
Plasma wind tunnel test of UHTCMC leading edge prototypes in hypersonic conditions

**Diletta Sciti¹, Antonio Vinci¹, Luca Zoli¹, Matteo Mor¹, Francesca Servadei¹, Pietro Galizia¹,
Alessandro Airoidi², Antonio Maria Caporale², Daniele Guida³, Mario De Stefano Fumo³**

¹*CNR-ISSMC, National Research Council of Italy - Institute of Science, Technology and Sustainability for Ceramics, Via Granarolo 64, 48018 Faenza, Italy*

²*Politecnico di Milano, Department of Aerospace Science and Technology – Milan, Italy*

³*CIRA, Italian Aerospace Research Centre - Capua, Italy*

diletta.sciti@issmc.cnr.it

Abstract

For the first time, prototypes of UHTCMC with a leading-edge profile were evaluated in a hypersonic plasma wind tunnel at CIRA in Italy. Two sets of samples were produced: one set involved machining UHTCMC manufactured by impregnating unidirectional carbon preforms with a 0/90° architecture, followed by sintering and EDM machining. The unique geometry of the leading edge caused the fiber orientation to deviate from the outer profile. The second set comprised three leading edges created through polymer infiltration and pyrolysis to achieve a near-net shape prototype with fiber alignment along the profile.

All six prototypes were placed in a customized sample holder (Fig. 1) and exposed to a high enthalpy flow in the Scirocco plasma wind tunnel facility. Notably, the two types of prototypes, due to different manufacturing processes, exhibited distinct compositions, leading to variations in thermal behavior. The temperature for sintered samples gradually increased to around 1900°C, while for PIP-derived samples, the temperature immediately rose to 2000°C with a constant profile. Following three minutes of stable flux conditions, the samples were cooled down to room temperature, undergoing a slight weight change.

Microstructural analyses were conducted to thoroughly investigate the materials oxidation, and mechanical tests were scheduled to understand the strength degradation caused by exposure in the Scirocco environment.

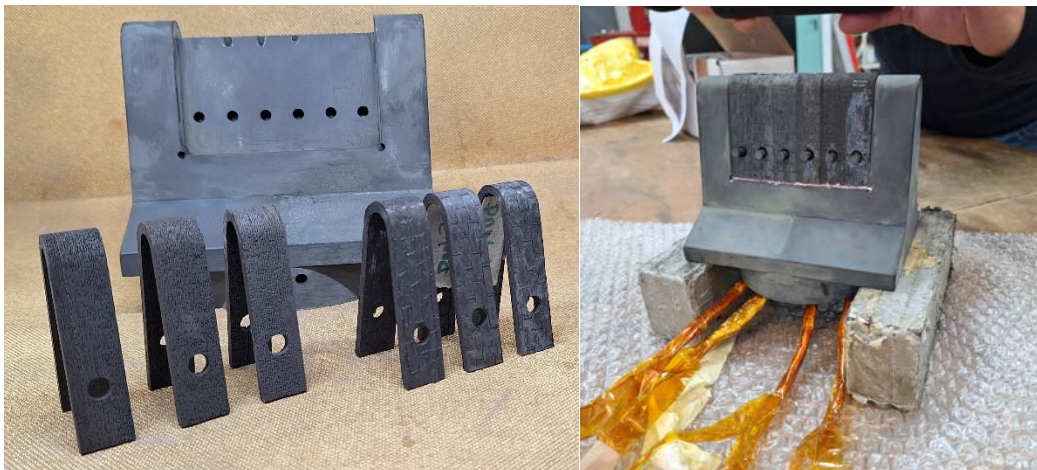


Figure 1: (Left) leading edge prototypes and (right) their placement in the sample holder with four thermocouples
