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Thermal Cycling Performance of $La_2Ce_2O_7$/ 50 vol. % YSZ Composite Thermal Barrier Coating with CMAS Corrosion

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Abstract:

$La_2Ce_2O_7$ (LC) is receiving increasing attention due to its lower thermal conductivity, better phase stability and higher sintering resistance than yttria partially stabilized zirconia (YSZ). However, the low fracture toughness and the sudden drop of CTE at approximately 350 °C greatly limit its application. In this study, the LC/50 vol. % YSZ composite TBC was deposited by supersonic atmospheric plasma spraying (SAPS). Compared to YSZ or double layered LC/YSZ coating, the thermal cycling life of LC/50 vol. % YSZ coating with CMAS attack increased by 93 % or 91 %. The latter possessed higher fracture toughness (1.48 ± 0.26 MPa·$m^{1/2}$) than LC (0.72 ± 0.15 MPa·$m^{1/2}$) and better CMAS corrosion resistance than YSZ owing to the formation of $Ca_2(La_xCe_{1-x})_8(SiO_4)_6O_{6-4x}$ with <001> orientation perpendicular to the coating surface. The sudden CTE decrease of LC was fully suppressed in LC/50 vol. % YSZ coating due to the change of temperature dependent residual stresses