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CHALLENGES AND OPPORTUNITIES FOR PRIME RELIANT THERMAL BARRIER COATING SYSTEMS

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Thermal protection systems based on thermal barrier coatings are widely used in turbine engines for propulsion and power generation. They commonly comprise oxide thermal barriers coatings (TBCs) deposited on an intermetallic bond coat (BC), and provide simultaneous thermal and oxidation protection. The benefit of these coatings resides in their ability to inhibit degradation of the underlying structural superalloy component by thermo-mechanical fatigue and oxidation. Existing commercial coatings are well-engineered with established durability and cost benefits. However, they lose adhesion and spall from the underlying metal with cyclic thermal exposure. Because coating failure occurs in a stochastic manner, with no assured cyclic life, the coatings cannot be used in a prime-reliant manner. Prime reliability is only achievable if a high level of basic understanding is gained about failure mechanisms, and material responses, that arise upon thermal cycling. Because of differing manufacturing approaches and operating scenarios, several specific mechanisms are involved. Present understanding of these phenomena has highlighted several nuances and challenges in developing thermal barrier coatings for use as prime-reliant components. This talk will review the current understanding of factors affecting coating durability and presents relationships between the durability, the governing material properties and the salient morphological features. The durability of thermal barrier coatings is governed by a sequence of crack nucleation, propagation and coalescence events that accumulate prior to final failure by large scale buckling and spalling.