Abstract

This work addresses the problem of high-temperature corrosion resistance in environments containing liquid salts based on sodium and magnesium sulfates, as well as vanadium pentoxide. It also explores thermal barrier coatings based on $Nd_2Zr_2O_7$ zirconates (single-phase coatings) and composite coatings of the $Nd_2Zr_2O_7$+8YSZ and $Nd_2Ce_2O_7$+8YSZ types.

The conducted studies demonstrated that the corrosion resistance of the tested coating systems in a liquid Na_2SO_4 environment is satisfactory for the $Nd_2Zr_2O_7$ coating. The addition of the $MgSO_4$ salt intensifies the corrosion processes, which result from the formation of salt eutectics with a lower melting point than Na_2SO_4. The introduction of V_2O_5 oxide to the system dramatically increases the corrosion process, associated with the formation of neodymium vanadate. Due to the intense corrosion processes, the tested coating cracked and completely fell off the IN-625 alloy-based substrate.

To increase the durability of the TBC systems, further testing was performed on $Nd_2Zr_2O_7$ + 8YSZ composite barriers, which were intended to demonstrate greater overall durability against aggressive corrosive environments. Analyses showed that the modified $Nd_2Zr_2O_7$ + 8YSZ system did not exhibit any tendency to fall off during the corrosion resistance tests. Tests in liquid Na_2SO_4 and Na_2SO_4 + $MgSO_4$ deposits revealed the decomposition of the $Nd_2Zr_2O_7$ pyrochlore phase into non-stoichiometric fluorite phases, which is the result of either the depletion of the pyrochlore phase in Nd_2O_3 oxide or the introduction of Y_2O_3 oxide into the pyrochlore. This resulted in a reduction in the ratio of the average radius of the neodymium and yttrium cations to the radius of the zirconium cations to the range corresponding to the stability of the fluorite phase. The introduction of V_2O_5 oxide into the environment resulted in the formation of neodymium and yttrium vanadate, which additionally resulted in the formation of monoclinic ZrO_2 oxide.

For the second type of composite coating based on neodymium cerate, the analyses conducted showed that the resulting systems were characterized by high phase stability. No decomposition of the $Nd_2Ce_2O_7$ fluorite network into non-stoichiometric forms was observed. The main symptom of the corrosion process was the formation of neodymium oxysulphates. In the presence of V_2O_5 oxide, interaction products in the form of neodymium vanadate and neodymium oxide-depleted $Nd_{0.4}Ce_{0.6}O_{1.8}$ cerates were observed.