DEVELOPMENT OF SOFCs BY THERMAL SPRAYING

inasmet tecnalia

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location

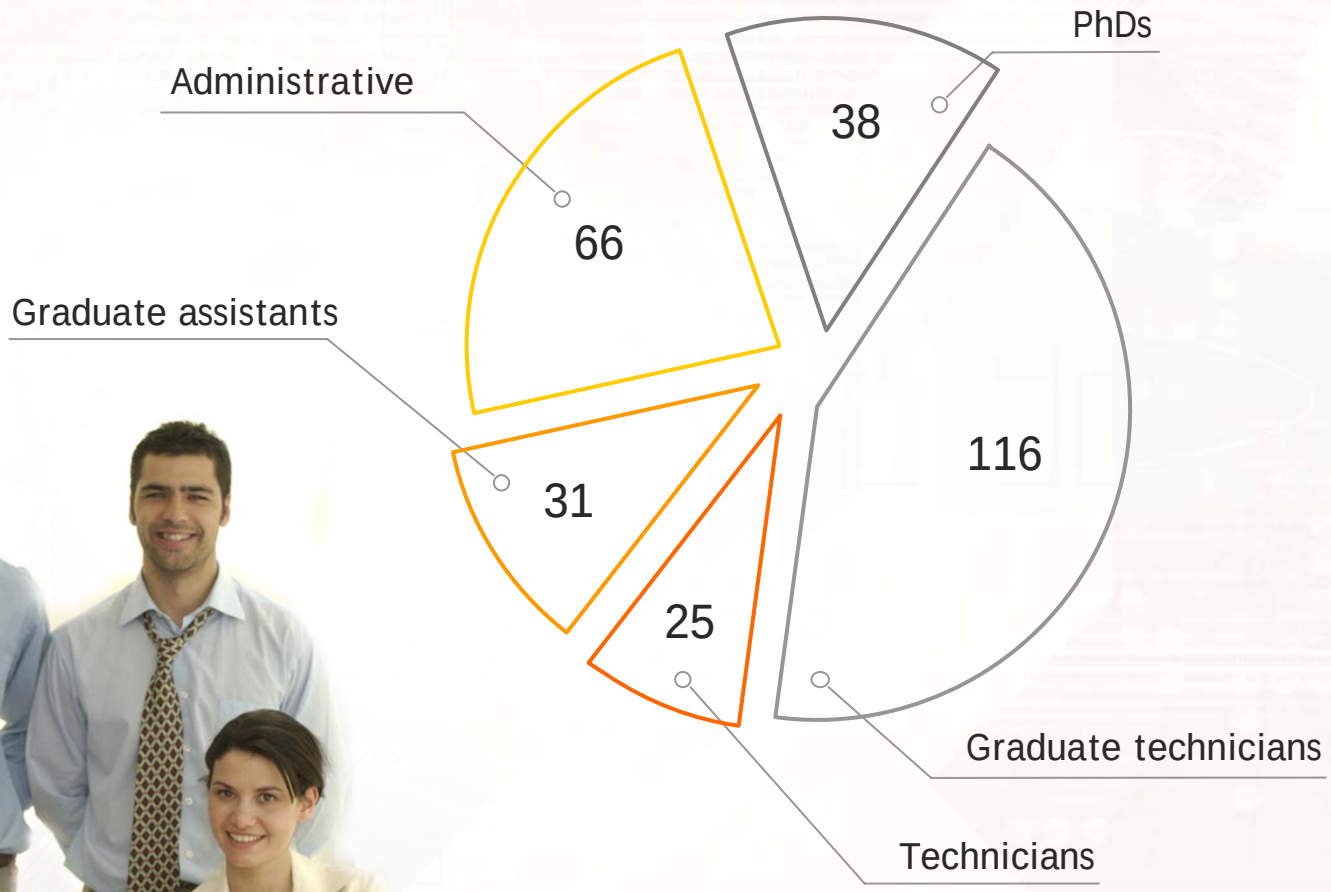
Headquarters
DONOSTIA-SAN SEBASTIÁN
16.000 m^2

Pilot plants
IRUN (GIPUZKOA)
2.000 m^2

Office
MADRID
200 m^2

Office
CÁDIZ
100 m^2

human resources 2007



TOTAL: 276 workers

tecnalia
Corporación Tecnológica

TECNALIA
Technological Corporation

Partners….

inasmet tecnalia

(since 2001)

labein tecnalia

(since 2001)

azti tecnalia

(since 2003)

robotiker tecnalia

(since 2001)

ESI European Software Institute tecnalia

(since 2004)

NEIKER
Instituto Vasco de Investigación y Desarrollo Agrario
Nekazal Ikerketa eta Garapenerako Euskal Erakundea

(in process of incorporation)

Activities

Aeroespacial

tecnalia energía

Automoción

Construcción

Energía

Fundición

Pesca, Naval y Transporte Marítimo

Siderurgia

Telecomunicaciones e Informática

1,100 staff members involved in research

Accumulates 60% of technological research in the Basque Country, 22.5% in Spain

The Energy Division is divided in three departments:

- **Hydrogen chain.**

  Development of materials and components for applications in the hydrogen chain as Fuel Cells, Electrolysers, materials for hydrogen storage, gas membranes,….

- **Materials for Renewable Energy.**

  Development and optimisation of materials and components for RE applications, specially for solar and wind energy.

- **Bioenergy.**

  Development of methods and processes for the production of new fuels and waste treatment.

Activities developed in the field of Hydrogen and Fuel Cells are:

ACTIVITIES IN HYDROGEN

◈ Production of Hydrogen

- ※ Thermal decomposition of Natural Gas
  - *Plasma Technology
  - *Thermal Catalytic Decomposition
- ※ Gassification (biomass)
- ※ Fermentation (biomass)

◈ Storage of Hydrogen

- ※ Composite light tanks
- ※ Metallic hydrides obtained by Self-Propagating High Temperature Synthesis (SHS)

◈ Safety in the use of Hydrogen as energy carrier

ACTIVITIES IN FUEL CELLs

◈Proton Exchange Membrane Fuel Cells (PEMFC)

- ※ Development of Membranes by Plasma Polymerization.
- ※ Deposition of catalysts by Physical Vapour Deposition (PVD).
- ※ New Materials and Coatings for bipolar plates.
- ※ Software for the design and modelling of PEMFC.
- ※ Fuel Cell Testing Equipment.

◈ Solid Oxide Fuel Cells (SOFC)

- ※ Development of Electrodes and Electrolyte by new Thermal SprayTechniques.
- ※ New Electrolyte Materials for medium temperature SOFC.
- ※ Fuel Cell Testing Equipment.

PLATFORMS AND ASSOCIATIONS

- European Hydrogen and Fuel Cell Platform / Implementation Panel / WG Cross Cutting Issues
- Full member of N.ERGHY
- Plataforma Tecnológica Española del Hidrógeno y las Pilas de Combustible / Grupos de Producción de H_2 / Almacenamiento / Capacidades
- Basque Contact Point Hidrógeno y Pilas de Combustible
- Red Española de Pilas de Combustible
- Asociación Española del Hidrógeno (AEH2)
- Asociación Española de Pilas de Combustible (APICCE)
- Member of the AENOR CTN 181 (Hydrogen Technologies) and CTN 206 / SC 105 (Fuel Cells)

RELATED PROJECTS

- SPAIN - PROFIT “Nuevas tecnologías de superficie para la producción de componentes de pilas de combustible tipo PEM”
- European project - EESD “Development of cost effective PEMFC for automotive applications” (OPTIMERECELL)
- European project - EESD “Development of cost effective and high quality planar solid oxide fuel cells by using advanced thermal spray techniques” (CEXICELL)
- European project - CRAFT “Development of low temperature and cost effective solid oxide fuel cells” (SOFCSPRAY)
- European project - CRAFT “Development of efficient software for optimization of performance of PEMFC” (PEMTOOL)

DEVELOPMENT OF SOFCs

Development of electrolyte layers by High Frequency Pulse Detonation (HFPD) spraying – Technology developed by Aerostar Coatings, a former spin-off from Inasmet

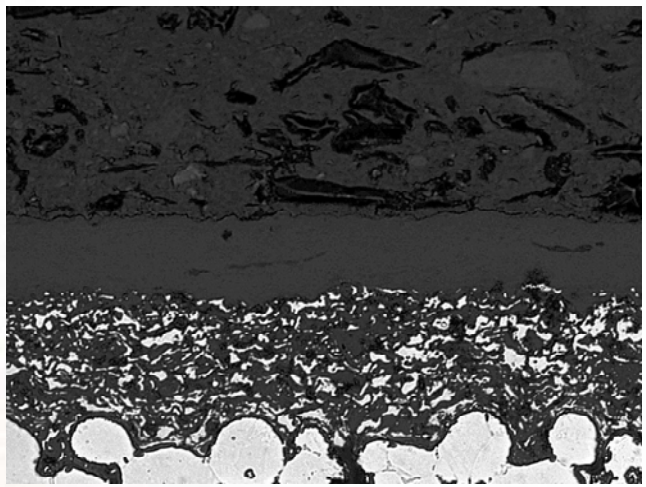
- Tested electrolyte materials
  - YSZ
  - Sc_2O_3 stab. ZrO_2
  - Gadolinium doped ceria (CGO)
- Advantages
  - Possibility to coat metal substrates with thicknesses down to 0,3 mm
  - Very dense ceramic layers in one spray pass using fine structured powders

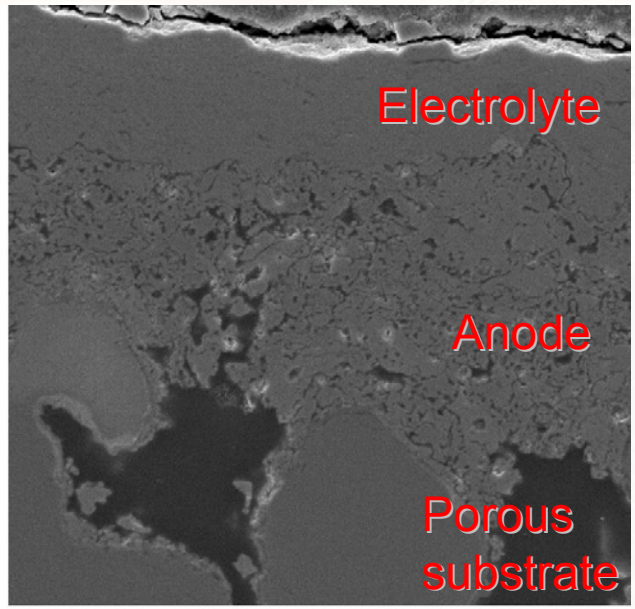
DEVELOPMENT OF SOFCs

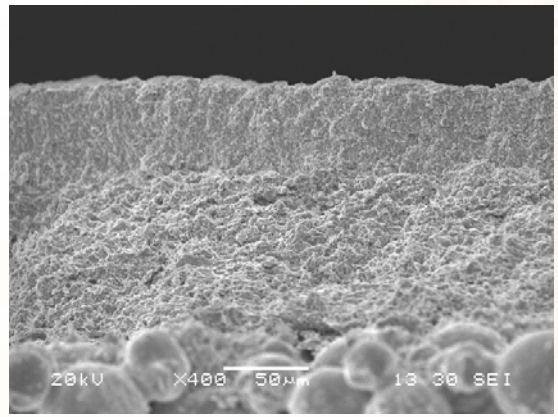
Metal supported design

Slurry painted →

NiO + YSZ by APS →







OCV @ 800 ºC: 0,98 – 1,01 V

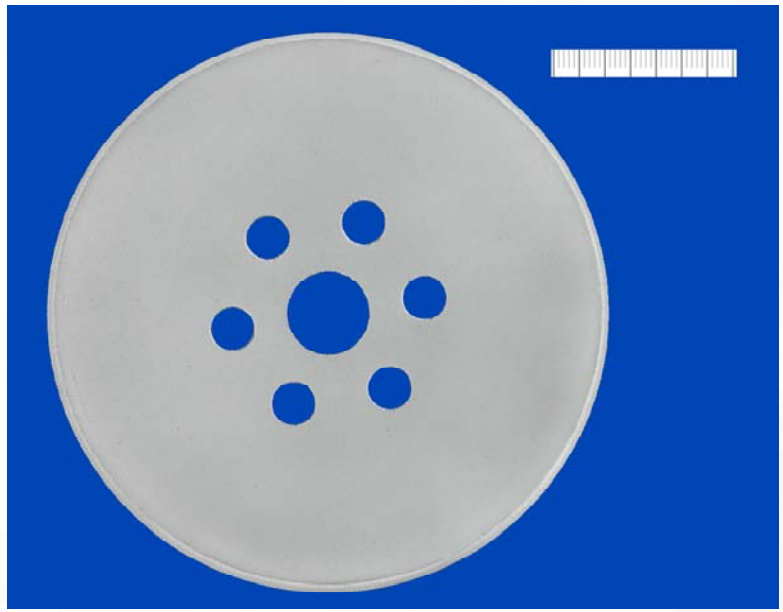
Max. power density: ~400 mW/cm^2 (H_2)

DEVELOPMENT OF SOFCs

Metal supported design

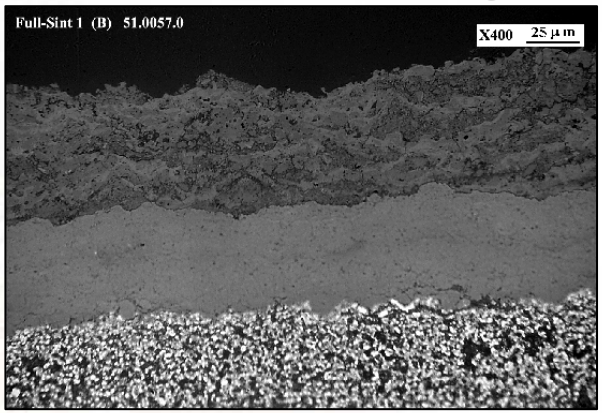
Testing on large stack cells:

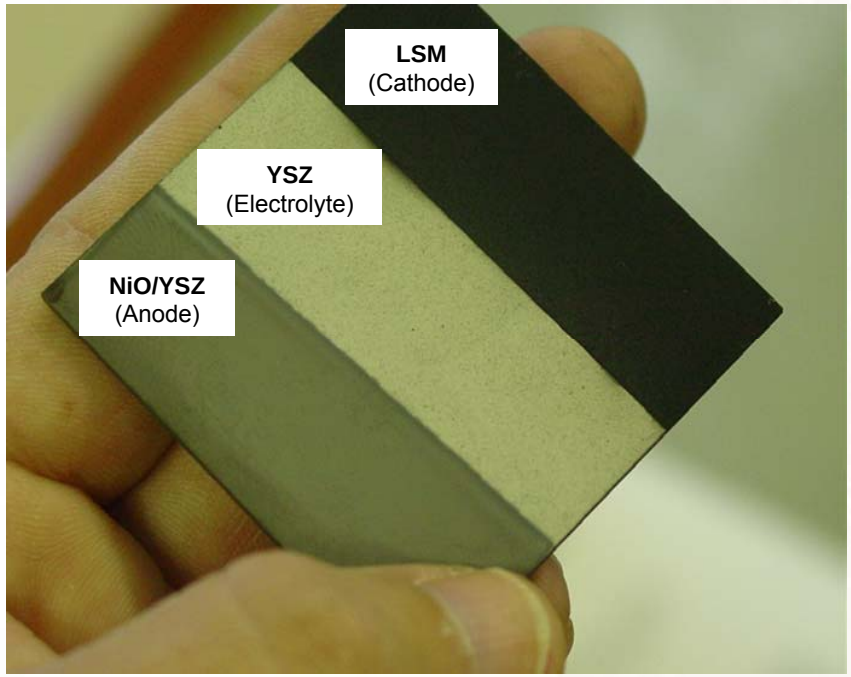
- Deposition of the anode and electrolyte layers without substrate deformation and/or deterioration – no substrate pre-heating
- High homogeneous and dense electrolyte layers in one spray pass with thicknesses down to 30 µm – HFPD spraying
- Possibility to produce dense layers for seals on thin metallic substrates



DEVELOPMENT OF SOFCs

Anode supported design





OUTLOOK

- Completion of a SOFC test facility for button cells.
- Further characterisation of the long-term performance.
- Development of electrolyte layers for low/intermediate temperature SOFCs:
  - Further development of ScSZ (with CeO_2 or Al_2O_3) and CGO layers.
  - Testing of new materials with lower melting point and higher ion conductivity than YSZ as lanthanum strontium gallium magnetite (e.g. LSGM).

OUTLOOK

- Optimisation of the anode architecture and composition to decrease the polarisation resistance and increase the long-term stability.
- Development of intermediate layers for the optimisation of the cell's long-term performance.
- Development of dense layers for stack sealing, specifically addressing compressible metal, metal-composite and non-crystallizing glasses for the seal.
- Further testing of the developed metal supported planar cells in industrial stack prototypes.
- Development of cell components on further metal supported designs: thin planar cells, tubular cells, etc.

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http://www.inasmet.es