DESIGN OF NOVEL γ' BONDCOATS AND INTERDIFFUSION WITH Re-RICH SUPERALLOYS

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Increasing the life of thermal barrier coating (TBC) systems critically relies on maintaining good adhesion between the bondcoat, the thermally grown oxide (TGO) and the topcoat. A common cause of failure, rumpling occurs as stress generated by oxide growth and thermal cycling results in creep of the mechanically weak bondcoat – this currently limits the life of EB-PVD TBCs with β coatings used in aircraft turbine blades and vanes. γ' coatings are known to present a better creep strength than β coatings and thereby markedly reduce rumpling, while still offering adequate oxidation resistance. The higher solubility of reactive elements (RE) in γ' also provides more flexibility in optimizing RE additions, as it limits the risk of overdoping; this can be used to further improve TGO adhesion. Furthermore, γ' compositions can, by essence, be adjusted to reduce the chemical potential mismatch with the substrate; this in turn will help curb the development of secondary reaction zones, which have become an issue when β coatings are used on Re-containing superalloys.

The poster will present recent efforts made at ONERA in the development of new γ' compositions for Re-rich substrates. Our current design strategy focuses on limiting substrate-coating interdiffusion and the associated loss of load-bearing section in the alloy. As mechanical properties improve and the bondcoat Al content is reduced, however, the bondcoat ability to maintain exclusive Al_2O_3 formation throughout extended cycling becomes critical to the system durability. Coating compositions are thus adjusted to a given alloy following the "equilibrium coating" concept, and then slightly modified to help maintain an appropriate composition relative to oxidation resistance. Compositions are assessed through the study of interdiffusion profiles obtained from both experiments and numerical simulations via a finite-difference method.