



**LIGHT-TPS - Super Light-Weight thermal protection system for space application**

## **Short introduction to TECNALIA and its expertise related to LIGHT-TPS**

Dr. Jorge Barcena & Dr. María Parco, Tecnalia Research & Innovation

Kick-off Meeting, TECNALIA – San Sebastian, 28.05.14

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# SHORT INTRODUCTION TO TECNALIA

TECNALIA has come into being as a global project.

As a result of the merger of 8 technological centres, we have combined our capabilities and energy to work towards a common goal:

**Generating and developing  
business opportunities through  
applied research.**

We are the leading private R+D+i entity in Spain and the fifth largest in Europe, with a **staff of over 1,500** and a annual turnover of approximately **140 million** Euros.

**A unique  
commitment,  
an opportunity,  
a challenge**





## An open mind.

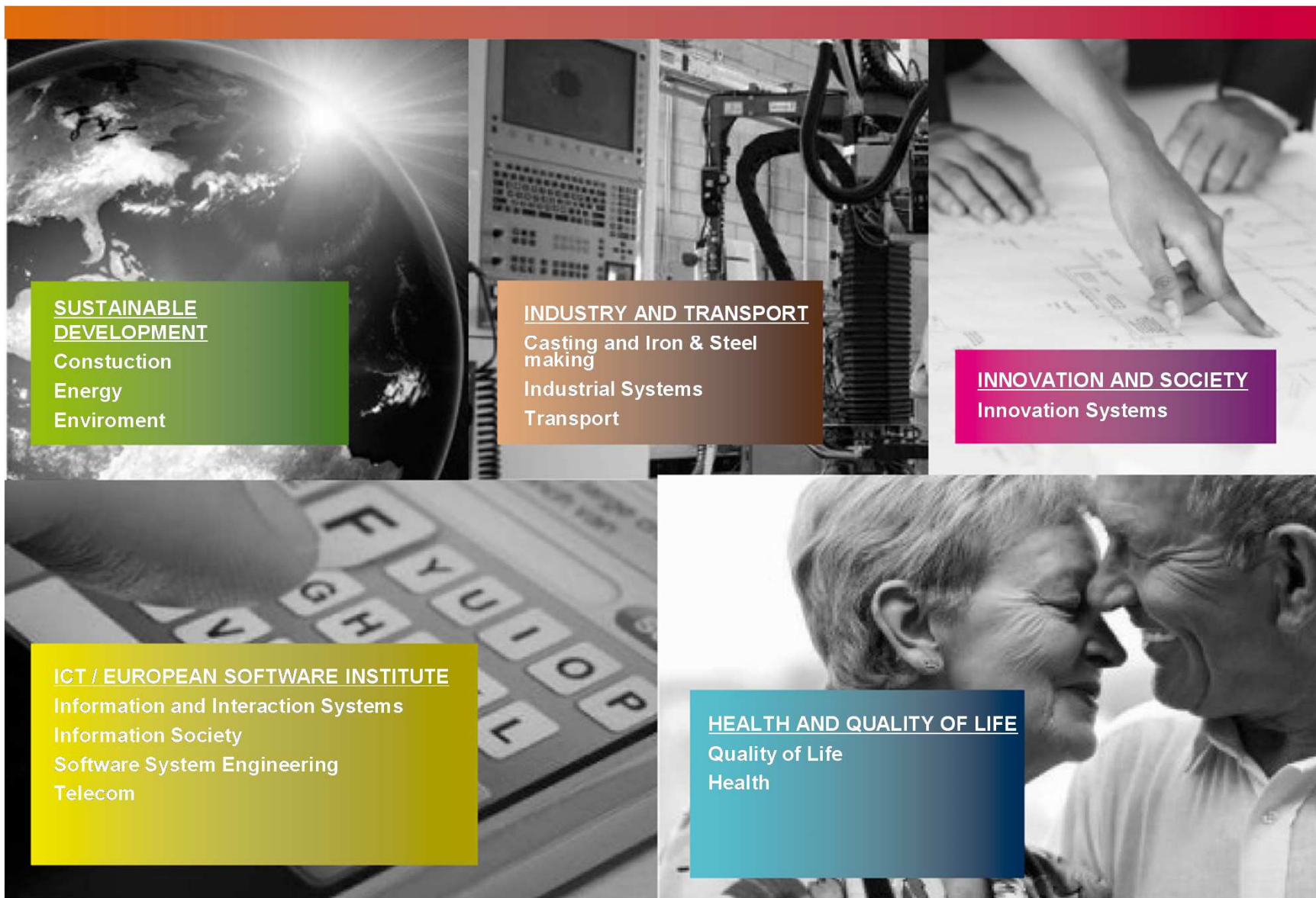
We network with leading technological organisations to enhance our capabilities and learning, in order to efficiently bring products and services to market.

We collaborate through:

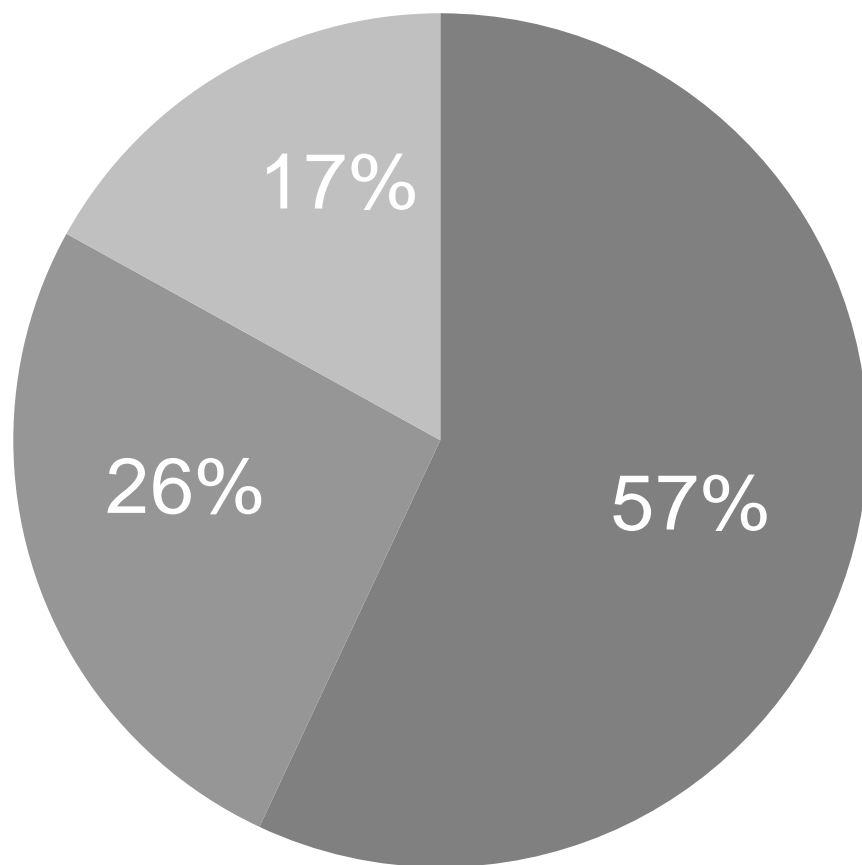
- Fixed investments.
- Technological alliances.
- Commercial alliances.
- Joint ventures.

Germany (Tübingen and Munich), Argentina (Buenos Aires and Rosario), Belgium (Antwerp), Brazil (Rio Grande do Sul, Brasilia DF, Paraná and Porto Alegre), Bulgaria (Sofia), Chile (Santiago), China (Hong Kong), Colombia (Bogota and Manizales-Caldas), Korea (Seoul), Denmark (Aalborg), Ecuador (Quito), Spain (Badajoz, Barcelona, Bilbao, Huelva, Madrid and San Sebastián), Egypt (Cairo), U.S.A. (West Virginia and Florida), Finland (Espoo), France (Montpellier, Anlet and Versailles), Hungary (Budapest), Ireland (Co. Galway), Italy (Pisa and Torino), Panama (Panama), Peru (Lima), Portugal (Amadora and Porto), U.K. (London and Witney, Oxfordshire), Dominican Republic (La Caleta Boca Chica), Serbia (Belgrade), Uruguay (Montevideo) and Venezuela (Mérida).

# Short introduction to TECNALIA



# Our figures



**140**  
million Euros  
income

Distribution of income:

- Projects under contract
- Competitive public funding
- Non-competitive public funding



**53** patents filed

**11** granted

**3** licenced

**2 M €** income from licences

Share participation in **35** NTBCs.

## VII Framework Programme



TECNALIA is Spain's leading private entity in terms of FP7 income.

TECNALIA manages an office to support companies with their European and International projects (OPEI)

Figures: 2007 - November 2010

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# EXPERTISE OF TECNALIA RELATED TO LIGHT-TPS

# Tecnalia's expertise related to LIGHT-TPS



# Tecnalia's expertise related to LIGHT-TPS

**AERONAUTICS**

- ADVANCED MATERIALS
- ENGINEERING
- TESTING BENCH
- COMMUNICATIONS
- EMC CERTIFICATION
- TROUBLE & RESOURCE MGMT
- MAINTENANCE
- CMMI & SPICE ASSESSMENT

**SPACE**

- ELECTRONIC PROPULSION
- SOLID LUBRICANTS
- TPS
- CRITICAL SOFTWARE
- STABLE STRUCTURES
- INSTRUMENTS
- GaN THERMAL MANAGEMENT
- SPACELINK ESA TTP

**SECURITY**

- RACKS HOUSINGS
- UAV FOR SECURITY
- RADARS & RADOMES
- MANUFACTURING
- SENSORS

**tecnalia**  
aerospace

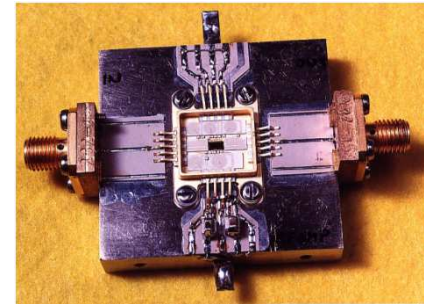
# Tecnalia's expertise related to LIGHT-TPS

## SPACE PRODUCTS

**Tribology  
Mechanism  
Materials**



**Electronic  
Packaging  
Materials**



**Telecom  
Antenna**

**Extreme  
temperature  
Materials  
Hot Structures**



**Propulsion  
Materials**



**Lightweight  
Stable  
Multifunctional  
Structures**



**Sensors  
Instruments**



**Space  
Technology  
Transfer**

# Tecnalia's expertise related to LIGHT-TPS

Hot structures-TPS materials portafolio: extreme conditions materials

	TRL1	TRL2	TRL3	TRL4	TRL5	TRL6
IMA orthorhombic Intermetallic Ti <sub>2</sub> AlNb alloy by Hot rolling	Blue	Blue	Blue	Blue	Blue	EXPERT
IMA gamma TiAlNb alloy by SHS process	Blue	Blue	Blue	White	White	White
IMA g-TiAlNb alloy by tape casting	Blue	White	White	White	White	White
IMC o-Ti <sub>2</sub> AlNb reinforced SiC fibers by PVD coating+HP	Blue	Blue	White	White	White	White
IMC o-Ti <sub>2</sub> AlNb Reinforced SiC-Hot rolling/HP (Fiber-Foil)	Blue	Blue	Blue	White	White	White
IMC g-TiAlNb Reinforced TiB-powder metallurgy process-HP	Blue	White	White	White	White	White
TMC-Titanium reinforced TiB particles	Blue	Blue	Blue	White	White	White
TMC-Titanium reinforced SiC fibers	Blue	Blue	Blue	Blue	Blue	White
TSW- Titanium based sandwich Ti skin-honeycom B21, foam	Blue	Blue	Blue	Blue	White	White
Brazing: CSiC-C/C, CSiC-CSiC, CSiC-PM1000	Blue	Blue	Blue	White	White	White
IMAF: TiAlNb foam	Blue	Blue	Blue	White	White	White
PCM based inserts for HT-Controlled CTE	Blue	Blue	Blue	White	White	White
Thermal paintings / T <sup>a</sup> indicators	Blue	Blue	Blue	Blue	White	White
Thermal barrier coatings CCr <sub>3</sub> NiCr (Plasma, HFPP/HVOF/OFI)	Blue	Blue	Blue	Blue	White	White
HT (1500°C) Fiber optic sensor HITOS on TPS	Blue	Blue	Blue	Blue	White	White
Ceramic heat shield-UHTC ZrO <sub>3</sub> B <sub>2</sub> /SiCp (SMARTEES)	Blue	Blue	Red	Red	White	White
Joining for TPS based ablative materials (HYDRA)	Blue	Red	Red	Red	Red	White

## Hot Structures and TPS – Programs + projects

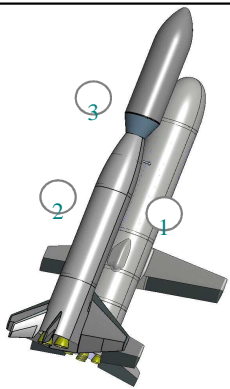
- IMC Hot Structures- RLV
- GammaTiAl testing FESTIP/X-38
- Smart TPS- EVEREST
- FLPP TPS & System engineering- RLV
- FLPP TPS & Hot Structures-RLV
- SHS Intermetallic Gamma TiAl –complex parts . A5 Vulcain turbine.
- EXPERT- IMC based TPS experiment on Reentry Capsule
- FLPP2-IXV smart tps intermetallic sandwich
- EXTREMAT CSIC-PM1000 integration
- Plansan materials vs PM2000. Development and characterization program. ESA TRP.



## Metallic TPS & Hot structures- Programs II

- IMA
  - Sandwich with PCM stand-off with PM2000 skins and FEI core
  - Characterisation at 700°C, plasma and thermal-vacuum

EVEREST Booster



Everest vehicle



- IMA  
Gamma-TiAl produced by SHS process.

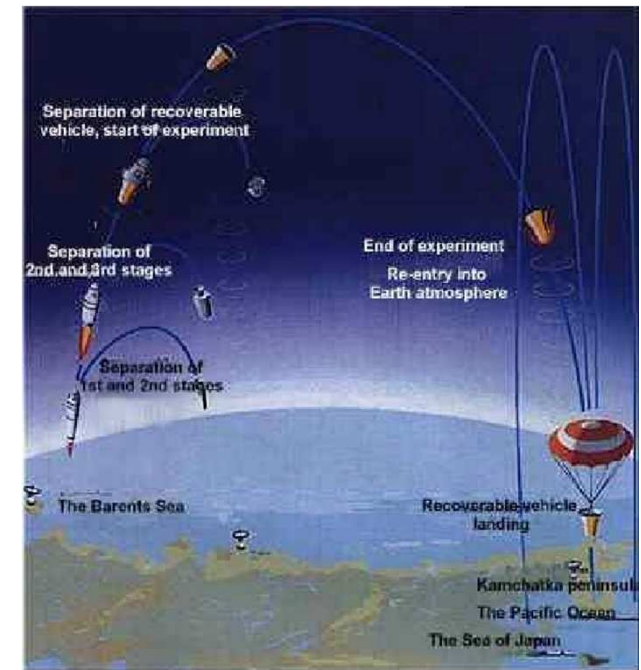
Creep, thermal & mechanical properties characterisation  
700°C

A5-VULCAN-Turbine blades



- **EXPERT PL18 Intermetallic TPS**

A new alloy with high temperature resistance is being developed, and tested in a entry probe Expert, launch waiting. Future concept for Launchers.



# Tecnalia's expertise related to LIGHT-TPS

Thermal barrier coating  
Ti based alloys at HT



# Tecnalia's expertise related to LIGHT-TPS

Manufacturing Equipment	CAD/CAE Systems	Testing Equipment
<ul style="list-style-type: none"> <li>• Autoclaves</li> <li>• RTM, resin infusion techniques</li> <li>• Injection machines: plastic, ceramic &amp; metal</li> <li>• Extrusion machines (polymers and ceramics)</li> <li>• Surface treatment: PVD, CVD &amp; Ion implantation, plasma (HVOF, HFPD...)</li> <li>• Casting of non ferrous alloys. Gravity, squeeze casting, thixocasting, HPDC, LPDC, investment casting, etc.</li> <li>• Ceramic manufacturing: Hot Press, sintering, microwave sintering...</li> <li>• Welding Machines: Electrical, Spot, TIG, MIG, Arc Plasma, EB and brazing</li> <li>• Laser machines: CO<sub>2</sub> Laser Gantry, Nd-Yag Laser</li> <li>• Spark Plasma sintering, HP,</li> <li>• Tape caster</li> <li>• Electronics Laboratory</li> <li>• Clean rooms: 10,000 &amp; 100,000</li> </ul>	<p>CAD</p> <ul style="list-style-type: none"> <li>• CATIA v5, ProEngineer, UGS NX</li> <li>• ProMechanica</li> <li>• VR: Alias Wavefront, Division</li> </ul> <p>Manufacturing Process Simulation</p> <ul style="list-style-type: none"> <li>• Autoform, Pam-Stamp, Pam-Crash</li> <li>• Sysweld</li> <li>• Robcad</li> </ul> <p>CAE</p> <ul style="list-style-type: none"> <li>• NASTRAN</li> <li>• ESARAD, ESATAN</li> <li>• I-DEAS, CATIA FE, Cosmos</li> <li>• ABAQUS</li> <li>• FLUENT</li> </ul> <p>Computer Platforms</p> <ul style="list-style-type: none"> <li>• WS: from PC to SGI</li> <li>• Analysis Servers: Multi CPU (Intel, SGI Origin 2000, etc.)</li> <li>• VR: SGI ONIX2 REALITY Graphical</li> </ul>	<ul style="list-style-type: none"> <li>• Vibration bench</li> <li>• Fatigue LCF, SCF test rigs</li> <li>• Flammability testing</li> <li>• Environmental fatigue &amp; stress corrosion (SC) tracking testing</li> <li>• Corrosion and oxidation at high temperature</li> <li>• Standard test under FSS &amp; MIL-ST for material certification</li> <li>• Static &amp; dynamic high temperature mechanical testing</li> <li>• Thermal Vacuum Chamber (TVC)</li> <li>• Physicochemical analysis systems</li> <li>• Non-Destructive Tests (NDT): US, X-ray &amp; Induced Currents</li> <li>• Tribology and wear</li> <li>• Microscopy and metallographic: AFM, XPS, SEM, RAMAN...</li> <li>• Stereo-microscopy for macrographs</li> <li>• Faraday Chamber for EMC</li> </ul>



## FEW EXAMPLES OF ADVANCED STRUCTURES JOINING:

### Knowledge and experience in

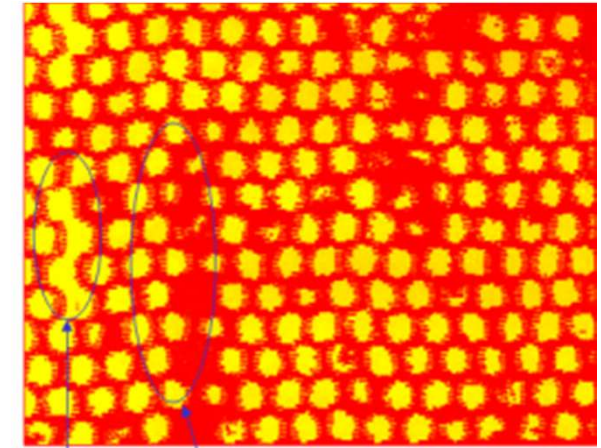
Brazing, Diffusion brazing processes.

Sandwich structures : Ti6Al4V

Ti beta 21

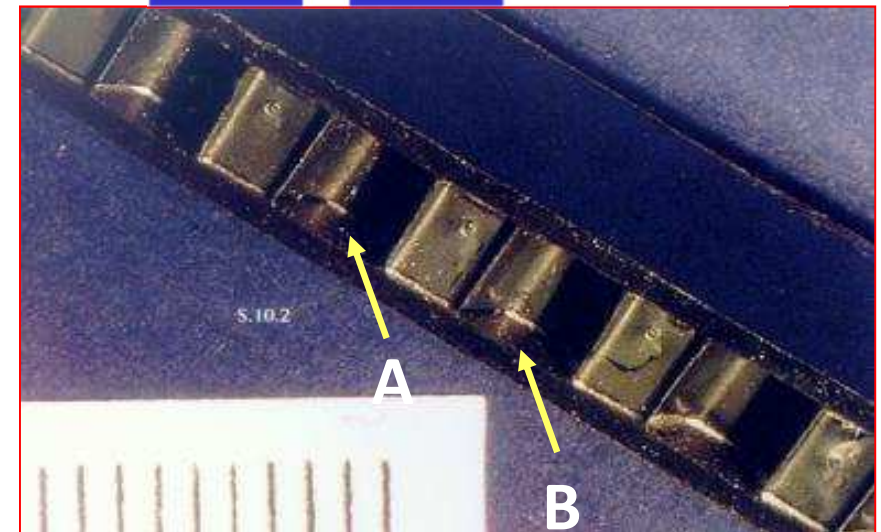
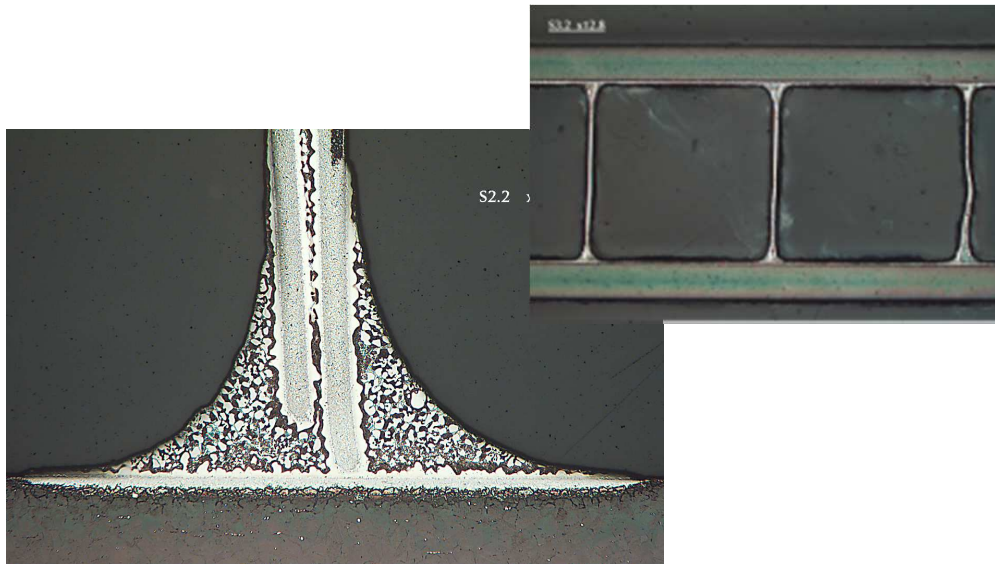
Inconel 625

Inconel 718



Zona 1

Zona 2



## Knowledge and experience in : Joining technologies



Sandwich structures with intermetallic porous materials as core and perforated material at skins.



Project related:

SILENCER  
NOISE  
MASALTE  
BRASATI



## Knowledge and experience in Joining technologies

### High temperature applications:

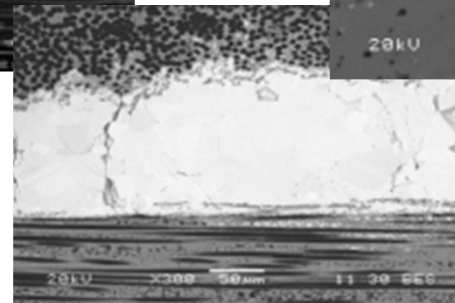
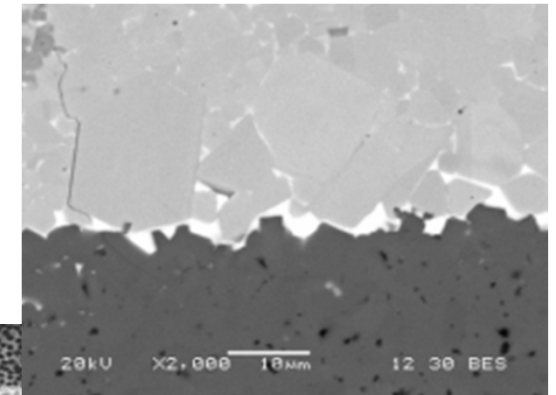
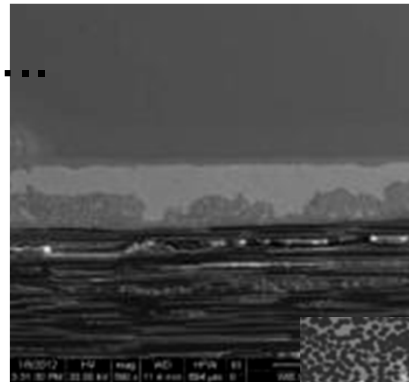
Joining SiC, C/SiC/ titanium, Nimonic 95, Nimonic 105.  
PM1000

### Ultra High temperature applications:

Joining SiC, C/SiC, Zrb2.....

### Main Projects related:

EXTREMAT  
HiTOS  
SMARTEES



### TECNALIA SKILLS & CAPABILITIES FOR THE PROJECT:

- EC Project management & dissemination
- TPS materials knowledge
- TPS and hot structures for spacecraft & launchers
- Advanced ceramics processing lab
- Joining technologies
- Thermal and mechanical characterisation facilities.
- Diffusion & promotion technology-networking.
- Exploitation/ technology transfer.



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**END OF PRESENTATION**

**Many thanks for your attention**