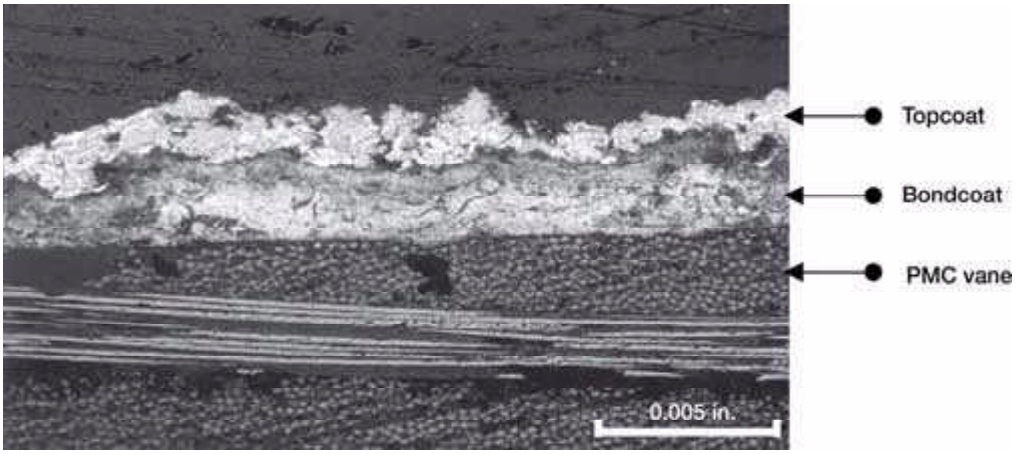
NASA Glenn/AADC Collaboration Optimized Erosion Coatings for Inlet Guide Vanes



Glenn's coating on a PMC inlet guide vane.

There is a need for lightweight, durable materials and structures to reduce the weight of propulsion systems. Polymer matrix composites (PMC's) are promising materials for aerospace applications because of their high strength-to-weight ratio relative to metals. Unfortunately, they are limited to applications where they are not exposed to high-temperature oxidizing atmospheres and/or particulates from ingested air. This is because oxidation and erosion occur on the surface, leading to weight loss, nodulation, and/or cracking on the surface, and a consequent decline of mechanical properties over time.

Although prior research has shown that oxidation can be slowed when metallic or ceramic coatings are applied onto PMC's, there remains a need for erosion-resistant coatings that protect PMC's from high-velocity particulates in the engine flow path. These erosion-resistant coatings could extend the life of polymer composites. Polymer composites are heavily damaged without an erosion-resistant coating because they are not as hard as metallic engine structures.

The effectiveness and life of the coatings depends on their inherent properties as well as on the interaction between the coating and the PMC. Since polymers, in general, have high thermal expansion coefficients in comparison to metals and ceramics, failure of the coatings often occurs at this interface. The objective of this research is to develop strategies to improve this interface and tailor overlays for erosion resistance (see the photomicrograph). The bondcoat, which was developed at the NASA Glenn Research Center, is composed of zinc blended with polyimides to improve the compatibility between the PMC and the overlay material. Initial coating trials at AADC produced vanes that had poor bonding between the overlay and bondcoats. Subsequently, Glenn successfully demonstrated that high-quality plasma-sprayed erosion coating systems could be applied

to these guide vanes. Inlet guide vanes from AE 3007 engines fiber composites were coated using a coating system composed of a bondcoat and a hard topcoat (see the preceding photomicrograph). Optimization of the plasma spray process has led to plans for future erosion testing in gas turbine engine environments.

NASA Glenn erosion coating on a PMC inlet guide vane section.

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