

CHROMATE-FREE CERAMIC COATING COMPOSITIONS FOR HOT CORROSION PROTECTION OF SUPERALLOY SUBSTRATES

Coating System of the invention in Thermal Cycling Test in air at 1500°F(815°C)

Fig. 1a: after 140 cycles

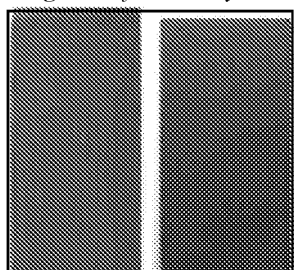


Fig. 1b: after 260 cycles

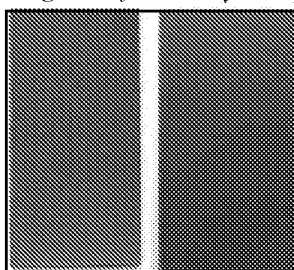
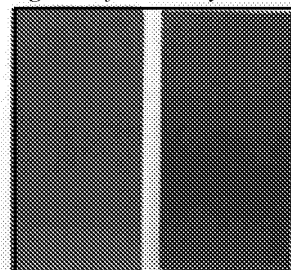


Fig. 1c: after 400 cycles



Coating System of the invention in Thermal Cycling Test: surface morphology after 200 cycles in air at 1500°F(815°C)

Fig. 2a: optical microscopy (x40)

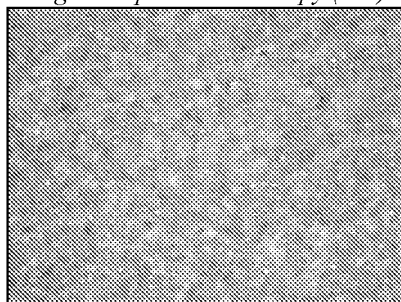


Fig. 2b: SEM (x500)

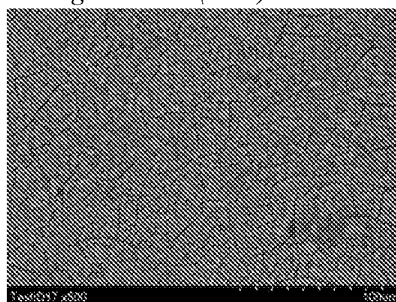
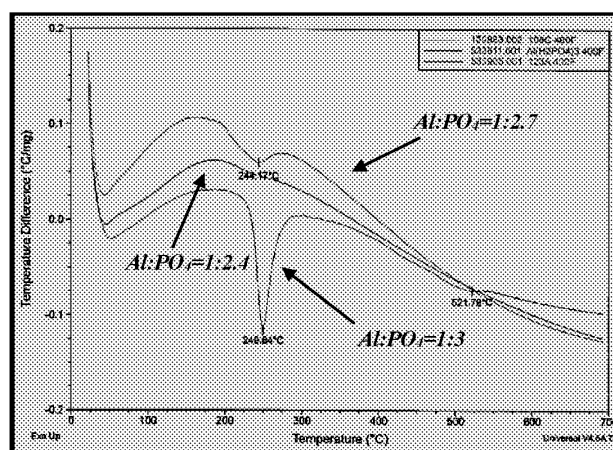


Fig. 3 Thermal Analysis of Aluminum Phosphate binders with different Al: PO₄ molar ratios
Al:PO₄ = 1:3 (stoichiometric Al(H₂PO₄)₃); Al: PO₄ = 1:2.7; Al: PO₄ = 1:2.4



Coating System of the invention in Thermal Cycling Test in the absence of deposit of corrosive sulfates: Visual appearance before test (a), after test (b) of 100 cycles in air at 1310°F(710°C) and after- test cross-sectional SEM

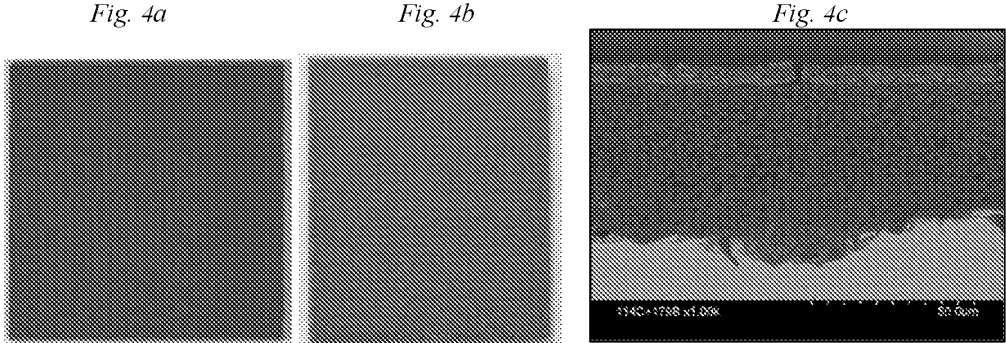
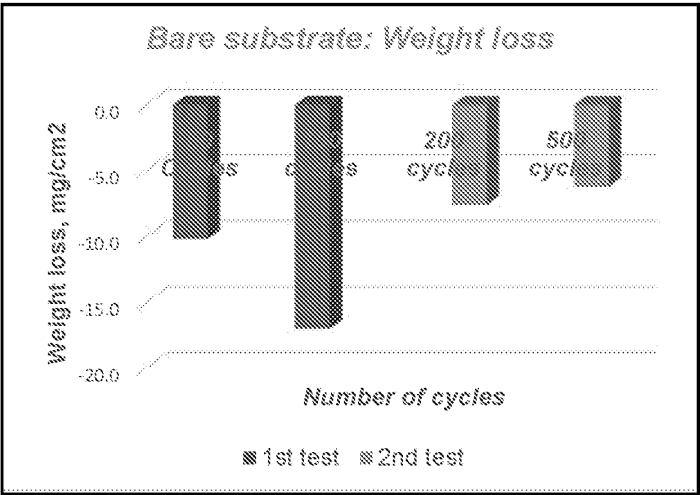


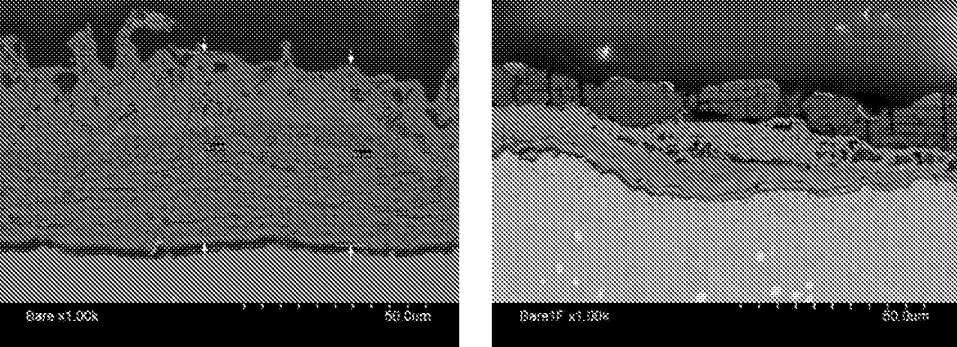
Fig. 5 Sulfate attack on bare superalloy substrate: weight loss in Thermal Cycling Test at 1310°F(710°C).

1st Test performed with Mixture A; 2nd Test performed with Mixture B



Sulfate attack on bare superalloy substrate: Cross-sectional SEM after Thermal Cycling Test at 1310°F(710°C).

Fig. 6a Test with Mixture A: after 100 cycles Fig 6b Test with Mixture B: after 500 cycles



Thermal Cycling Test in the presence of aggressive Mixture A deposit of corrosive sulfates: Visual appearance of the coating System of the invention (a) vs. prior art Cr (VI) containing coating system (b) after 100 cycles at 1310°F(710°C)

Fig. 7a

Fig. 7b

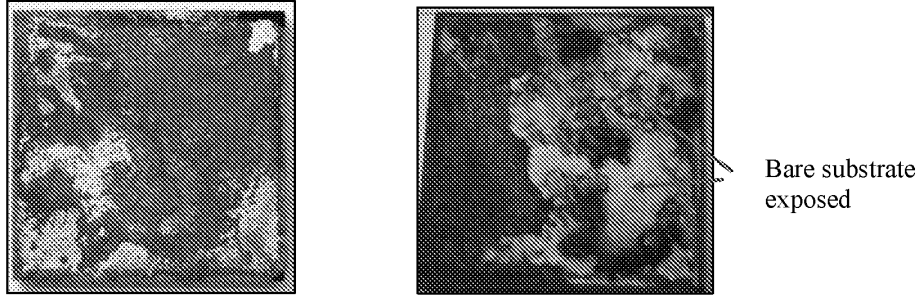
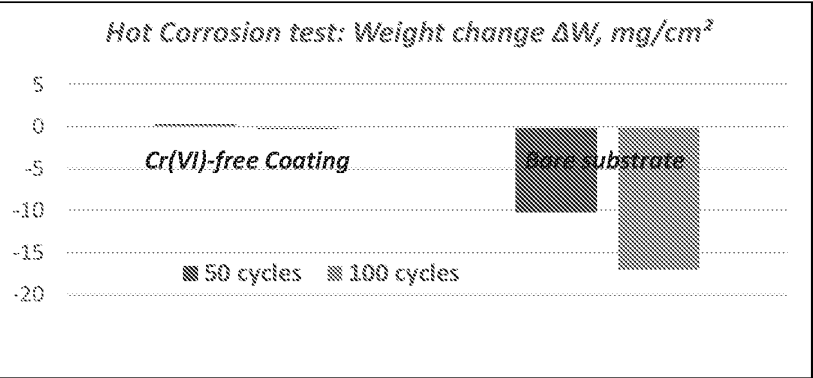


Fig. 8 Thermal Cycling Test in the presence of Mixture A deposit of corrosive sulfates at 1310°F(710°C): Bare substrates vs. substrates coated with the Coating System of the invention



Thermal Cycling Test of the Coating system of the invention: Cross-section SEM after 100 cycles at 1310°F(710°C) without sulfate (a) and with deposit of aggressive Mixture A (b)

Fig. 9a

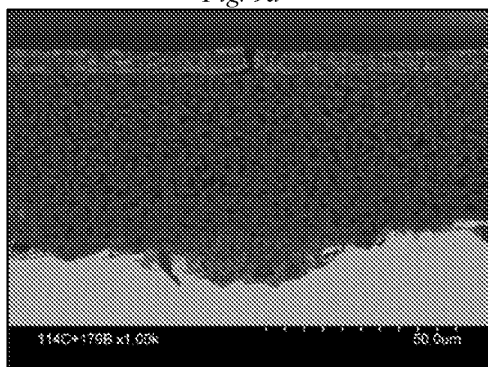
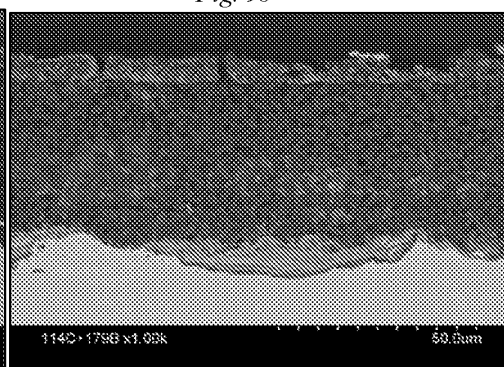


Fig. 9b



Thermal Cycling Test with Mixture B sulfate deposit at 1310°F(710°C): Cr (VI)-free Coating of the invention as-prepared (a), after 100 (b) and after 500 cycles (c)

Fig. 10a As-prepared

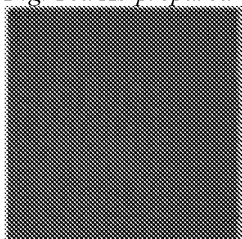


Fig. 10b Sample E

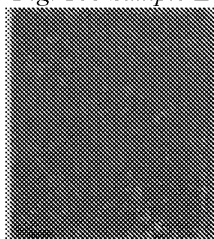
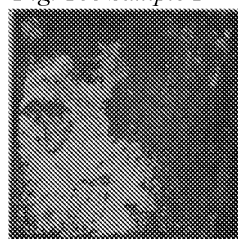


Fig. 10c Sample F



Thermal Cycling Test of the Coating system of the invention: Cross-section SEM after 100 cycles (a) and after 500 cycles (b) at 1310°F(710°C) with deposit of Mixture B sulfates

Fig. 11a

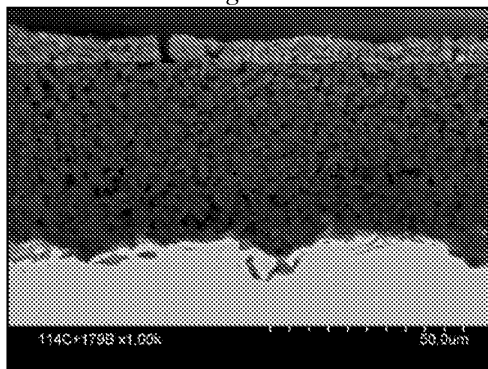
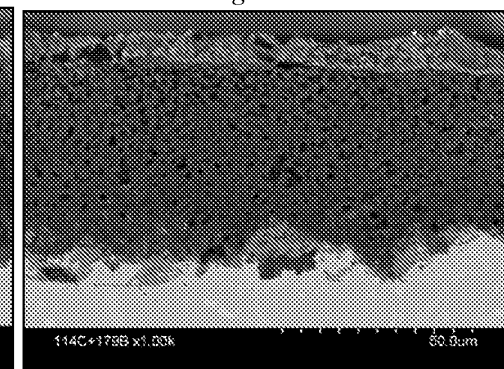


Fig. 11b



*Thermal Cycling Test with Mixture B sulfate deposit at 1310°F(710°C):
Cr (VI)-containing Coating of Example 4 as-prepared (a), after 100 (b) and after 500 cycles (c)*

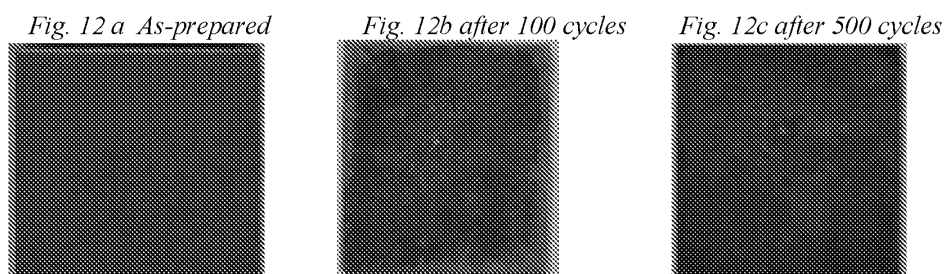


Fig. 13 Thermal Cycling Test with Mixture B sulfate deposit at 1310°F(710°C): Bare substrates vs. substrates coated with the Cr(VI)-free Coating System of the invention and Cr(VI)-containing Coating system of the prior art as in Comparative Example 1

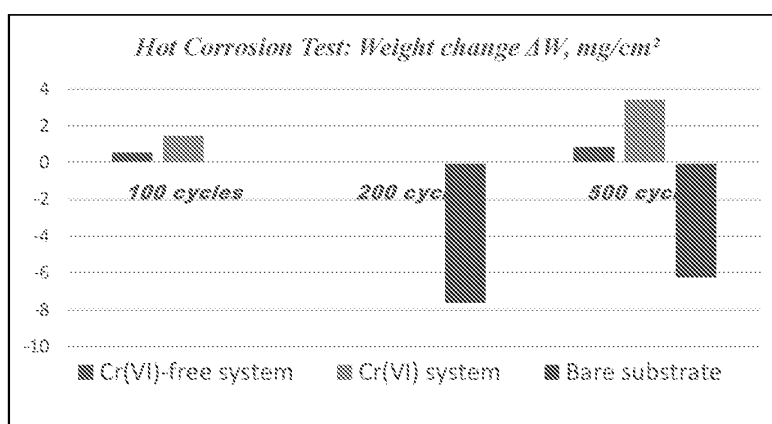


Fig. 14 Thermal Cycling Test with Mixture A sulfates at 1310°F(710°C) for 150 cycles: Bare substrates vs. substrates coated with the Cr (VI)-free Coating System of the invention and Cr (VI)-containing Coating systems of the prior art as in Comparative Example 2

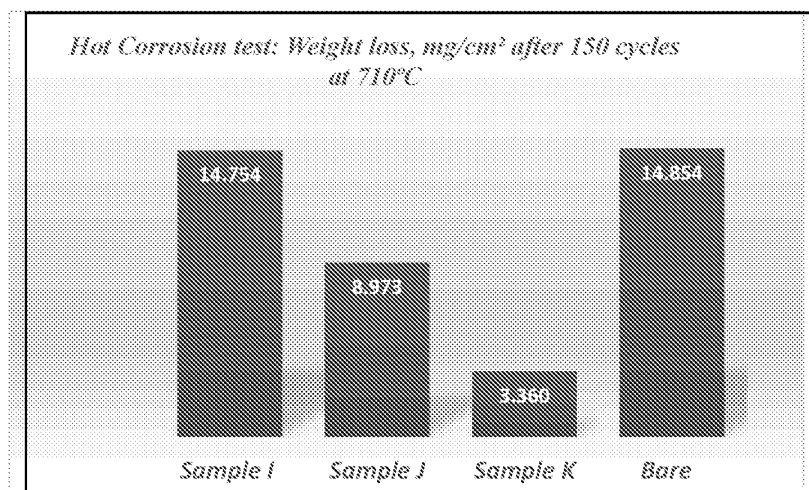


Fig. 15 Thermal Cycling Test with Mixture A sulfates at 1310°F(710°C) for 50 cycles: Substrates coated with the Cr (VI)-free Coating System with Li-doped Potassium silicate-based basecoat as in Comparative Example 3

