Technological infrastructure for materials characterization at CIEMAT



Luis A. González

AMICI-I.FAST WP13 Workshop 22-23 June. Orsay, France





Division of Materials for Engineering

**Mechanical Properties Laboratory** 

Microstructure Laboratory

**Corrosion Laboratory** 

**Radioactive Laboratory** 

**Division of Electrical Engineering** 

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Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Applied Superconductivity Laboratory



#### Sites at CIEMAT



**Materials Division** 

Mechanical Properties Laboratory Microstructure Laboratory Corrosion Laboratory Radioactive Laboratory



CIEMAT - Bldg. 31 Av. Complutense, 40, 28040 Madrid, SPAIN

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### Stress Corrosion Cracking (SCC)







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MAGNET INFRAS

IFAST

### **Stress Corrosion Cracking (SCC) - Characterization**



Understanding of all that is necessary to estimate materials and components lifespan

90% of activities at CIEMAT are focused on the support for new materials developement



# **Stress Corrosion Cracking (SCC) - Characterization**



#### **Mechanical Properties Laboratory**

| Creep test                                     |      | Temperature Range: |   | Specializat            |
|--|------|--------------------|---|------------------------|
| Small Punch test                               | IR09 | -160ºC -> 1000ºC   |   | Screening I            |
| Small Punch Creep test                         |      |                    |   | Resolution             |
| Tensile, Toughness, Fatigue, Crack growth Test |      |                    |   | -Scale<br>-Cristalogra |
| Impact Test                                    |      |                    | [ |                        |
| Vicker Hardness Test                           |      |                    |   | anne e                 |
| Nanoindentation Test                           |      |                    |   | 2015-3 4recom5         |
| Metrology                                      |      |                    |   |                        |

Specialization in small samples Screening method

Resolution in: Scale Cristalographic orientation



# **Stress Corrosion Cracking (SCC) - Characterization**



#### **Microstructure Laboratory**

| Spectroscopy            |                       |      | Reso |
|-------------------------|-----------------------|------|------|
| XPS                     |                       |      | Opti |
| Auger                   |                       |      |      |
| Νιστοςτοργ              |                       |      |      |
| SEM                     |                       |      |      |
| FEG-SEM                 |                       |      |      |
| TEM – <mark>Only</mark> | installation in Spain | IR09 |      |
| Noar Euture             | . High Posolution TEM |      |      |
|                         |                       |      |      |

Resolution Range: Optic -> SEM (nm) XPS -> In Situ Ion Etching

Auger -> In Situ Breakage

Sctructural and Chemical analysis before oxidation



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- Ettle

## **Stress Corrosion Cracking (SCC) - Characterization**

THIM

#### **Microstructure Laboratory**



XPS

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FEG-SEM

TEM



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Q !!! Qi

ACCELERATOR AND MAGNET INFRASTRUCTURE FOR COOPERATION AND INNOVATION IFAST

## **Stress Corrosion Cracking (SCC) - Characterization**

#### **Corrosion Laboratory**

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MINISTERIO DE CIENCIA E INNOVACIÓN

GOBIERNO

| Dynamic regime Stress Corrosion Cracking (SCC) tests:   | Temperature Range: |
|---|--------------------|
| Light water reactor (LWR) conditions<br>Boiling Water Reactor (BWR) conditions (HALDEN)<br>Supercritical water for IV generation reactors | RT -> 700ºC        |
| Static Autoclaves for corrosión and initiation tests in agressive environments:   |                    |
| Acidic PH<br>Basic PH   |                    |
| Molten salt – Controlled gas atmosphere   |                    |
| Liquid metal: Pb – Bi -> Creep test   |                    |



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### **Stress Corrosion Cracking (SCC) - Characterization**

#### **Corrosion Laboratory**



#### Liquid Metal

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Irradiated Samples



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# **Radioactive Laboratory - NAYADE**



Pool type installation – Shielding 100000 Ci of Cobalt-60

Size: 1.2 m side X 4.5 m Depth

Applications:

DE CIENCIA

Electronics for aerospace industry

Study of accelerated aging of materials in nuclear industry

Genetics, food preservation and microbiological sterilization

Irradiation of gemological materials

Dose Range: **IR06** 9 Gy/h -> 50 kGy/h







**Division of Electrical Engineering** 

Applied Superconductivity Laboratory

CEDEX C\ Julián Camarillo 30, 28037 Madrid, SPAIN



# Applied superconductivity lab



Two Cryostats for testing of superconducting magnets at 77K & 4.2K

GMM Cryocooler for superconducting magnets testing at variable temperature T>=10 K





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# **Applied superconductivity lab**

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Low Temperature Superconductor (LTS) magnet at cryostat insert

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MINISTERIO DE CIENCIA E INNOVACIÓN High Temperature Superconductor (HTS) coil before assembly onto cryostat insert

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# Thank you



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