PHYSICS AND ACCELERATORS

Mission and Objectives | Achievements

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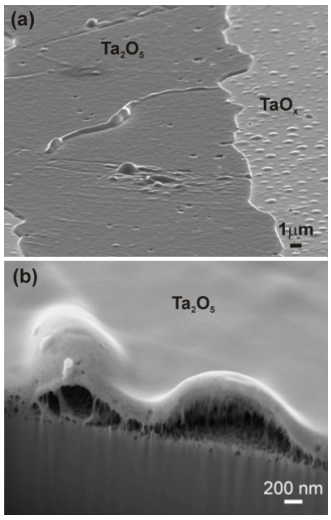
- R&D of advanced materials, processes and technologies for applications to **Industry, Biomedicine, Environment and Cultural Heritage** using Nuclear Techniques and Radiation Technologies.
- Operation and upgrading of infrastructures and techniques open to the community, through collaborations and services.
- Dissemination of knowledge and know-how and promotion of advanced learning in the areas of expertise.
- Specialized services and consultancy and technical assistance to the industry.
- Development of equipment using ionizing radiation for industry and research.

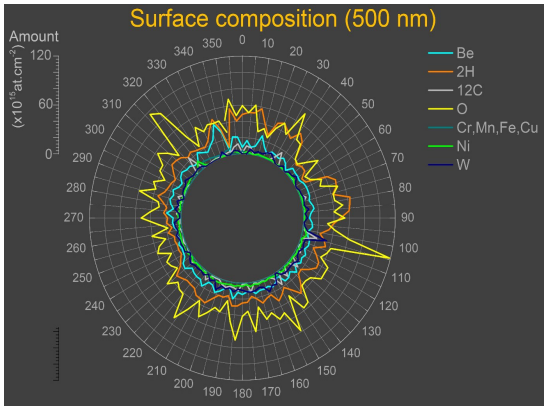
Ion beam studies of hand-written documents with iron gall inks from the XIX century (left) and pigments on XVII century oil paintings on copper support, attributed to the Flemish artist Frans Francken (right).

Main Achievements

- Rare earth doping of wide bandgap compounds and low dimensional structures with optical active ions was achieved.
- Embedded ferromagnetic nitrides in large bandgap semiconductor oxides for electronics applications.
- Development and Fuel Retention studies on High-Z materials for Plasma Wall applications.
- Ion beam analysis of ITER Like Wall (ILW) tiles exposed to JET plasma in 2012. A significant reduction of erosion and fuel trapping was found.

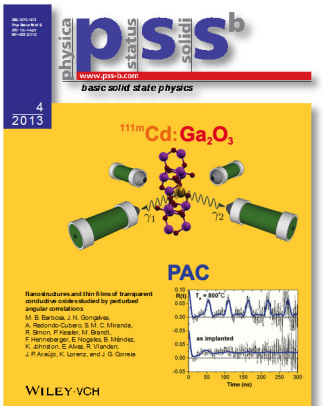


Microstructures observed in W-Ta implanted sequentially with He+ and D+ ions evidencing (a) blistering in Ta2O5 and TaOx regions and (b) blister profile in Ta2O5 region.



Distribution of deposited elements in a rotating collector from the divertor region of JET.

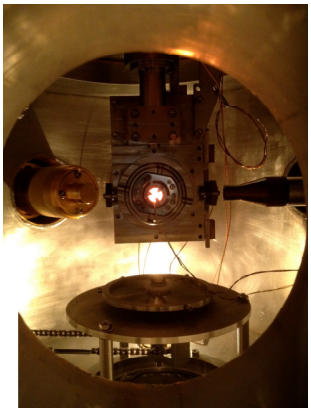
- Ion beams studies of Cultural Heritage objects, mainly metals, glass and paintings (*Frans Francken: Fleming artist*).
- Study of production processes of decorative paintings with noble metals Au, Ag and Pd in high added value Pb-glasses using ion beams.



^{111m}Cd/^{111}Cd: Ga_2O_3 PAC studies were chosen to picture the back-cover of Physica Status Solidi B 250, iss 4, 2013, http://dx.doi.org/10.1002/pssb.201200923.

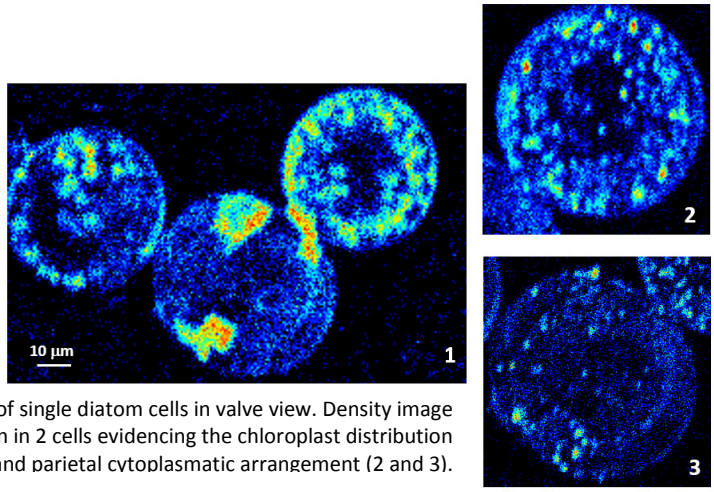
- At ISOLDE Perturbed Angular Correlations (PAC) have been used to study Ga_2O_3, a promising material for high power electronics, showing that implanted ^{111m}Cd (p-type dopant) occupies only the octahedral substitutional Ga-sites, in single-crystals, pellets and nanowires.

- Emission Channelling with Short-lived Isotopes (EC-SLI) three milestones were achieved when concluding studies on a) Cation versus anion substitution in transition-metal doped GaN and ZnO, b) Lattice sites of implanted Mg in the group-III nitrides and, c) the Lattice sites of transition metals Mn, Fe, Co, and Ni in Si.



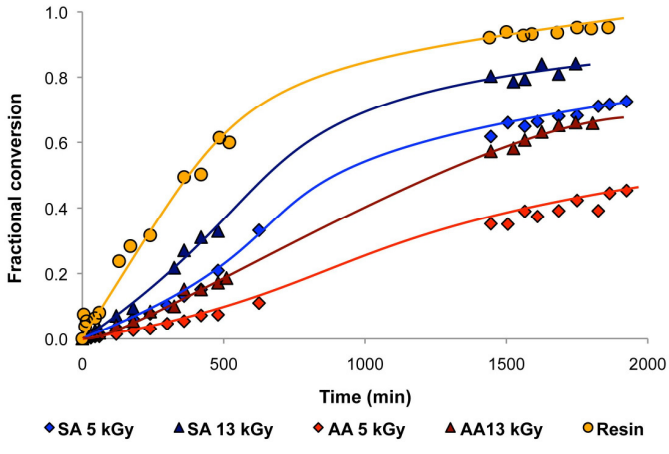
The picture shows the EC-SLI goniometer during vacuum annealing of a sample at 900°C. The beam of radioactive probes enters from the right, through the collimator nozzle.

- The relationship between iron deposits and ferritin in inflammatory conditions of skin
- Bioaccumulation of metals by diatom cells and plants exposed to metal pollution.



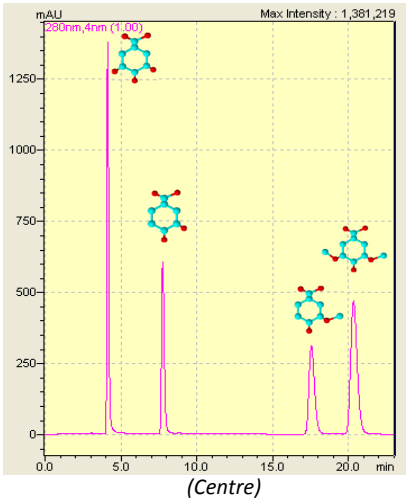
Nuclear microscopy of single diatom cells in valve view. Density image (1) and Ca distribution in 2 cells evidencing the chloroplast distribution and parietal cytoplasmatic arrangement (2 and 3).

- Functionalization of hybrid materials to promote bioactivity.
- Optimization of PVA supported catalytic cross-linked membranes for biodiesel production.

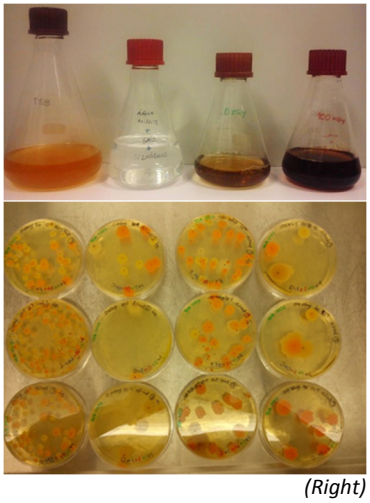


Kinetic curves of esterification reaction of LA over free resin and over resin supported on PVA crosslinked membranes (10% of PVA –OH groups).

(Left)
Gamma irradiated strawberries at 5 kGy for shelf-life extension.



(Centre)
Extraction of antioxidants from cork wastewater by activated carbon: HPLC chromatogram of phenolic compounds.



(Right)
Batch biodegradation experiments of cork wastewater microbiota on irradiated phenolic acids solutions.

- Irradiation effects on small fruits to improve the diet of immune-compromised patients.
- Preservation of medicinal plants by gamma radiation.
- Ionizing radiation inactivation patterns of enteric viruses.
- Study of the effects of gamma radiation on cork wastewater: physical-chemical and microbiological aspects.
- Extraction of antioxidants from cork wastewater by activated carbon.
- Evaluation of indoor concentration of airborne bacteria and fungi in several public buildings.
- Microbiological assays of the activity of antibiotics *in vitro*.

Laboratory Equipment for the Determination of Radioactive Element Traces by Electrodepostion.

Nuclear Instruments and Methods:

- Modelling of radiation fields and equipment design;
- Determination of nuclear data - CERN n_TOF Experiment (phase 2);
- Development and application of plasma at atmospheric pressure;
- Development of software for control and data analysis;
- Design of electronic instrumentation for nuclear applications;
- Specialized services (consulting, training and technical assistance);
- Marketing of nuclear instrumentation made in CTN.
- Commissioning of two new EC-SLI electron position sensitive Si pad detectors (30 x 30mm^2, 22x22 pads, 300 µm thick) equipped with new vatagp7 readout chips.