

New multipurpose coating systems based on novel particle technology for extreme environments at high temperatures

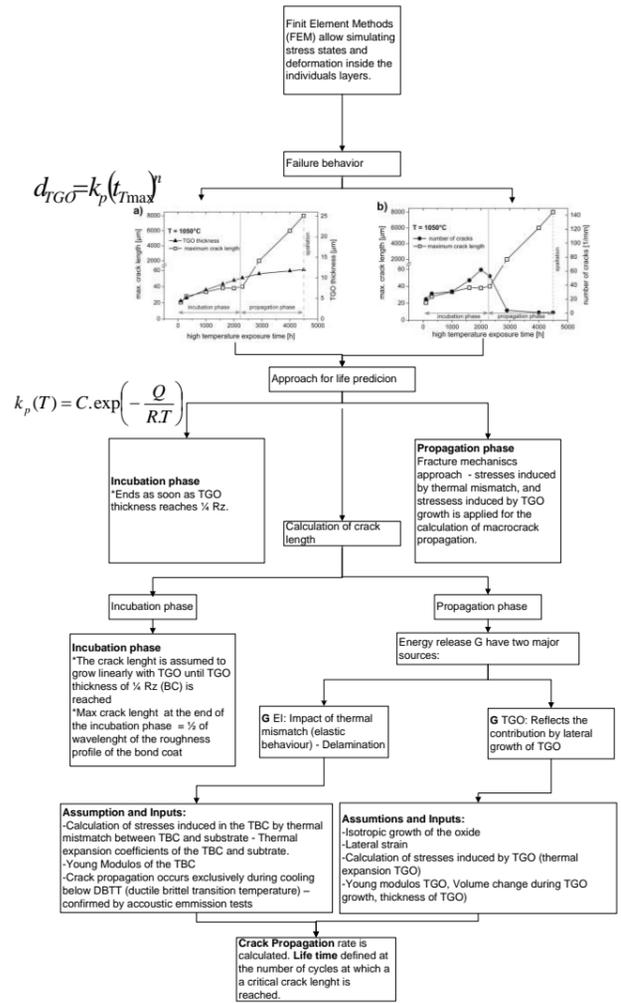
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Overview of general damage mechanisms for the components considered in PARTICOAT

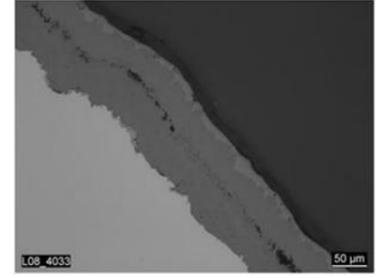
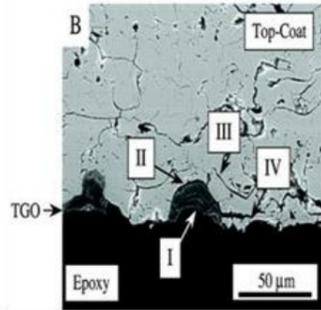
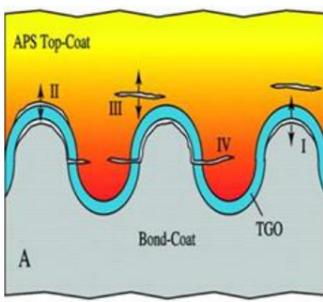
Most reasons for failure are among others:

1. Growth of the TGO leading to a specific local stress situation. The thermal-expansion mismatch between the TGO and the bond-coat leads to residual stresses in the TGO. The stresses create cracks in the TGO and the interface between TGO and the bond coat and thus induce the subsequent spalling off of parts of the coating;
2. The bond-coat is an oxidation-resistant metallic layer. Inward diffusion of oxygen through the TGO controls further growth of TGO into the bond-coat. This results in the depletion of Al in the remaining bond-coat. The formation of other oxides, such as Ni- and Co-containing spinels could be promoted. The formation of these phases weak the structural integrity of the TGO and accelerates localized oxidation.
3. Diffusion of elements can occur between the superalloy substrate and the bond-coat. This interdiffusion can have a profound influence on the spallation failure of the TBC.
4. Stresses arising from the thermal-expansion mismatch between the ceramic top-coat and the underlying metal create cracks, which may propagate in the TGO/bond-coat.
5. Oxidation of the metal induced by cracks in the coating/TGO
6. Abrasion of the top coat or hot corrosion effects



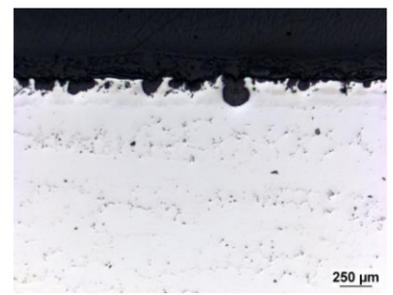
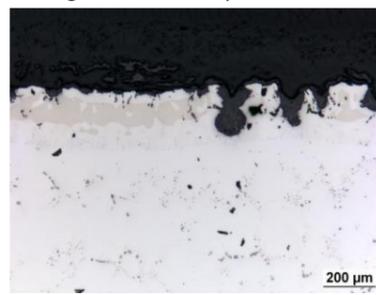
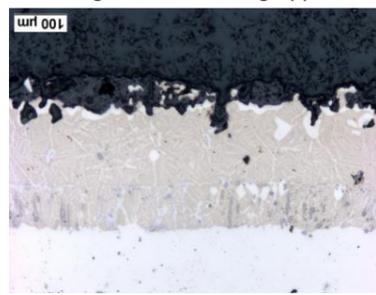
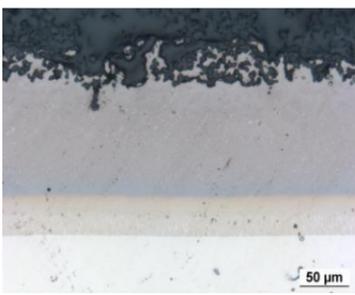
Principal damage mechanism

The mechanisms by which TBCs fail are varied, and the factors that are responsible are numerous. They are influenced by the continuously changing compositions, microstructures, interfacial morphologies, and properties of the TBC system. TBC failure in general is given by the spallation of the top-coat.



Changes of the layer thickness during isothermal exposure

The isothermal exposure of the PARTICOAT coating results in changes in thickness of different layers. With increasing time, the single TBC layers are getting harder to define. Even after a short period of time damages in the coating appears. This damage occurs mainly in the TGO.



Thicknesses of the TBC layers at different temperatures vs. time

The calculated values for the TGO thickness vary from the expected data. In general, the TGO can be described by a power function (Arrhenius-function), whose parameters are depending on the material and temperature.

