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High temperature molten salt corrosion behavior of aluminide and nickel-aluminide coatings for heat storage in concentrated solar power plants

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Abstract

Sprayed slurry aluminide and nickel-aluminide coatings deposited by means of electrodeposition and slurry application to 9 wt.% Cr P91 alloy were studied to mitigate molten salt corrosion in concentrated solar power plants. Both coatings were tested isothermally at 580ºC in contact with the Solar Salt (60% wt.% $NaNO_3$, 40 wt.% KNO_3) under static and dynamic conditions. Uncoated P91 showed considerable mass gains in both conditions and there was evidence of extensive spallation on both cases. Mass loss was therefore also measured after removing the corrosion products by chemical etching so that the corrosion rate could be better estimated. P91 developed a complex, fast growing multilayered oxide scale which included Fe_2O_3, Fe_3O_4 and $NaFeO_2$ in molten nitrates whatever the test conditions. All the coated systems and in particular the nickel-aluminide coating in contact with the Solar Salt up to 1000 h performed much better than the uncoated material as they exhibited lower weight variations and no evidence of significant spallation. The aluminide coating developed a thin Na ferrite scale as shown by SEM-EDS and XRD after testing under static conditions. On the tested nickel-aluminide coating $NiAl_2O_4$ was detected only by XRD, so it is not possible to establish