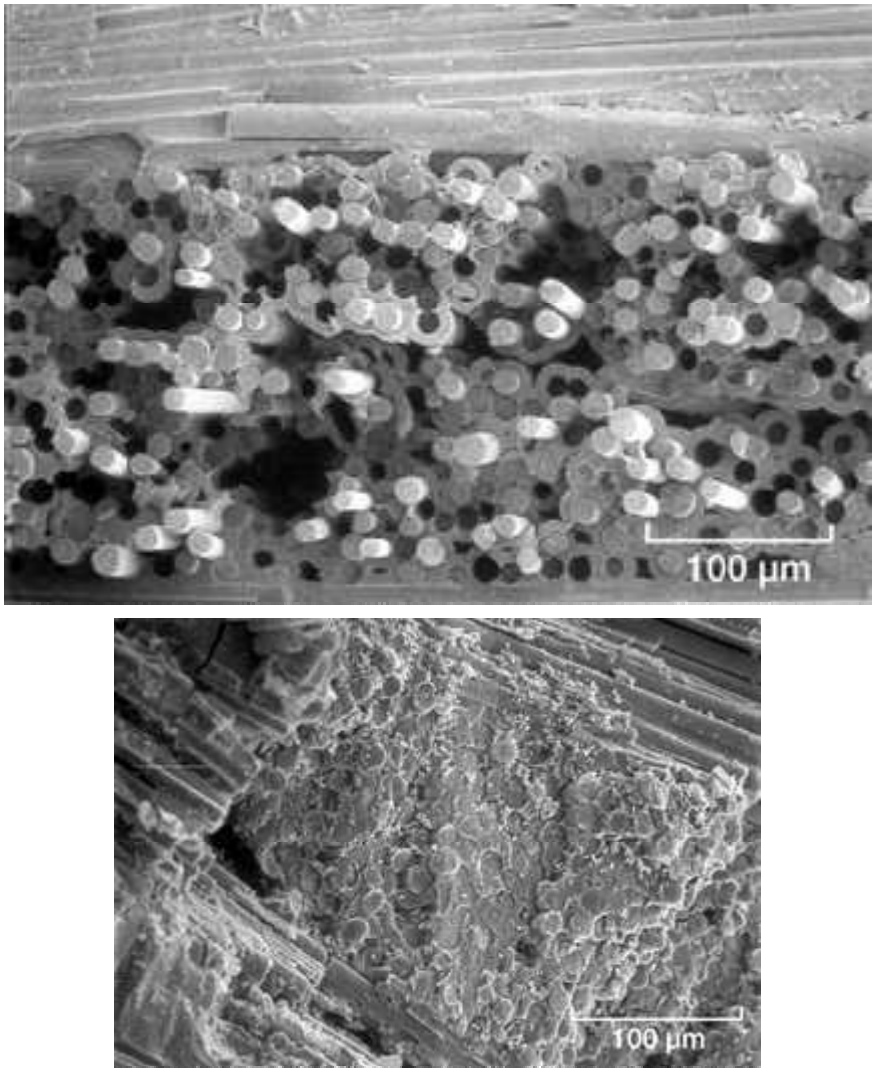
# Interfacial Thickness Guidelines for $SiC_{Fiber}/SiC_{Matrix}$ Composites

Researchers at the NASA Lewis Research Center have developed a guideline for the interface thickness necessary for $SiC_{Fiber}/SiC_{Matrix}$ composites to demonstrate good composite properties. These composite materials have potential commercial applications for high-temperature structural components such as engine hot sections. Several samples of each were composed from three different small-diameter (less than 20 μm), polymer-derived SiC fibers that were woven into two-dimensional cloths and laid up as preforms. The preforms were treated with a chemical-vapor-infiltrated boron nitride layer as an interfacial coating on the fiber surfaces to provide the necessary debonding characteristics for successful composite behavior. Then, the preforms were filled with additional SiC as a matrix phase.

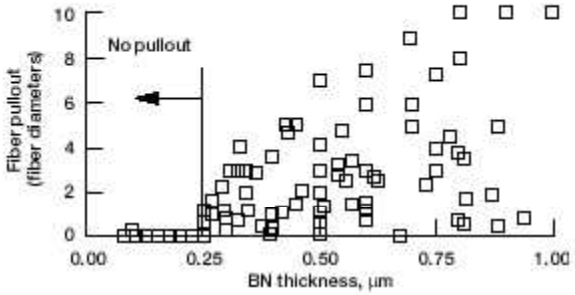



*Top: Good fiber pullout from the matrix. Bottom: Brittle fracture of fiber and matrix.*

We found that the interface thickness must be at least 0.25 μm for the fiber to decouple from the surrounding matrix. An example of this decoupling is shown in the photo on the left. When the interface was less than 0.25 μm, the fracture front passed through both the fiber and matrix as a unit, as shown in the photo on the right. The fiber was bonded within the matrix and behaved as a brittle monolithic material. Both fiber debonding and brittle fracture may occur within the same specimen and often within immediately adjacent areas.

In addition, we found that an interface thickness greater than 0.5 μm did not provide a substantial benefit. Investigations of the microstructure and fracture surfaces of numerous samples containing fibers made by different manufacturers and by different processes all required the same interface thickness of 0.25 μm of boron nitride to assure that fibers would decouple from the matrix. Measurements of fiber pullout length versus interface thickness shown in the following graph illustrate the 0.25-μm-thickness requirement.

We also found that the surface roughness of the fiber did not affect the required interface thickness. It had been previously proposed that a rough fiber surface might require a thicker interface thickness to overcome potential mechanical interlocking of adjacent fiber surfaces. Samples containing fibers with the greatest degree of surface roughness still required a thickness of 0.25 μm for decoupling to occur.




*Interface thickness guideline. Pullout lengths for small-diameter SiC fibers.*

# Bibliography

Hurst, J.B.; Freedman, M.R.; Kiser, J.D.: Fracture Surface Observations for SiC Fiber/SiC Matrix Composites. Paper presented at the 20th Annual Conference on Composites, Materials & Structures, Cocoa Beach, Florida, Jan. 1997.

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