C³HARME

NEXT GENERATION CERAMIC COMPOSITES FOR COMBUSTION HARSH ENVIRONMENTS AND SPACE

APRIL 2018

EDITORIAL

C³HARME is a research project funded under the EU's Horizon 2020 Framework Programme for Research and Innovation. Its main purpose is the design, testing and manufacturing of a new class of ceramic matrix composites based on ultra-high temperature ceramics.
The new UHTCMC materials should be suitable to operate in severe aerospace environments, with applications in rocket nozzles and vehicles for hypersonic re-entry. The 8M€ project, started in June 2016, will run for 4 years and involves 12 partners from 6 European countries. Every 6 months, our newsletter shares relevant news and a summary of our achievements. If you wish to be updated with C³HARME's progresses, sign up on our website (www.c3harme.eu).

In the meantime, enjoy reading!

Diletta Sciti
Project Coordinator

NEWSLETTER #1

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C³HARME VIDEO

Would you like to see the C³HARME personnel in action? Now you can with our official video, available on the C³HARME YouTube channel! The video, produced in collaboration with the Material Research Society, features interviews of key personnel and shots of the facilities involved in the project.

Check it out at this link!

WWW.C3HARME.EU

PARTNERS

ISTEC-CNR
UNIVERSITY OF NAPLES
UNIVERSITY OF BIRMINGHAM
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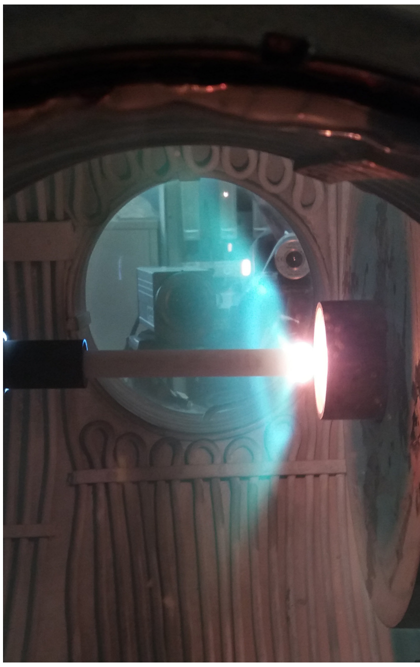
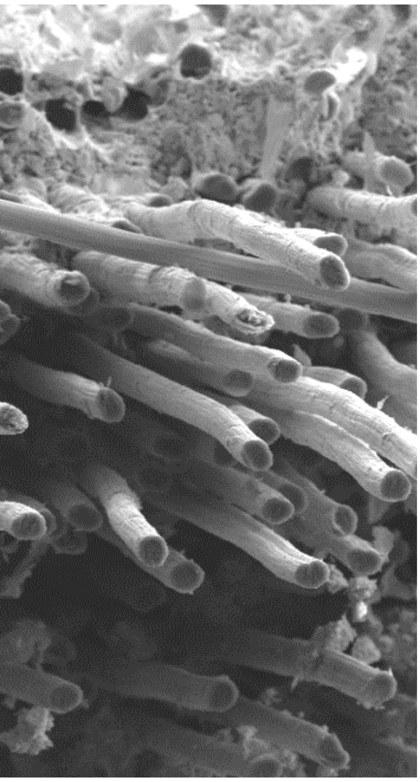
SIMULATING & TESTING PROPULSION AND RE-ENTRY



Halfway through its journey, C³HARME is carrying out an extensive experimental campaign to characterize and validate the performance of the new-class UHTCMC materials. To correctly represent space propulsion and hypersonic re-entry, experiments are performed in relevant laboratory environments (TRL 4), namely the Aerospace Propulsion Laboratory and the SPES (Small Planetary Entry Simulator) arc-jet facility, both available at the University of Naples "Federico II", which has proven experience in aero-thermo-dynamics and rocket propulsion research.

The experimental campaign is complemented by computational simulations carried out by the University of Naples. In fact, the extremely complex flow conditions in rocket combustion chambers or in high-enthalpy plasma wind tunnels hinder the measurement of several relevant parameters. Numerical models, based on fluid mechanics (Computational Fluid Dynamics, CFD) and experimental data, come in handy to accurately predict the aero-thermo-chemical conditions around and inside the samples and to quantify many parameters. So far, the simulated results have helped to improve the test design and provided additional information about the expected behaviour of the ceramic materials, paving the way for future tests and higher TRL.



THE MOST PROMISING MANUFACTURING ROUTES

The C³HARME team is actively investigating how to adapt existing and well-established technologies for the production of two prototypes made of the new UHTCMC material: TPS tiles and rocket nozzles. The four selected techniques are generally used to produce either bulk ceramics like the spark plasma sintering (SPS), or ceramic matrix composites, like the chemical vapour infiltration (CVI), the reactive melt infiltration (RMI) and the polymer infiltration and pyrolysis (PIP). Hybrid approaches that integrate two of the selected techniques are also under investigation, but further work is needed to fully characterize them.

During the last year, the preliminary results have suggested that the production of TPS tiles is feasible with either SPS (by ISTEC and TECNALIA) and/or with a special type of CVI (radio frequency CVI, by the University of Birmingham). For rocket nozzles, however, the shape and size make their production more challenging and, so far, the best solutions identified are either SPS or hybrid techniques based on RMI (by DLR). RMI alone is very expensive, but when combined with other approaches its potential is highly enhanced. PIP processing (by Airbus), is equally promising as it can be used to improve oxidation and to include the self-healing properties but, again, the scale-up is feasible only for the TPS prototypes. Future work will focus exclusively on the routes that prove to yield the required properties while being the most cost-effective solution.