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A DESIGN PERSPECTIVE ON THERMAL BARRIER COATINGS

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This technical paper addresses the challenges for maximizing the benefit of thermal barrier coatings for turbine engine applications. The perspective is from a customer's viewpoint, a turbine airfoil designer, who is continuously challenged to increase the turbine inlet temperature capability for new products while maintaining cooling flow levels or even reducing them. This is a fundamental requirement to achieve increased engine thrust levels. Developing advanced material systems for the turbine flowpath airfoils is one approach to solve this challenge; such as high temperature nickel based superalloys or thermal barrier coatings to insulate the metal airfoil from the hot flowpath environment. The second approach is to increase the cooling performance of the turbine airfoil, which enables increased flowpath temperatures and reduced cooling flow levels.

Thermal barrier coatings have been employed in jet engine applications for almost 30 years. The initial application was on augmenter liners to provide thermal protection during afterburner operation. However, the production use of thermal barrier coating in the turbine section has only occurred in the past 15 years. The application was limited to stationary parts, and only recently incorporated on the rotating turbine blades. This lack of endorsement of thermal barrier coatings resulted from the poor initial durability of these coatings in high heat flux environments. Significant improvements have been made to enhance spallation resistance and erosion resistance which has resulted in increased reliability of these coatings in turbine applications.