

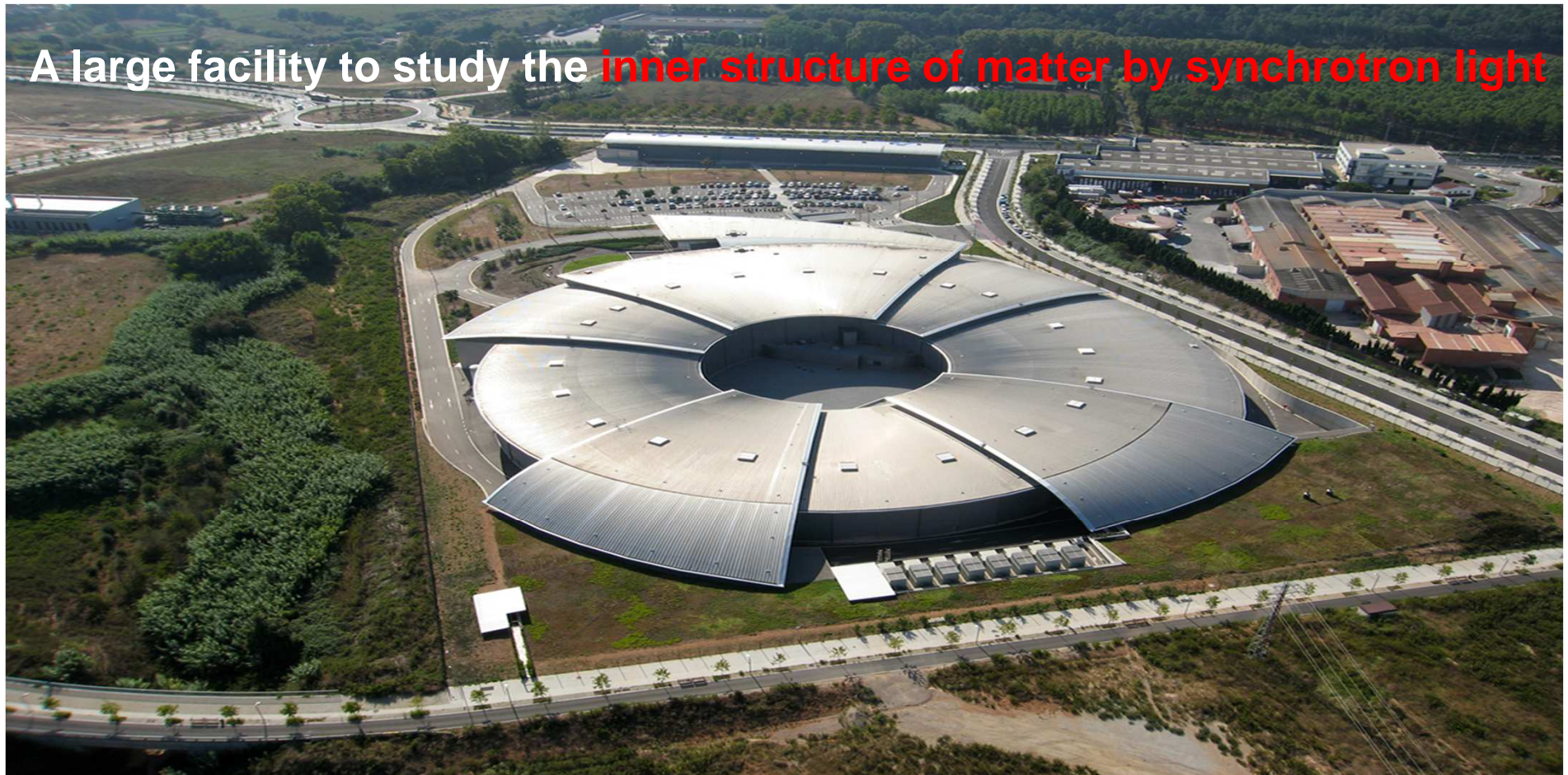


Metal coatings characterization with synchrotron light

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Industrial Office Director
ALBA Synchrotron Light Source



ALBA Synchrotron in short



A large facility to study the **inner structure of matter by synchrotron light**

1st
SCIENCE FACILITY
IN SOUTH-WEST EUROPE

200
STAFF (20% INTERNATIONAL)

1700
RESEARCHERS PER YEAR

250
EXPERIMENTS PER YEAR

210 M€
PUBLIC INVESTMENT
(2011)

5000
HOURS PER LAB PER YEAR

TOP-NOTCH RESEARCH IN:

- BIOTECHNOLOGY AND LIFE SCIENCES
- MICROELECTRONICS AND NANOTECHNOLOGY
- ENVIRONMENT, ENERGY AND AEROSPACE
- MATERIALS DESIGN, DRUGS AND FOOD
- CULTURAL HERITAGE

ALBA Synchrotron Beamlines

Chemistry & Material
Science

Life sciences & soft
condensed matter

Electronic & magnetic
structure of matter

BL29: BOREAS
REsonant Absorption
and Scattering
ES1: HECTOR ES2: MARES

BL24: CIRCE
Photoemission
Spectroscopy and microscopy
ES1: PEEM ES2: NAPP

BL01: MIRAS
IR Microspectroscopy

BL04: MSPD
Materials Science and
Powder Diffraction
ES1: HRPD ES2: HP

BL22: CLÆSS
Absorption &
Emission Spectroscopies
ES1: XAS ES2: XES

BL06: XAIRA (under construction)
Microfocus macromolecular
cristallography

BL20: LOREA (under construction)
Low-energy Ultra-high
Resolution Angular
Photoemission (ARPES)

BL09: MISTRAL
Transmission soft X-ray
microscopy

BL16: NOTOS (under construction)
XAS, HRPD, Instrumental
development

BL13: XALOC
Macromolecular
Cristallography

BL11: NCD - SWEET
Non Cristalline Diffraction
SAXS/WAXS



WHY DO COMPANIES USE ALBA SYNCHROTRON ?

Synchrotron light techniques:

- X-ray microscopy
- Powder diffraction
- X-ray absorption
- IR micro-spectroscopy
- Macromolecular crystallography
- Small and wide angle scattering (SAXS and WAXS)
- Photoemission (microscopy, near ambient pressure)
- X-ray magnetic dichroism

The ALBA Synchrotron techniques allow to obtain outstanding results not achievable with other equipments or techniques very valuable to help boosting the competitiveness of companies.



LOWER DETECTION LEVELS



CHEMICAL MAPPING



OXIDATION STATE DETERMINATION



HIGHER RESOLUTION

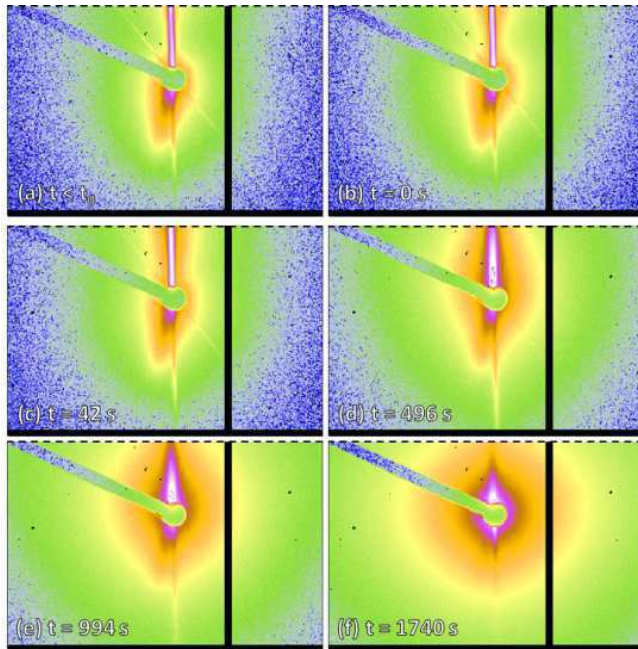


FASTER EXPERIMENTS



WIDE VARIETY OF
SAMPLES MEASURABLE

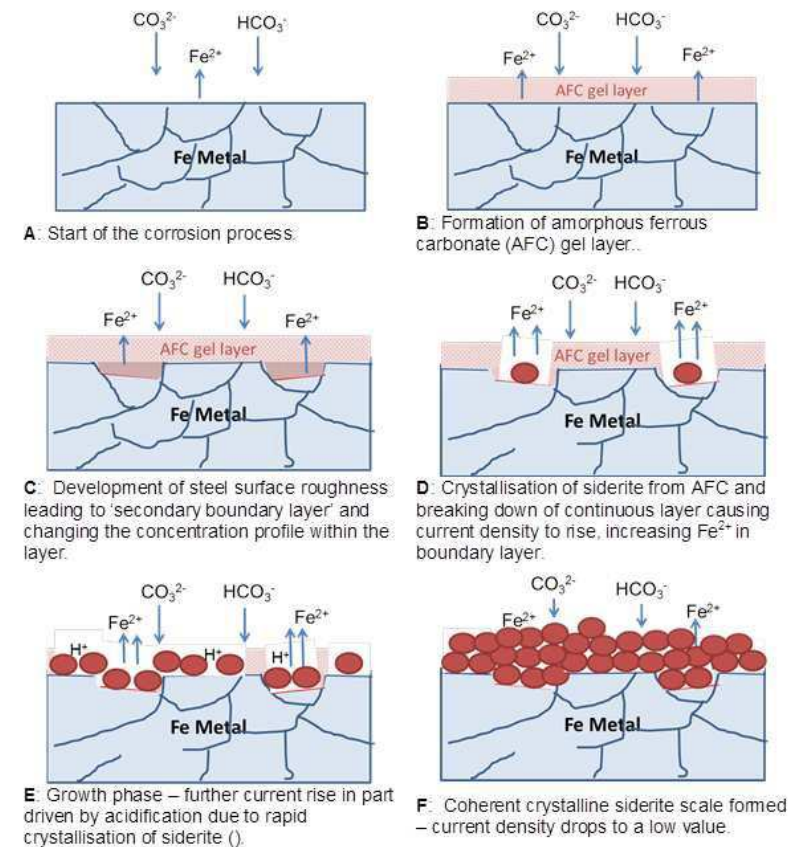
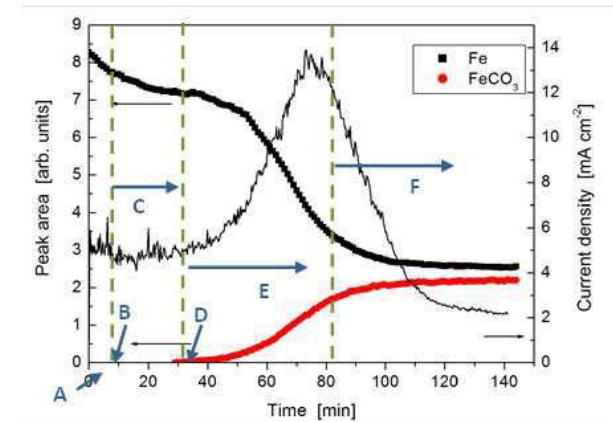
CO₂ corrosion of steel



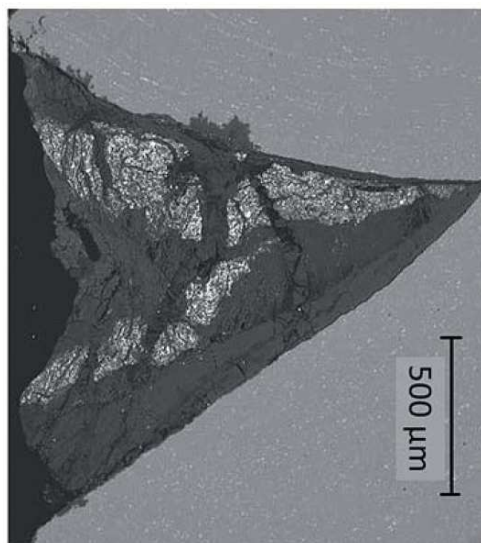
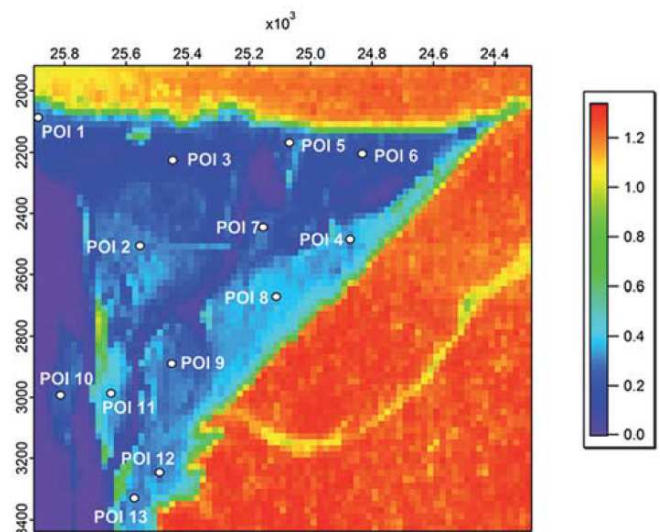
Grazing incidence (GI-SAXS) patterns measured with the X-ray beam during an electrochemical experiment with CO₂

Pipelines steel corrosion process was identified:

- instantaneous film formation
- followed by development of a separate population of particles at later times,
- then by the formation of crystalline species

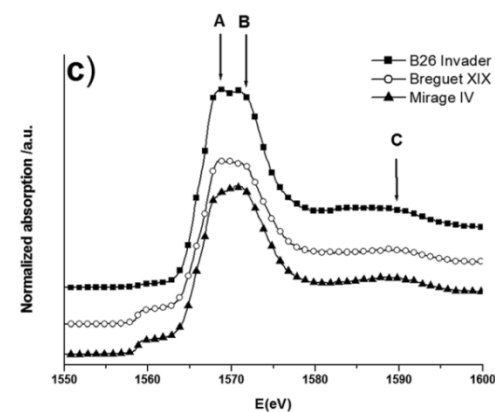
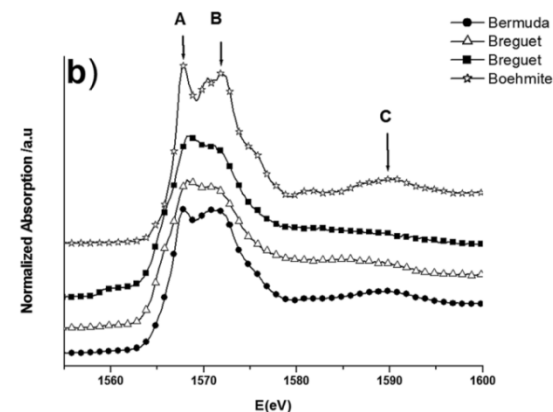
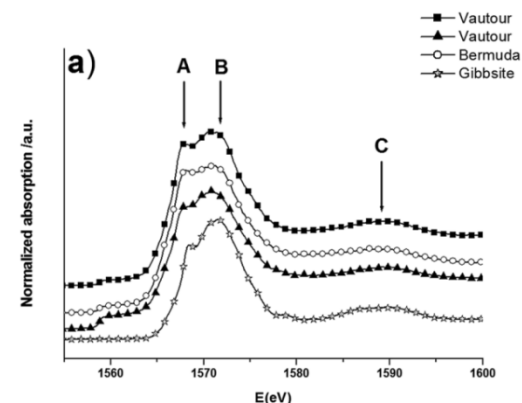


Aluminum corrosion layers of air and space museum aircrafts



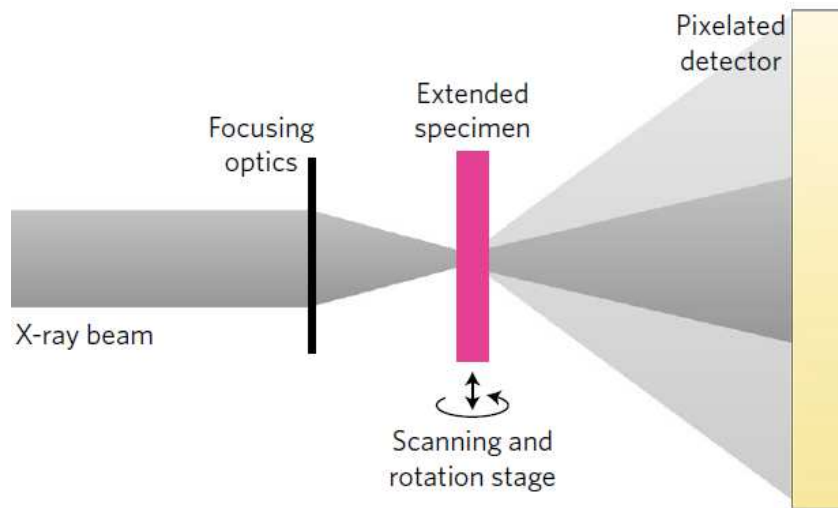
XRF (Synchrotron X-ray Fluorescence) map and SEM image recorded on the Bermuda sample with the locations of the XANES acquisitions

- Corrosion products are mainly composed of poorly crystalized or amorphous phases of 6-fold coordinated Aluminum.
- No 4-fold coordinated Aluminum has been detected



XANES (Synchrotron X-ray absorption) spectra recorded at the Al-K edge

3D structure analysis of a barrier marine coating

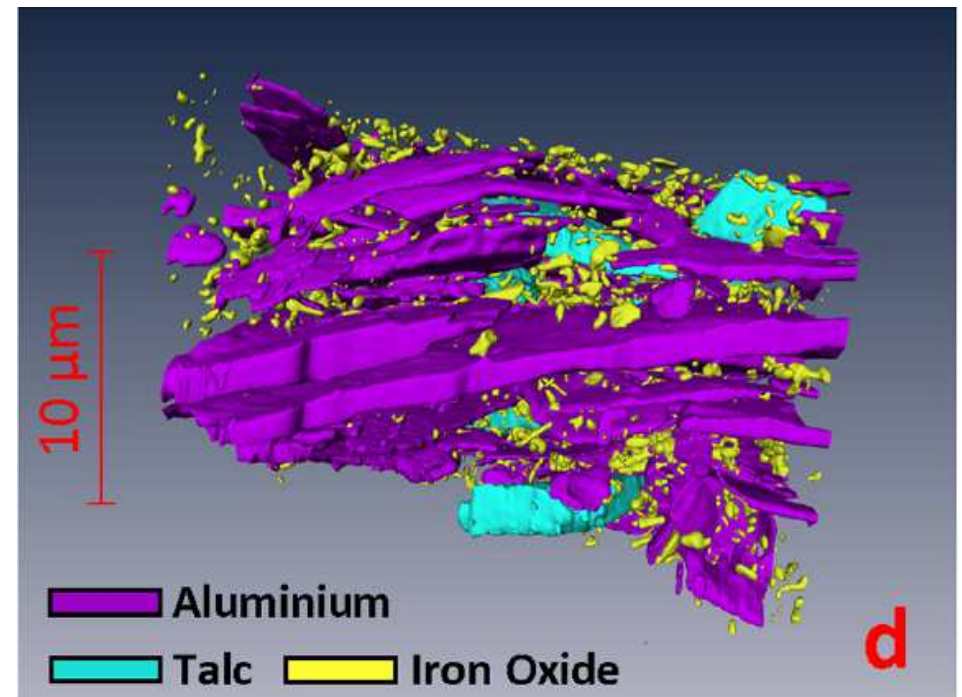


Ptychographic X-ray computed tomography (PXCT). Transmission set up

Anticorrosion enhancement findings:

- A more compact microstructure (degassed coatings versus non-degassed coatings prepared by conventional coating technology)
- A more aluminum flakes alignment with the coating surface

Aluminum flakes epoxy coatings are widely used to protect marine steel structures because of their excellence anticorrosive performance



Rendering of 3D spatial structure of the coating

Synchrotron light can be of help for metal coatings!



Thank you for your attention !

A. Sánchez

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Position & Intensity Monitors
The photons you lose at least counts

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Vacuum configuration



Standard configuration

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