PLASMA WIND TUNNEL CHARACTERIZATION OF PLASMA SPRAYED UHTC COATINGS

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Ceramic coatings are widely used as thermal barrier or as oxidation barrier, in many industrial applications. The use of UHTC is mandatory when dealing with hypersonic vehicles characterized by high thermal flux in oxidizing environment.

Since 2000, in the framework of the national aerospace research program (PRORA-SHS) and within various other National and European programs, CIRA has studied, developed, and tested monolithic UHTCs and UHTC coatings on different high temperature structural materials. Small winglets and nose made in UHTC (EXPERT and SHARK project) or UHTC coated (SCRAMSPACE project) were designed, manufactured and installed on rockets or re-entry vehicles for in-flight qualification. Unfortunately, only the SHARK nose tip experienced the flighty environment.

CIRA and CSM is developing and improving the features and the capabilities of the UHTC coating by plasma spray on metals. Some specific metallic interlayers with the aim to permit the use of metal alloys even in most severe thermodynamic conditions and at higher temperatures. A wide campaign for characterization and selection of ceramic coatings, substrates and spraying techniques were already performed [1].

Figure 1 – GHIBLI PWT TEST

More recently, in the framework of an agreement between the US Department of Defense and the Italian Ministry of Defense, AFRL and CIRA are cooperating on the development and test of UHTC coatings on CMC materials [2]. In particular, different combinations of US and Italian CMC substrates and UHTC coatings will be tested in the CIRA plasma wind tunnel facilities. Initial test campaigns on small samples are currently carried out in the 2MW facility GHIBLI. In the next phase of the activity, larger metallic and CMC components UHTC coated will be tested in the 70MW SCIROCCO facility, to characterize the behavior of the proposed materials combinations under representative conditions of hypersonic flight, using also representative geometries (Nose cones and wedges).

The paper shows CIRA results obtained with UHTC coating on metallic substrates. Then, it is focused on the three coupons with AFRL substrates and Italian UHTC coating that have been recently tested in the GHIBLI plasma wind tunnel in representative environment, achieving temperature beyond 1800°C. Furthermore, a brief overview of the next test activities on UHTC coated metallic and CMC coupons will be presented.

References:

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