DEGRADATION OF ALUMINIDE TYPE BONDCOATS DUE TO OXIDATION AND INTERDIFFUSION: EFFECT OF BASE ALLOY COMPOSITION

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Key Words: NiAl-bondcoats, oxidation, interdiffusion, effect of base alloy elements.

NiAl-type bondcoats are commonly used in TBC-systems on Ni-based superalloys. The oxidation resistance and microstructural stability of the bondcoats are thus of primary importance for extended lifetimes of TBC-systems. During coating manufacturing and especially long-time service, incorporation of alloying elements from the underlying Ni-based superalloy such as C, B, Cr, Hf, Ti and Ta into the bondcoat occurs. As the alloy compositions are very much different between Ni-based alloy classes (e.g. wrought vs. cast) as well as between different alloys within one class (e.g. conventionally cast vs. e.g. single-crystal), the exact interdiffusion behavior of a particular system is difficult to predict. Extensive experimental work is typically required to study time and temperature dependent degradation of each coating system. Recently, modeling methods became available that in many cases allow accurate prediction of the interdiffusion effects thereby drastically reducing the lab efforts.

In the present talk, examples will be given on the behavior of several CVD-aluminized Ni-based superalloys during cyclic oxidation testing in the temperature range of 950 to 1150 °C. After the oxidation exposures the coating systems were characterized using GDOES and SEM / EDX / WDX / EBSD. A coupled thermodynamic-kinetic model was employed to describe the effect of the base material composition on the depletion processes and microstructural changes in the aluminide coatings. Combining experimental observations and modelling, the effects of alloying elements can be related to formation of precipitates in the interdiffusion zone (C, B), promotion of bondcoat microstructural changes (Cr, Ta, Ti), and incorporation into the TGO (Hf, Ti) strongly influencing its growth rate and adherence.