molten salt 24 to 168 hours. |  | Coating thickness 300 – 450 µm  Alumina crystalline restructure at 1100OC isothermal treatment for 2 h.  Alumina surface roughness – 6.19 ± 1.04 µm.  Average porosity – 7.1 ± 1.1%  Microhardness – 12.8 ± 1.2 GPa. | Linear coating thickness reduction based on the immersion time increases.  Corrosion rate was 5.8\*10-2 µm/h | | (Lee and Baik 2009)  (Di Girolamo et al. 2014) |
| 12 | Zinc ferrite (Zn-Fe-O) | Siliconized silicon carbide (SiSiC) | Washcoat | Water vapour | 1190OC for 30 mins  Total 58 cycles | Water vapour mixed through preheated nitrogen (purity 2.8) |  |  | Partial coating molten and formed accumulations on the honeycomb channels.  Surface area reduction happens on the base material. This may be the reason for the hydrogen production decreases. | | (Neises et al. 2010) |
| 13 | Fe2O3 | Siliconized silicon carbide (SiSiC) | - | Liquid sulfuric acid | 100 hours at 850OC and ambient pressure. | Nitrogen flow rate is 100, 500 and 1000 Nml/min |  |  |  | | (Karagiannakis et al. 2012) |
| 14 | CuO | Siliconized silicon carbide (SiSiC) | - | Liquid sulfuric acid | 100 hours at 850OC and ambient pressure. |  |  |  |  | | (Karagiannakis et al. 2012) |
| 15 | Nickel alloy coating | Inconel 625 | - | CuCl and HCl environment-Molten slat | High temperature | Potentiostat is used to study the EIS |  |  | High imaginary impedance and resistance. | | (Naterer et al. 2010) |
| 16 | Tantalum | Alumina tubes | DC Sputter deposition |  |  | 0, 100, 200 hours in Hydrogen Iodide (HI). |  |  | No damages absorbed in the coating surfaces. | | (Bhushan et al. 2017) |
| 17 | Lu2Si2O7 + Lu2SiO5 | Mullite |  | Molten salt (95%Na2So4 + 5%NaCl) |  | 20 hours of heating at 950OC in a muffle furnace. |  |  | Lu2Si2O7/Lu2SiO5 composites shows high performance compared to the single component Lu2Si2O7 | | (Xu and Li 2014) |
| 18 | Cr3C2-NiCr powder blend with 75% LA - 6304 and 25% LA - 7319 | Ni based superalloy superni 75 | HOVF | Molten salt (Na2SO4-60%v2O5) |  | 1 hour heating at 900OC and 20 mins cooling at room temperature for 50 cycles | Porosity above 1.5 % | Coating thickness – 290 µm  Microhardness – 870 – 950 Hv  Powder particle size – 45 + 5 µm (irregular) | Weight gains after the test 7.481 mg/cm2  Minor spallation at the edges and corners at initial cycles. | | (Sidhu Prakash and Agrawal 2006) |
| 19 | NiCrBSi | Ni based superalloy superni 75 | HOVF | Molten salt (Na2SO4-60%v2O5) |  | 1 hour heating at 900OC and 20 mins cooling at room temperature for 50 cycles | Porosity above 1.5 % | Porosity - 0.5±0.02 %  Hardness - 890±63 (HV0.3)  Young’s modulus - 81±8GPa  Coating thickness – 285 µm  Powder particle size – 45 µm (Spherical)  The coating characteristics which include microstructure, porosity, oxide level, phase composition, hardness, adhesion and young’s modulus. | Weight gains after the test 8.699mg/cm2  No spalling on the edges and corners. | | (Sidhu Prakash and Agrawal 2006)  (Planche et al. 2005) |
| 20 | Stellite-6 | Ni based superalloy superni 75 | HOVF | Molten salt (Na2SO4-60%v2O5) |  | 1 hour heating at 900OC and 20 mins cooling at room temperature for 50 cycles | Porosity above 2 % | Coating thickness – 298 µm  Microhardness – 850 – 900 Hv  Powder particle size – 45 µm (Spherical) | Weight gains after the test 9.902mg/cm2  Spalled and peeled from the eighth cycle. | | (Sidhu Prakash and Agrawal 2006) |
| 21 | Stellite-6 | Boiler steel SAE 431 | Detonation gun | Molten salt (Na2So4-82%Fe2(SO4)3) | 900OC | Elevated temperature of 900OC total duration 50 cycles on 1 hour/cycle followed by 20 mins cooling |  |  | Weight gains after the test 54.812mg/cm2 | | (Mishra et al. 2014) |
| 22 | Stellite-6 | Stainless steel AISI 304 | HVOF |  | Room temperature 25OC corrosion test |  |  | Thickness 885 ± 14 µm, porosity 0.51 ± 0.20%, micro hardness 7.2 GPa, wear resistance 1.66 \* 10-5, corrosion current density 1.17 \* 10-5 (run 1) | 1 to 6 run depositions with different hydrogen, powder, oxygen flow rate. | | (Sassatelli et al. 2018) |
| 23 | Ni-20Cr (wire form) | Ni based superalloy superni 75 | HOVF | Molten salt (Na2SO4-60%v2O5) |  | 1 hour heating at 900OC and 20 mins cooling at room temperature for 50 cycles |  | Coating thickness – 236 µm  Microhardness – 600 – 630 Hv  Wire diameter – 3.17 mm. | Weight gains after the test 7.121mg/cm2  Negligible amount of spalling at edges and corners. | | (Sidhu Prakash and Agrawal 2006) |
| 24 | Ni20Cr | Stainless steel 304 type (rod 0.25 inches diameter) | HOVF | Molten salt (ZnCl2-KCl) | 350, 400, 450OC | Test performed in the crucible with furnace, molten salt and SS rod as a working electrode.  350OC deposited and grinded use it 400OC then grinded use it 450OC |  | Microhardness – 1950 MPa.  The properties enhanced with electromechanical treatment (EMT).  The pores in the coating from 8.0 ± 1.5% to 2.0 ± 0.5%  Elastic modulus from 67 ± 3to 131 ± 5 GPa.  Shear adhesion strength from 55 ± 15 to 183 ± 15 MPa. | Corrosion current density increases gradually with the temperature increases. | | (Porcayo-Calderon et al.2014)  (Ivannikov et al. 2016) |
| 25 | Ni20Cr | T24 steel pipes | HVOF | Air | 650, 750OC | Isothermal and cyclic test carried out 650 and 750OC for 360 h. |  |  | No substrate degradation observed in high temperature 750OC. | | (Abu-Warda et al. 2020) |
| 26 | Ni20Cr | SA516 steel | Cold gas dynamic spray (CGDS) | Coal (boiler environment) | 700±10OC | 15 cycles, each cycle is 100 h heating and 1 h cooling at room temperature. |  | Coating thickness – 250 µm  Microhardness range – 181 – 247 Hv.  Erosion corrosion rate decreases 58% | Overall weight loss 5.44mg/cm2  Thickness loss 0.21  Corrosion rate 48.28mpy | | (Bala Singh and Prakash 2017) |
| 27 | Ni20Cr blended with 24wt% TiC | SA516 steel | Cold gas dynamic spray (CGDS) | Coal (boiler environment) | 700±10OC | 15 cycles, each cycle is 100 h heating and 1 h cooling at room temperature. |  | Coating thickness – 250 µm  Microhardness range – 131 – 320 Hv.  Erosion corrosion rate decreases 76% | Thickness loss 0.12  Corrosion rate 27.59mpy | | (Bala Singh and Prakash 2017) |
| 28 | Ni20Cr blended with 24wt% TiC, 1wt% Re | SA516 steel | Cold gas dynamic spray (CGDS) | Coal (boiler environment) | 700±10OC | 15 cycles, each cycle is 100 h heating and 1 h cooling at room temperature. |  | Coating thickness – 250 µm  Microhardness range – 243 – 336 Hv.  Erosion corrosion rate decreases 78% | Overall weight loss 4.784/cm2  Thickness loss 0.11  Corrosion rate 25.291mpy | | (Bala Singh and Prakash 2017) |
| 29 | MCrAlY | Stainless steel (SS) 304 | HOVF | Modified geothermal fluid | Autoclave at 170OC |  |  | The mechanical properties significantly depend on the spraying process and microstructure of the coatings. | Corrosion rate 14.1863 mm/year-1 | | (Morales -Hernandez et al. 2014)  (Saeidi Voisey and McCartney 2011) |
| 30 | Stellite-21 | Boiler steel SAE 431 | Detonation gun | Molten salt (Na2So4-82%Fe2(SO4)3) | 900OC | Elevated temperature of 900OC total duration 50 cycles on 1 hour/cycle followed by 20 mins cooling |  |  | Weight gains after the test 82.556mg/cm2 | | (Mishra et al. 2014) |
| 31 | Ni-5Al | Superni 76 | HOVF | Air | 900OC | 900OC total duration 100 cycles on 1 hour/cycle followed by 20 mins cooling | Porosity – 2.0 %  Coating thickness – 174 µm  Coating weight gain reduces 12.65% compared to the bare superni 76 | Powder particle size – 45 -90 µm  Microhardness – 210 – 272 Hv.  Small amount of the iron and chromium present at the substrate interface. | Kp value 0.84\*10-10g2cm-4s-1  Ni-5Al coating provides successful protection.  Light grey transformation of the coating initially. Micro sputtering on coating after 48th cycle. | | (Mahesh Jayaganthan and Prakash 2008) |
| 32 | Ni-5Al | Superni 750 | HOVF | Air | 900OC | 900OC total duration 100 cycles on 1 hour/cycle followed by 20 mins cooling | Porosity – 2.0 %  Coating thickness – 194 µm  Coating weight gain reduces 51% compared to the bare superni 750 | Powder particle size – 45 -90 µm  Microhardness – 210 – 272 Hv.  Iron diffusion on the top of the coating. | Kp value 0.50\*10-10g2cm-4s-1  Light green colour observed on the coating. | | (Mahesh Jayaganthan and Prakash 2008) |
| 33 | Ni-5Al | Superfer 800 | HOVF | Air | 900OC | 900OC total duration 100 cycles on 1 hour/cycle followed by 20 mins cooling | Porosity – 1.8 %  Coating thickness – 200 µm  Coating weight gain reduces 31.94% compared to the bare superni 800 | Powder particle size – 45 -90 µm  Microhardness – 210 – 272 Hv.  Aluminium found splat boundaries in the top of the scale. | Kp value 0.249\*10-10g2cm-4s-1  Shows the least weight gain.  Dark grey coating transformation end of second cycle. | | (Mahesh Jayaganthan and Prakash 2008) |
| 34 | SYSZ  (NiCrAlY bond coat) | Ni based super alloy | Air plasma spraying (Amdry 962 used as a bond coat) | Molten salt (V2O5) | 910OC | Specimen inspected 6,12,18,30 hours in furnace. | Coating thickness – 200 ± 13 µm  Bond coating thickness – 110 ± 10 µm | Powder particle size – 40 – 50 nm  Morphology – semi spherical  Microcracks formation on the coating accelerate the corrosion rate. | SYSZ shows high degradation due to the crack formation.  Coating degradation observed after 30h. | | (Loghman-Estarki, Razavi and Jamali 2016) |
| 35 | CYSZ | Nickel based super alloy (Inconel 738) | Air plasma spraying (Amdry 962 used as a bond coat) | Molten salt  (45wt% Na2SO4 + 55wt % V2O5) | 1000OC | Sample in the 1000OC furnace from 6 to 300 h. |  |  | The coating withstands in the hot corrosion environment for 300 h.  A minor portion of the coating come apart from the corner due to thermal stress. | | (Hajizadeh-Oghaz et al. 2016) |
| 36 | Ni50Cr |  | HVOF | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | No corrosion products on the coating surface.  No internal crack and fully protect the substrate. | The coating destroyed.  Chromium was selectively attacked by chloride. | | (Uusitalo vuoristo and Mantyla 2004) |
| 37 | Ni50Cr | - | Excalibur HVOF | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | Cracking of internal coating.  The corrosion resistance is excellent. But occupationally the oxides form on the coating surface. | Some cracks and partially coating disintegrated.  Chlorine was detected all over the coating and potassium in some places. | | (Uusitalo vuoristo and Mantyla 2004) |
| 38 | Ni57Cr | - | HVOF | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | Coating could not protect the substrate from the corrosion.  Iron oxides on the surface od the substrate. | Chromium oxide on the outer layer reduces the corrosion rate significantly. | | (Uusitalo vuoristo and Mantyla 2004) |
| 39 | Ni21Cr9Mo | - | HVOF | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | Severe oxidation attack on the splat boundaries. | The substrate massively attacked.  Plenty of chlorine, some potassium and sodium were detected on the coating substrate interface. | | (Uusitalo vuoristo and Mantyla 2004) |
| 40 | Fe3Al | - | HVOF | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | Oxidation throughout the coating.  Most corrosion degradation of all coating areas and the substrate also corrded. | The whole coating is severely oxidized.  Chlorine detected in the splat boundaries. | | (Uusitalo vuoristo and Mantyla 2004) |
| 41 | Ni53Cr | - | Laser cladd | Synthetic salt (40 wt% K2SO4, 40 wt%Na2SO4, 10 wt%KCl and 10 wt%NaCl) | 550OC | Immersion test for 100 h at 550OC chloride containing fuel (salt) |  | No corrosion on the coating. | The coating is undamaged.  Chloride, potassium and oxygen close to the coating surface | | (Uusitalo vuoristo and Mantyla 2004) |
| 42 | Silicon oxide | Isotropic graphite (9G540) | Atmospheric pressure Chemical vapour deposition (APCVD) | Air | 500OC to 1200OC | 10h oxidation test in air upto temperature 1200OC |  |  | Coated graphite maintained its flexural yield. | | (Bahlawane 2001) |
| 43 | Chromium carbide | Nickel based alloy | APS  Cold gas dynamic spray | Molten salt (Fluoride salt) | 700 -850OC |  |  |  | The coating has the advantages of the corrosion resistance. | | (Brupbacher et al. 2015) |
| 44 | CoNiCrAlY | 316L SS substate | Cold gas dynamic spray (CGDS) | Air | 900OC | Oxidized test for 200, 500, 1000 h at 900OC |  |  | The mass gain on the coating is low.  CGDS provides high hardness, low porosity, high density of the coating compared to the HVOF. | | (Khanna and Rathod 2015) |
| 45 | CoNiCrAlY | 316L SS substate | HVOF | Air | 900OC | Oxidized test for 200, 500, 1000 h at 900OC |  | The hardness (HVOF) of the coating is high compared to the VPS (Vacuum plasma spray) coating.  HVOF sprayed has γ+β microstructure  VPS sprayed has the γ microstructure. | The mass gain on the coating gradually increases with the temperature rise. | | (Khanna and Rathod 2015)  (Saeidi Voisey and McCartney 2011) |
| 46 | CoNiCrAlY | Aluminium 6061 | CGDS |  | 1000OC | Samples in the heated furnace for 5,25,50 and 100 hours. Cooling at room temperature. |  |  |  | | (Richer et al. 2010) |
| 47 | CoNiCrAlY | Aluminium 6061 | HVOF |  | 1000OC | Sample in the heated furnace for 5,25,50 and 100 hours. Cooling at room temperature. |  |  | No oxide scale spallation observed. | | (Richer et al. 2010) |
| 48 | CoNiCrAlY | Aluminium 6061 | APS |  | 1000OC | Samples in the heated furnace for 5,25,50 and 100 hours. Cooling at room temperature. |  |  | No oxide scale spallation observed.  High oxide growth rate. | | (Richer et al. 2010) |
| 49 | Cr3C2-WC-NiCoCrMo | Plain carbon steel | HVOF |  | Coating deposition temperatures (450, 550, 650OC) |  |  |  | In 650OC the wear resistance is high | | (Zhou et al. 2017) |
| 50 | Cr3C2-NiCr | Plain carbon steel | HVOF |  | Coating deposition temperatures (450, 550, 650OC) |  |  | The indentation toughness is 2.75 ± 0.50 Mpa m1/2.  Elastic modulus 193±19 GPa.  Roughness 4.72±0.22µm  Hardness 11400±65 MPa  (Nanocrystalline Cr3C2-Ni20Cr coating)  Cr3C2-Ni20Cr - Low hardness and wear resistance for long term high temperatures. | Wear resistance is low. | | (Zhou et al. 2017)  (Roy et al. 2006) |
| 51 | Al2O3-NiAl | AISI 304 steel | HVOF |  | 750, 850OC | Thermal cyclic test for 2,6,10,15 days.  Each cycle 99 mins heating and 7 mins forced cooling. |  |  | No significant changes are observed at 750OC.  Coating delamination on the 850OC due to high thermal stress. | | (Abu-Warda et al. 2019) |
| 52 | 80Ni20Cr | T91 Boiler | HVOF | Molten salt (Na2SO4–60%V2O5) | 750OC | Under cyclic temperatures 50 cycles.  1 h heating at 750OC and 20 min cooling at room temperature |  |  | Shows low level of weight gain.  No change in the coating surface. | | (Chatha Sidhu and Sidhu 2012) |
| 53 | 75Cr3C2–25(Ni–20Cr) | T91 Boiler | HVOF | Molten salt (Na2SO4–60%V2O5) | 750OC | Under cyclic temperatures 50 cycles.  1 h heating at 750OC and 20 min cooling at room temperature |  |  | Little changes in the coating surface. | | (Chatha Sidhu and Sidhu 2012) |
| 54 | NiCr | Low alloy steel | HVOF | Salt mixture (KCl-K2SO4) | 550, 600OC | Immersion in the salt mixture for a week (168h) |  |  | No significant changes in the oxide layer. | | (Varis et al. 2015) |
| 55 | NiCr | Ferritic stainless steel/Nimonic alloy 263/Iron based alloy (SAN25) | HVOF | Molten salt (NaCl,Na2SO4,KCl) with gas synthetic air + 10% H2O | 575,625OC | Corrosion test for 168hours. | Powder particle size – 53+20 µm. |  | Better corrosion resistance  CJS spray coating thickness – 220 µm  DJ spray coating thickness – 270 µm | | (Oksa, Tuurna and Varis 2013) |
| 56 | FeCr | Low alloy steel | HVOF | Salt mixture (KCl-K2SO4) | 550, 600OC | Immersion in the salt mixture for a week (168h) |  |  | With the air, the corrosion resistance is good.  Added salt mixture, the corrosion resistance decreases. | | (Varis et al. 2015) |
| 57 | NiCrAlY | Ni based superalloy (IN100) | **Arc ion plati**ng |  | 900-1100OC | Oxidation experiment for 100h for 100 cycles. (50mins heating and 10 mins air cooling). |  | Powder particle size – 45 – 90 µm  Morphology –spherical | No oxide spallation and the oxidization resistance are increased.  (NiCrAlY can work as a bond coating) | | (Wang et al. 2002)  (Loghman-Estarki, Razavi and Jamali 2016) |
| 58 | IN625 | Ferritic stainless steel/Nimonic alloy 263/Iron based alloy (SAN25) | HVOF | Molten salt (NaCl,Na2SO4,KCl) with gas synthetic air + 10% H2O | 575,625OC | Corrosion test for 168hours. | Powder particle size – 45+11 µm. | Low wear resistance and mechanical strength. | Better corrosion resistance.  Some places coating layer detached.  CJS spray coating thickness – 140 µm  DJ spray coating thickness – 210 µm | | (Oksa, Tuurna and Varis 2013) (Bolelli et al. 2007) |
| 59 | Inconel 625 | Carbon steel tube | HVOF | Hot and cold economizer | maximum 520 -800OC | Water temperature in the hot economizer 200OC.  Flue gas hot economizer temperature 520-800OC for 2 years. |  | The dense of the coating, adhered to the substrate, coating porosity close to the Alloy 59.  Corrosion resistance of the coating is satisfactory. | Coating thickness 300µm  Hardness 506HV0.3 | | (Oksa et al. 2014) |
| 60 | NiCrBSiFe | P21 test coupons. | HVOF | High temp Salt (K2SO4-KCl) | 525,625,725OC | Corrosion test for 168hours in three different temperatures |  |  |  | | (Paul and Harvey 2013) |
| 61 | Ni alloy 718 | P21 test coupons. | HVOF | High temp Salt (K2SO4-KCl) | 525,625,725OC | Corrosion test for 168hours in three different temperatures |  |  |  | | (Paul and Harvey 2013) |
| 62 | Ni alloy 625 | P21 test coupons. | HVOF | High temp Salt (K2SO4-KCl) | 525,625,725OC | Corrosion test for 168hours in three different temperatures | Corrosion test 0.1M HCL.  The corrosion potential – 263.8 ± 11.8 mV  Corrosion current density – 2.48 ± 0.01 \*10-5 A/cm2. The corrosion products on the substrate interface. | Conventionally properties  Young’s modulus – 205Mpa  Melting range – 1280-1350OC  Density – 8.44 g/cm3 | Powder particle size – 53 + 20 µm.  Coating thickness – 329 ± 21 µm. | | (Paul and Harvey 2013)  (Azarmi and Sevostianov 2020)  (Bolelli Lusvarghi and Giovanardi 2008) |
| 63 | Ni alloy 625 |  | Air Plasma spraying (APS) |  |  |  |  | Porosity – 3%  Density – 7.77±0.35 g/cm3  Young’s modulus – 63.12±0.63GPa | Microstructure of the APS and WA coating is similar. | | (Azarmi and Sevostianov 2020) |
| 64 | Ni alloy 625 |  | Wire Arc spraying (WA) |  |  |  |  | Porosity – 6%  Density – 7.39±0.41 g/cm3  Young’s modulus – 57.41±1.47GPa |  | | (Azarmi and Sevostianov 2020) |
| 65 | Ni alloy 625 |  | Cold spraying (CS) |  |  |  |  | Porosity - less than 1%  Density – 8.2±0.15 g/cm3  Young’s modulus – 165.89±00GPa |  | | (Azarmi and Sevostianov 2020) |
| 66 | Ni alloy C 276 | P21 test coupons. | HVOF | High temp Salt (K2SO4-KCl) | 525,625,725OC | Corrosion test for 168hours in three different temperatures |  |  |  | | (Paul and Harvey 2013) |
| 67 | Cr3C2-25Ni20Cr | Mild steel | HVAF | Air | 700, 800, 900OC | Oxidised in hot furnaces for 48h. and cool it and clean it. The cycle for 60 days. |  | It has good hardness and fracture toughness than Cr3C2-Ni20Cr.  Cr3C2-25NiCr coating shows the maximum wear resistance and lowest coefficient of friction and shows poor corrosion resistance due to high roughness and porous nature. | Repeated oxidations affect the internal structure of the coating.  Shows good oxidation resistance. | | (Matthews James and Hyland 2013)  (Cunha et al. 2008)  (Vats et al. 2021) |
| 68 | Cr3C2-20NiCr | Mild steel | Pulsed detonation spray | Air | 900OC | Heat treated in hot furnace for (600OC) 90 mins and cooled in air (heat treatment) |  | The highest wear resistance of the coating achieved through HVOF.  HVOF coating is a better method for high temperature applications | Heat treatment enhances the erosion resistance of coating. | | (Murthy et al. 2007)  (Vats et al. 2021) |
| 69 | Ni |  |  | Molten salt (FLiNaK) | 650OC | Corrosion study for 60 hours. |  |  | Good corrosion resistance in without moisture situation. | | (Sawant et al. 2017) |
| 70 | Al2O3 + 8YSZ | AISI-304 stainless steel | RF magnetron sputtering |  | 500, 700OC | Isothermal oxidation test at 500, 700OC for 2,4,6 hours. | The coating thermal conductivity is low compared to the metallic substrate. |  |  | | (Amaya et al. 2009) |
| 71 | Alloy 718 + NiCrAlY | Grey cast iron | HVOF |  | 900OC | Oxidation test at 900OC for 50 cycles.  1 hr heating and 20 mins cooling in ambient air.  Erosion test at 800OC using air-jet erosion test rig. |  | Average alloy 718 coating microhardness is 563±15HV0.2  Bilayer coating has the low porosity.  Lower oxidation rate and marginal weight gain.  Alloy 718 shows the excellent erosion resistance. | Alloy 718 provides high oxidation and erosion resistance on the elevated temperature. | | (Vasudev et al. 2019) |
| 72 | Cr3C2-NiCr | Inconel 617 | Detonation spraying |  |  |  |  | Cr3C2- NiCr (HVOF) provides high corrosion resistance. But the coating damages poorly in erosive wear under liquid impingement conditions. | Thickness 300µm  Coating hardness 1000HV300 | | (Ulianitsky et al. 2022)  (Vats et al. 2021) |
| 73 | Alloy 59 | Carbon steel tube | HVOF | Hot and cold economizer | maximum 520 -800OC | Water temperature in the hot economizer 200OC.  Flue gas hot economizer temperature 520-800OC for 2 years. |  | Coating is dense with minor porosity.  Coating adhered in the substrate good and smaller detachment.  Corrosion resistance is excellent. | Coating thickness 300µm  Hardness 460HV0.3 | | (Oksa et al. 2014) |
| 74 | NiCrAlY | Carbon steel tube | HVOF | Hot and cold economizer | maximum 520 -800OC | Water temperature in the hot economizer 200OC.  Flue gas hot economizer temperature 520-800OC for 2 years. |  | High corrosion resistance performance.  Coating was sufficiently dense and low porosity.  Coating has the thicker deposition of the flue gas side.  (Severe corrosion attack on the uncoated pipeline areas) | Coating thickness 280µm  Hardness 530HV0.3 | | (Oksa et al. 2014) |
| 75 | Rare earth oxides (REOs) | Stainless steel | Metallo organic Chemical vapour deposition |  |  |  |  | In the oxidation test, the thin film leaves from the substrate. The thin film could not provide the enough corrosion protection. | Thickness 0.2µm | | (Bonnet et al. 1995) |
| 76 | YPSZ (thermal barrier coating) |  | APS |  | 700OC | Erosion test at 700OC with feed rate 2g/min |  | High erosion rate.  Single and multiple crack propagation on coating | Thickness - 416±28µm  Porosity - 19±1%  Microhardness - 571±105HV300g | | (Cernuschi et al. 2011) |
| 77 | YPSZ (thermal barrier coating) |  | Electron beam physical vapour deposition (EB-PVD) |  | 700OC | Erosion test at 700OC with feed rate 2g/min |  | Low erosion rate  Densification layer forms on the coating. | Thickness - 156±4µm  Porosity – 10.0±0.5% | | (Cernuschi et al. 2011) |
| 78 | α-CrAlY/TiCrAlY | Ferritic steel | PVD | air | 800OC | Exposure to the 800OC air up to 1000h. | No changes. High thermal stability. | Minimal changes on the coating thickness in oxidation exposure. | Thickness – 1-4µm | | (Gannon et al. 2008) |
| 79 | Β-CrAlY/CoCrAlY | Ferritic steel | PVD | air | 800OC | Exposure to the 800OC air up to 1000h. | 1µm coating thickness increases after the exposure time. | Minimal changes on the coating thickness in oxidation exposure. | Thickness – 0.5-2µm | | (Gannon et al. 2008) |
| 80 | γ-CoMn/TiCrAlY | Ferritic steel | PVD | air | 800OC | Exposure to the 800OC air up to 1000h. | High thermal stability. | Minimal changes on the coating thickness in oxidation exposure. | Thickness – 0.5-1.5µm | | (Gannon et al. 2008) |
| 81 | Fe-Al, Cr-Al, Ni-Al | Stainless steel 310 | Thermal diffusion technology |  | 800OC | Structure evaluation at 800OC for 3000h |  | No spallation, cracks, delamination.  Mass gain on the aluminized coating is high. |  | | (Medvedovski and Dudziak 2019) |
| 82 | Fe-Al, Cr-Al, Ni-Al | Incoloy 800H | Thermal diffusion technology |  | 800OC | Structure evaluation at 800OC for 3000h |  | No spallation, cracks, delamination.  Mass gain on the aluminized coating is high. |  | | (Medvedovski and Dudziak 2019) |
| 83 | ZrB2-SiC |  | Plasma spray deposition | Air | Room temperature to 1873K. | Oxidation resistance test from room temperature to 1873K. |  | Significant weight gain on the sample.  Passive oxidation forms on the coating on high temperature. | Coating thickness – 4mm. | | (Bartuli, Valente and Tului 2002) |
| 84 | NiCoCrAlY + YSZ | Nickel based superalloy C263 | NiCoCrAlY and YSZ (APS) | Corrosive salts (50wt% Na2SO4+50wt%V2O5) coated on the substrate 5-7mg/cm2. | 1073K | Corrosion test for 30h at 1073K in muffle furnace. |  | Coating degradation happens due to corrosive salts react and penetrate through the coating pores.  Corrosion products formation of the coating. | NiCoCrAlY bond coat thickness – 100 µm  YSZ thickness – 250 µm, porosity around 10%. | | https://www.sciencedirect.com/science/article/pii/S0257897222001815#! |
| 85 | NiCoCrAlTaY (Bond coat) +  YSZ | Nickel based superalloy | Air plasma spraying | High temp salt Na2SO4 + V2O5 | 1000OC | Sample placed on the electrical furnace with ambient atmosphere at 1000OC. |  | Large salt crystals formed on the coating. | 35 -75 µm top coating thickness | | (Liu et al. 2014) |
| 86 | NiCoCrAlY + YSZ +LZ/LZC | Nickel based superalloy C263 | NiCoCrAlY and YSZ (APS)  LZ/LZC – SPPS (Solution precursor plasma spray process) | Corrosive salts (50wt% Na2SO4+50wt%V2O5) coated on the substrate 5-7mg/cm2. | 1073K | Corrosion test for 30h at 1073K in muffle furnace. |  | The interface between the YSZ and LZ/LZC well adhered.  Vertical cracks on the top coating layer.  LZ/LZC provides inherent resistance for the coating degradation and YSZ coating is unaffected. | NiCoCrAlY bond coat thickness – 100 µm  YSZ thickness – 250 µm  LZ/LZC thickness – 180 µm. | | https://www.sciencedirect.com/science/article/pii/S0257897222001815#! |
| 87 | 70wt%ZrO2 + 30wt%Ta2O5 (30TaSZ) |  |  | High temp 50wt %Na2SO4 and 50wt %V2O5 mixture on the substrate  Air | 1100OC | Test in the electrical furnace for 4h at 1100OC (1 cycle) total 10 cycles done. |  | Better hot corrosion resistance than the 30TaYSZ. | Thermal barrier coating enhance the corrosion resistance in salt electrolyte conditions. |  | (Habibi Yang and Guo 2014) |
| 88 | 70wt%YSZ + 30wt%Ta2O5 (30TaYSZ) |  |  | High temp 50wt %Na2SO4 and 50wt %V2O5 mixture on the substrate  Air | 1100OC | Test in the electrical furnace for 4h at 1100OC (1 cycle) total 10 cycles done. |  | No evidence foe the direct interaction with the coating and salts.  It has the hot corrosion resistance. |  | (Habibi Yang and Guo 2014)  (Habibi et al. 2013) |
| 89 | 50wt%ZrO2 + 50wt%Ta2O5 (50TaSZ) |  |  | Hight temp 50wt %Na2SO4 and 50wt %V2O5 mixture on the substrate  Air | 1100OC | Test in the electrical furnace for 4h at 1100OC (1 cycle) total 10 cycles done. |  | Shoes good corrosion resistance.  Small quantity of the salt formation on the coating. |  | (Habibi Yang and Guo 2014) |
| 90 | 30wt%ZrO2 + 70wt%Ta2O5 (70TaSZ) |  |  | High temp 50wt %Na2SO4 and 50wt %V2O5 mixture on the substrate  Air | 1100OC | Test in the electrical furnace for 4h at 1100OC (1 cycle) total 10 cycles done. |  | Corrosion products formation on the coating is high. |  | (Habibi Yang and Guo 2014) |
| 91 | 4.5Sc1.5YSZ |  | Mechanically pressing | Na2SO4 + V2O5 (Molten salt) | 1000OC | Corrosion test 4 cycles. One cycle for 25 h. |  | Coating attacked on the high temperature.  Corrosion  products present on the coating. | ScYSZ is a ceramic.  The corrosion resistance increases with the increasing the Sc2O3 amounts. | | (Chen et al. 2019) |
| 92 | 5.5Sc1.5YSZ |  | Mechanically pressing | Na2SO4 + V2O5 (Molten salt) | 1000OC | Corrosion test 4 cycles. One cycle for 25 h. |  | Coating attacked on the high temperature.  Less corrosion products presence compared to the 4.5Sc1.5YSZ. | (Chen et al. 2019) |
| 93 | 6.5Sc1.5YSZ |  | Mechanically pressing | Na2SO4 + V2O5 (Molten salt) | 1000OC | Corrosion test 4 cycles. One cycle for 25 h. |  | Shows excellent corrosion resistance. | (Chen et al. 2019) |
| 94 | ScYSZ |  | Plasma sprayed coating | Calcia-magnesia-alumino-silicate (CMAS) (molten) | 1320OC | TBC/CMAS interactions performed at 1320OC for 24 and 72h in a muffle furnace. | Powder particle size 20 – 60 µm.  Porosity 2.2% | CMAS Penetration on the top layer of the coating.  SCYSZ effectively inhibit the molten CMAS infiltration. |  | | (Fan et al. 2019) |
| 95 | NiCoCrAlTaY (Bond coat) +  ScYSZ | Nickel based superalloy | Air plasma spraying | High temp Na2SO4 + V2O5 | 1000OC | Sample placed on the electrical furnace with ambient atmosphere at 1000OC. | Porosity of coating about 11% and low thermal conductivity. | No corrosion product on the coating. No effect of the corrosive degradation.  ScYSZ has the superior chemical stability and phase stability. | 35 -75 µm top coating thickness | | (Liu et al. 2014) |
| 96 | YSZ (TBC) + Lanthana precursor (La2O3) | Nickel based alloy substrate | Atmospheric plasma spraying (APS) |  |  |  | YSZ - The thermal diffusivity 0.354 mm2 s-1 at 200OC.  YSZ + La2O3 – thermal diffusivity 0.243 mm2s-1 at 200OC. Diffusivity reduced 17% and 24% in annealed temperature 800OC and 1200OC respectively. | The SEM confirms the grain size increases with the annealing process. | Coating annealed at 1200to 1400OC for 50h.  The grain size increases with full dense morphology.  Coating thickness 3 mm.  Thermal diffusion decreased. | | (Liu et al. 2009) |
| 97 | La2(Zr0.7Ce0.3)2O7 | Alumina substrate | Electron beam physical vapour deposition | High temp Calcium magnesium alumino silicate (CMAS) | 1250OC | Corrosion test carried out in muffle furnace at 1250OC for 0.5h, 4h, 12h and 24h. |  | 0.5 h – minor amount of Zr and Y detected.  CMAS penetrate only 32µm after 24h corrosion test. | Coating thickness 100 µm.  CMAS brushed on the substrate | | (Zhou et al. 2017) |
| 98 | Haynes 230 (Alloy) |  |  | Molten FLiNaK  Density – 2.02 g/cm3 | 850OC | Corrosion test at 850OC for 500h. | Weight loss 1.8% Fe 22.5% Cr |  | Uniform entire coating thickness corrosion attack on the gain boundaries | | (Olson et al. 2009) |
| 99 | Inconel 617 (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. | Weight loss 1.1% Fe 22.1% Cr |  | Uniform Cr depletion upto depth 100 µm. Corrosion grain boundaries attack throughout the thickness. | | (Olson et al. 2009) |
| 100 | Hastelloy – N (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. | Weight loss 4.0% Fe 6.3% Cr |  | Corrosion attack is severe where Cr depletion upto 50µm depth. | | (Olson et al. 2009) |
| 101 | Hastelloy – X (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. | Weight loss 19.3% Fe  21.3% Cr |  | Grain boundaries attack up to the depths of 300µm. | | (Olson et al. 2009) |
| 102 | Nb-1Zr (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. |  |  | Severe embrittlement on the coating. Zr is more reactive with the molten salt. | | (Olson et al. 2009) |
| 103 | Incoloy – 800H (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. | Weight loss 45.3% Fe  20.4% Cr |  | High amount of the Cr detected. Cr observed on the small grain boundaries. | | (Olson et al. 2009) |
| 104 | Ni-201 (Alloy) |  |  | Molten FLiNaK | 850OC | Corrosion test at 850OC for 500h. | Weight loss 0.1% Fe 0.0% Cr |  |  | | (Olson et al. 2009) |
| 105 | Cr3C2-25%NiCr | Superni 75 | Detonation gun | High temp 75 wt% Na2SO4+25 wt% K2SO4 | 900OC | Hot corrosion study at 900OC for 100 cycles. | The nickel formation in the interface where Cr is depleted | Kp – 0.509 \* 10-10 g2cm-4s-1 | Each cycle 1h heating and 20mins cooling. | | (Kamal Jayaganthan and Prakash, 2009) |
| 106 | Cr3C2-25%NiCr | Superni 718 | Detonation gun | High temp 75 wt% Na2SO4+25 wt% K2SO4 | 900OC | Hot corrosion study at 900OC for 100 cycles. | Cr and nickel on the top of the coating.  The nickel formation in the interface where Cr is depleted | Kp – 0.221 \* 10-10 g2cm-4s-1  Lowest weight gain | Each cycle 1h heating and 20mins cooling | | (Kamal Jayaganthan and Prakash, 2009) |
| 107 | Cr3C2-25%NiCr | Superfer 800H | Detonation gun | High temp 75 wt% Na2SO4+25 wt% K2SO4 | 900OC | Hot corrosion study at 900OC for 100 cycles. | The nickel formation in the interface where Cr is depleted  Ni and Cr high amount on the coating. | Kp – 0.727 \* 10-10 g2cm-4s-1 | Each cycle 1h heating and 20mins cooling | | (Kamal Jayaganthan and Prakash, 2009) |
| 108 | Nanostructured NiCrC |  | HVAF |  | 650OC | Heat treatment at 650OC for 200h in air. | Uniform distribution gives higher microhardness. | Particle size increases with the time of the heat treatment. | HVAF coating has the more homogenous and denser microstructure. | | (Tao et al. 2009) |
| 109 | YSZ/NiCoCrAlY;  LZ-LZC/YSZ/NiCoCrAlY  ([La(NO3)3.6H2O], [Ce(NO3)3.6H2O], and [Zr(C2H4O2)4]) | C263 | APS, SPPS | High temp 50wt.%Na2SO4 + 50wt.%V2O5 |  | 30 h at 800 OC | - | - | In both double-layered LZ/LZC + YSZ architectures, the underlying YSZ remained unaffected by the molten corrosive salts after 30 h. SPPS LZ and LZC coatings act as the sacrificial as well as resisting layer against molten salt corrosion. Thus, the double-layered coatings potentially improve performance over the standalone YSZ system. | | (Praveen et al. 2022) |

**Literature examples (thermally sprayed coatings for high temperature corrosion resistant applications.**

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