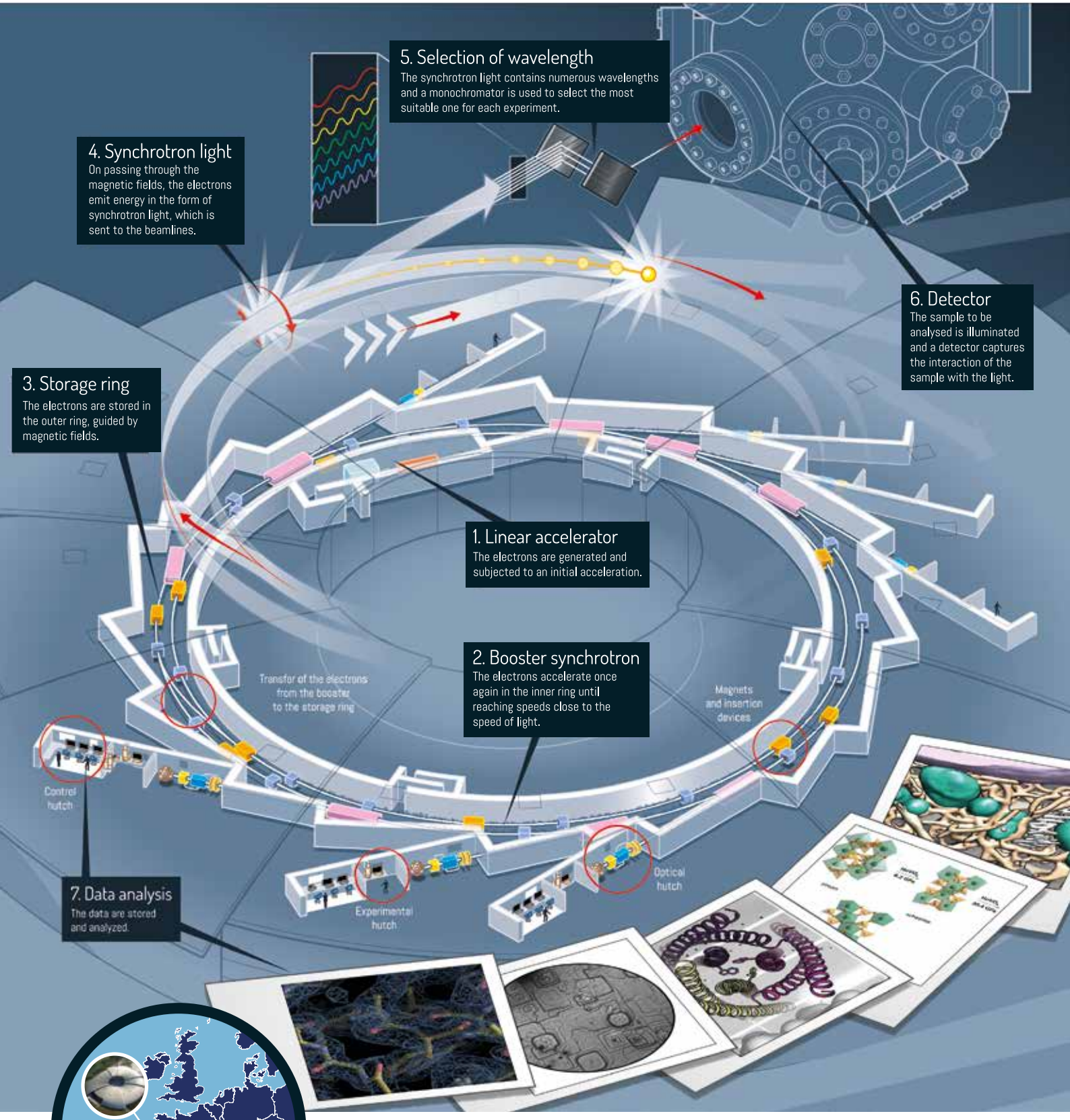
INDUSTRIAL APPLICATIONS

ALBA
SYNCHROTRON

ALBA
SYNCHROTRON



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ANSWERS **FOR INDUSTRY**

WHAT
DOES ALBA SYNCHROTRON OFFER TO INDUSTRY

ALBA Synchrotron offers industry **cutting-edge techniques for characterising materials** and processes at micro and nanoscopic levels by using synchrotron light, providing results focused on a company's specific needs.

WHY
DO COMPANIES USE ALBA SYNCHROTRON?

ALBA Synchrotron techniques provide **outstanding results** that cannot be achieved with other equipment and techniques and which are very valuable in boosting a company's competitiveness.

HOW
TO CONTACT ALBA

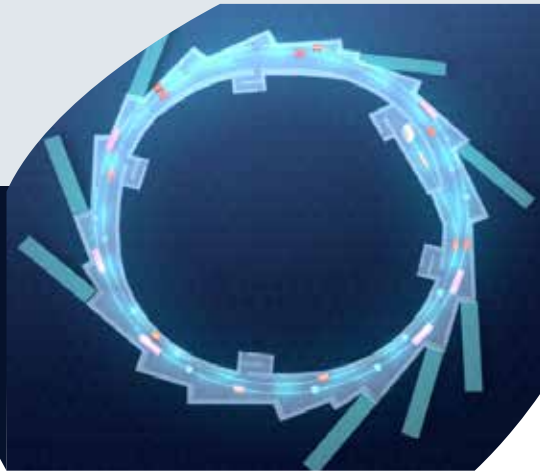
The ALBA Synchrotron has established an Industrial Liaison Office as a **single point of contact** to provide a full service to its customers, maintaining confidentiality and providing support throughout the service.

industrialoffice@cells.es

THE **ALBA SYNCHROTRON**

The ALBA Synchrotron is one of the most important scientific and technological infrastructures of South-West Europe funded by the Generalitat de Catalunya and the Government of Spain.

A synchrotron is a particle accelerator used as a source of extremely intense synchrotron light (from infrared to X-rays) produced by electrons moving at nearly the speed of light in a ring under ultra-high vacuum.
www.albasynchrotron.es



ALBA IN NUMBERS

8

8 beamlines available for experiments

4

4 beamlines under construction

Particle accelerator with a perimeter of 270 metres

270

1,000,000

A bunch of electrons runs a million times per second around the ring

1

The only synchrotron light facility in Spain

10 billion

Synchrotron light is 10 billion times more intense than the Sun

2,100

Over 2,100 industrial and academic scientists per year conducting high impact experiments

ADVANTAGES OF **SYNCHROTRON LIGHT**

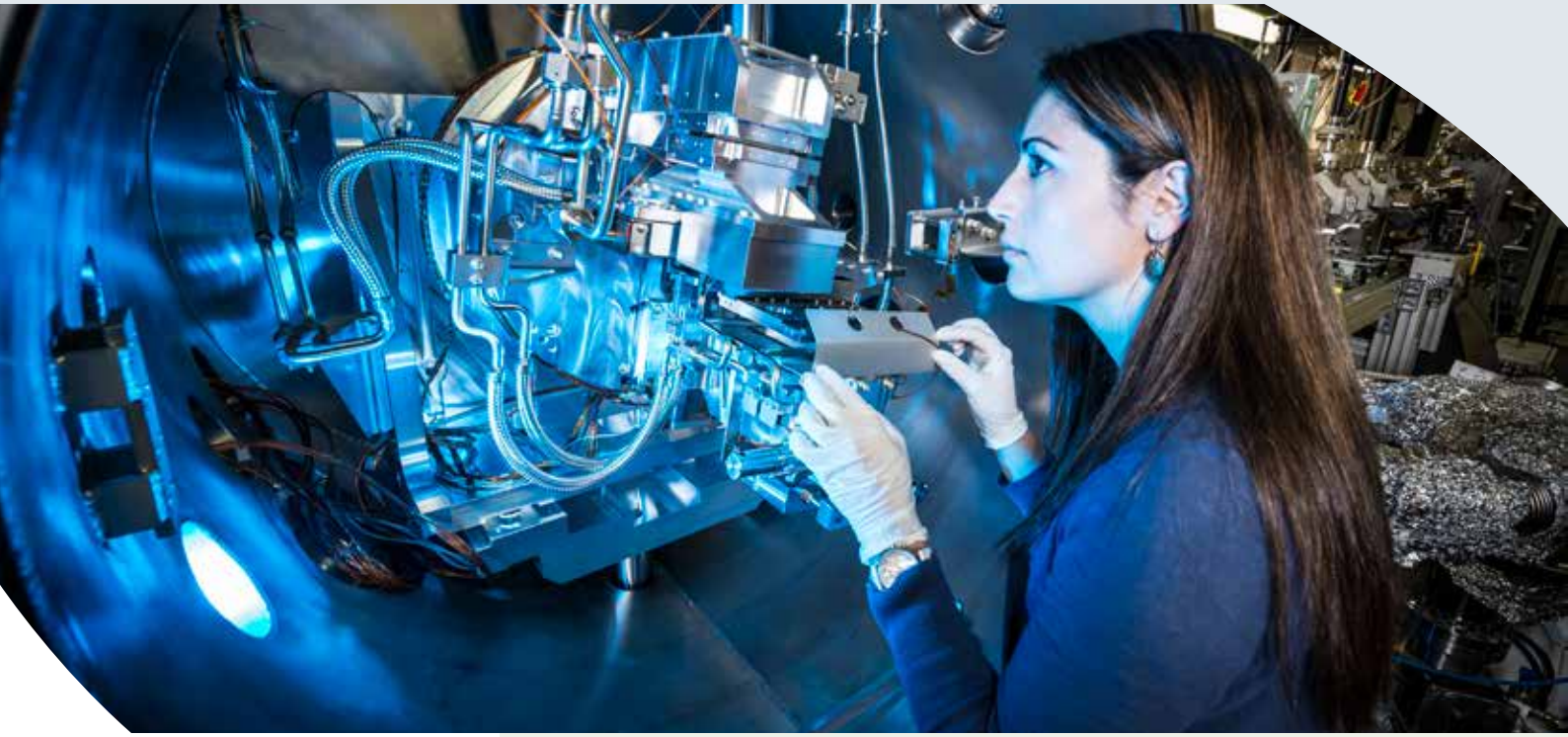
The synchrotron light **brightness** and quality is **outstanding** and presents unique features suitable for the study of many types of **materials** and **processes** at micro and nanometric scales. ALBA offers its synchrotron light techniques and in-house expertise to the industrial and scientific communities to enhance their research, development and innovation activities.

The services may include samples mail-in, pre- and post-experiment support, remote access, results reports, advice on synchrotron techniques, R+D+i contracts, etc.

- **LOWER DETECTION LEVELS**
- **CHEMICAL MAPPING**
- **OXIDATION STATE DETERMINATION**
- **HIGHER RESOLUTION**
- **FASTER EXPERIMENTS**
- **WIDE VARIETY OF SAMPLE ENVIRONMENTS**

SYNCHROTRON TECHNIQUES **AND INDUSTRIAL SECTORS**

Synchrotron light is used to provide a deeper understanding of materials through the visualization of their **nanostructure** and the determination of their **chemical, electronic and magnetic structure.** The powerful characterisation offered by synchrotron light can provide **meaningful details** related to materials and processes used in a wide variety of **industrial sectors.**



TECHNIQUES **AVAILABLE**

- **X-RAY POWDER DIFFRACTION**
- **MACROMOLECULAR CRYSTALLOGRAPHY**
- **SMALL AND WIDE ANGLE SCATTERING (SAXS AND WAXS)**

- **INFRARED MICROSPECTROSCOPY**
- **X-RAY ABSORPTION AND EMISSION SPECTROSCOPY**
- **PHOTOEMISSION NEAR AMBIENT PRESSURE SPECTROSCOPY**
- **MAGNETIC DICHROISM AND SOFT X-RAY MAGNETIC REFLECTIVITY AND RESONANT SCATTERING**

- **SOFT X-RAY MICROSCOPY**
- **PHOTOEMISSION MICROSCOPY**

INDUSTRIAL **SECTORS**

- CHEMISTRY
- ADVANCED MATERIALS
- NANOTECHNOLOGY
- PHARMACEUTICAL
- HEALTH
- FOOD AND PACKAGING
- ENVIRONMENT
- AUTOMOTIVE AND AEROSPATIAL
- ENERGY
- CULTURAL HERITAGE & FORENSIC SCIENCES

CHEMISTRY

WHAT CAN **BE STUDIED?**

- CATALYSTS
- PLASTICS, ELASTOMERS AND POLYMERS
- PAINTS AND PIGMENTS
- FIBRES
- PULP AND PAPER
- ENCAPSULATION OF ORGANIC COMPOUNDS
- HOME CARE PRODUCTS
- CHEMICAL REACTIONS

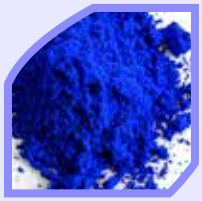
WHAT INFORMATION **CAN BE OBTAINED?**

- Structural characterisation of solid samples at the atomic level.
- Determination of the oxidation states and species in a wide variety of samples.
- Nanoscale characterisation of the shape, size and density of molecular aggregates.
- Characterisation of depositions, contamination and photochemical processes on surfaces.
- Microstructural characterisation of dispersions, emulsions and materials partially ordered.
- Chemical identification and characterisation of contaminants.
- Study of chemical reactions and processes in both a dynamic and steady state at the atomic level.

WHAT **ALBA DOES**

CUSTOM-MADE AND MORE EFFICIENT CATALYSTS

Rhodium and Palladium nanoparticles deposited on a ceria substrate are used as catalysts for the production of hydrogen. The analysis of their surfaces under working conditions conducted at ALBA showed that the oxide substrate induced a rearrangement of the nanoparticles that increased the reaction yield. This result helps to design catalysts with improved performance.



IMPROVING THE PROPERTIES OF PIGMENTS AND THEIR MANUFACTURING

The low detection limits and the possibility to determine oxidation states provided by ALBA permitted the colour properties of a commercial pigment, produced by different synthetic routes, to be correlated with its crystal and atomic structure.This information is very valuable for developing more efficient methods for pigment manufacturing.

GIVING SHAPE TO POLYMERS

Different degrees of crystallisation provide plastic materials with properties that are halfway between hard/solid and soft/flexible. ALBA characterised the degree of crystallisation of different polymers cooled down at different cooling rates, similar to those used under industrial conditions, to determine the most suitable process for tuning the rigidity or plasticity of the polymers for particular applications.

ADVANCED MATERIALS

WHAT INFORMATION **CAN BE OBTAINED?**

- In situ study of materials under similar conditions to the production process.
- Atomic structure, electronic and magnetic characterisation of materials.
- Oxidation state and chemical species determination.
- Structure of ceramics and its evolution during synthesis and manufacturing processes.
- Phase determination of materials such as cements and concretes.
- Surface corrosion characterisation with different agents and working conditions.
- Characterisation under high pressure and temperature.

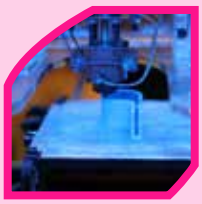
WHAT CAN **BE STUDIED?**

- **CEMENTS, CERAMICS AND BUILDING MATERIALS**
- **ADDITIVE MANUFACTURING MATERIALS**
- **METALS**
- **CORROSION OF MATERIALS**
- **CARBON-BASED**
- **MATERIALS**
- **MATERIALS UNDER EXTREME CONDITIONS**
- **COMPOSITES AND OTHER FUNCTIONAL MATERIALS**
- **SUPERCONDUCTORS**

WHAT **ALBA DOES**

TAILOR-MADE CEMENTS

The evolution of the crystalline phase of concrete, clinker and cement were determined during an in situ hydration process using the ALBA's powerful X-rays. The results permitted the kinetics and mechanisms for early stage hydration of eco-cements to be established and this will help improve their performance.



ADDITIVE MANUFACTURING/3D PRINTING

3D printed extruded filaments of poly-ε-caprolactone (PCL) were analyzed at ALBA under different manufacturing conditions. Results showed that polymer composition and extruder jet temperature are the main factors determining the internal structure and the mechanical properties of the manufactured object. With such findings, the process can be tuned to obtain objects with the desired properties.

MATERIALS UNDER EXTREME CONDITIONS

A new crystalline phase of CdAl2S4 at very high pressure (250,000 atmospheres) has been identified at ALBA, which remains unaltered after pressure removal, at 1 atmosphere. This new phase could enhance the performance of photovoltaic cells and could have industrial applications in optoelectronics and nonlinear optics.

NANOTECHNOLOGY

WHAT CAN **BE STUDIED?**

- NANOSTRUCTURED MATERIALS
- NANOMANUFACTURING
- MICRO AND NANOELECTRONIC DEVICES
- MICROACCELEROMETER AND MICROSENSORS
- MAGNETIC DATA STORAGE DEVICES
- PHOTONIC DEVICES
- FERROELECTRIC AND MULTIFERROIC DEVICES
- SEMICONDUCTORS

WHAT INFORMATION **CAN BE OBTAINED?**

- Chemical and nanostructural characterisation of nanoelectronic and nanomagnetic materials and devices.
- Visualisation of magnetic domains and nanostructures.
- Characterisation of spintronic and magnetoelectronic materials and devices.
- Characterisation of superconducting nanomaterials.
- Nanoparticle structure, composition and fabrication characterisation.
- Nanostructured materials characterisation.
- Surface and interface characterisation of nanomaterials.

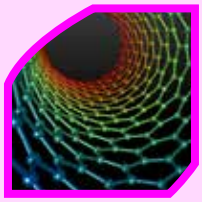
WHAT **ALBA DOES**

DATA STORAGE MATERIALS

A magnetic nanoscale switching triggered by electric fields in a ferromagnetic thin film has been detected at ALBA. As it is an electrical current-free mechanism, the energy consumption is very low representing a promising way to enhance the energy efficiency and data storage density of devices such as computers and mobile phones.

NANOELECTRONICS AND SPINTRONICS

A new method for manufacturing high quality ultrathin cobalt ferrite nanostructures has been characterised in real time. These nanostructures were fabricated in situ and the process was followed by the ALBA photoemission electron microscope. This new production method is applicable to a wide variety of nanoelectronic and spintronic devices such as the hard disk read heads in computers.



NANOSTRUCTURED FIBRE SENSORS

Millions of carbon nanotubes (CNT) have been processed into a continuous fibre similar to a kilometric human hair. It behaves like a sensor of gas and liquid molecules as in their presence it changes its electrical properties. Experiments done at ALBA have found that those electrical changes are due to the reshaping of the CNT. It opens a door to improving its properties.

PHARMACEUTICAL

WHAT INFORMATION **CAN BE OBTAINED?**

- Structural information of the interactions between a drug and a therapeutic target at the atomic level.
- Detection and quantification of crystalline phases present in small amounts in a pharmaceutical formulation.
- Detection of impurities and polymorphism studies. Crucial information for intellectual property protection and patent infringement.
- Determination of oxidation states of compounds in drugs.
- Determination of the structure of a drug at the atomic level, including chirality and absolute configuration.
- Penetration of drugs and pharmaceutical formulations in biological tissues such as the skin.
- 3D reconstruction of cells and cellular material to visualise the effect of diseases and drugs in the cell with minimal sample treatment. Innovative strategies for disease treatment.

WHAT CAN **BE STUDIED?**

- **DRUGS AND ACTIVE INGREDIENTS**
- **PHARMACEUTICAL FORMULATIONS**
- **POLYMORPHS**
- **THERAPEUTIC TARGETS (ENZYMES, VIRUS, DNA...)**
- **CELLS AND MICROORGANISMS**
- **DISEASES**
- **BIOLOGICAL PROCESSES**

WHAT **ALBA DOES**

DETECTION OF VERY LOW AMOUNTS OF COMPOUNDS IN DRUGS

Some compounds exist in very low concentrations in drugs and may only be detected using synchrotron techniques. The detection and identification of crystalline phases, compounds or polymorphs present in small quantities in drugs have been carried out at ALBA. This information may be crucial for drug development and intellectual property protection.

A 3D MAP OF THE HEPATITIS VIRUS ALTERATIONS IN CELLS

A 3D image of an entire cell infected with the hepatitis C virus (HCV) close to physiological conditions was observed for the first time using ALBA's innovative full-field transmission microscope. The structural alterations in the cell induced by the HCV and repaired by specific antivirals was visualised, proving to be a valuable method for checking drug effectiveness and understand complex biological processes.

A DRUG TO COMBAT MALARIA

Malaria is an infectious disease transmitted by a mosquito bite that causes more than one million deaths every year. Macromolecular structural studies at the atomic level performed at ALBA revealed the structure of a new antimalarial drug linked to DNA, covering specific areas that prevent the typical development of the parasite and cause its death. This research may significantly contribute to the effective treatment of malaria.

HEALTH

WHAT CAN **BE STUDIED?**

- PRODUCTS FOR PERSONAL CARE AND HYGIENE
- COSMETICS
- DENTAL MATERIALS
- EMULSIONS, FOAMS AND GELS
- BIOLOGICAL TISSUES
- CELLS AND BIOLOGICAL PROCESSES
- BIOMATERIALS FOR BIOCOMPATIBLE IMPLANTS
- BIODEGRADABLES FOR DRUG ADMINISTRATION

WHAT INFORMATION **CAN BE OBTAINED?**

- Study of the structure, stability and phase transitions in complex environments such as water-oil-surfactant mixtures, creams, etc.
- Characterisation of the impact and penetration of cosmetics or chemical products on the skin, lips, hair or nails at different times after application.
- Structural information of toothpaste, dental cements, resins and adhesives for dental implants.
- Determination and study of the microstructure of biological tissue (muscles, ligaments, tendons) in dynamic situations.
- 3D reconstruction of biological material for the understanding of cellular mechanisms.
- Structural studies of materials used for biological tissue regeneration.

WHAT **ALBA DOES**

ANALYZING ALZHEIMER'S MECHANISMS

Aggregates of different proteins are generated inside the brain of a person suffering Alzheimer. Location and effect of such aggregates in cultivated neuronal cells have been studied at ALBA. Results helped to better understand the Alzheimer's mechanisms, to better identifying the toxic causes of this disease and eventually to prevent its causes.

ESSENTIAL OILS

Essential oils are widely used as natural antimicrobial agents and fragrance preparations. Different vesicles used as carriers of essential oils were studied in the ALBA synchrotron. Results showed that these oils could be introduced in the vesicles without altering their structure and helped to assess the ability of the vesicles to release essential oils into the skin.

SKIN CARE COSMETICS

X-ray synchrotron diffraction makes it possible to observe the regular stepwise structure of collagen present in the skin. Studies performed at ALBA showed that infrared rays produce disorganisation in the structure of collagen and this effect can be prevented by using bilipidic systems. This information can be used to address new formulations to protect against harmful effects to the skin.

FOOD AND PACKAGING

WHAT INFORMATION **CAN BE OBTAINED?**

- Dynamics and stability of food emulsions.
- Phase transitions in fat and rheological activity in carbohydrate food.
- Determination of toxic chemicals including speciation in meat, fish, legumes and vegetables.
- Identification of chemical elements or species of a particular food for designation of origin purposes.
- Study of structural changes in plastics used for packaging and storage of products.
- Determination of copper and other metals in wine and liquors at their different oxidations steps.
- Chemical imaging of plants, seeds, grains, algae, etc.

WHAT CAN **BE STUDIED?**

- QUALITY AND NUTRITIONAL VALUE OF FOOD
- AGRI-FOOD
- TOXICITY IN FOOD
- PRODUCTS WITH DESIGNATION OF GEOGRAPHICAL ORIGIN
- SEAFOOD
- WINES AND CHAMPAGNES
- PACKAGING AND STORAGE OF PRODUCTS
- PET AND ANIMAL FOOD
- FERTILIZERS

WHAT **ALBA DOES**

HELPING TO DESIGN FUNCTIONAL FOODS

The ingestion of selenium in our diet is scarce, although it is a useful micronutrient to prevent cardiovascular diseases and some carcinogenic processes. The metabolisation of selenium in enriched wheat crops was characterised at ALBA by following the different absorbed selenium species in wheat in order to determine the best methods for producing selenium-enriched flour.

HAM CURING PROCESSES AND TRACEABILITY BIOMARKERS

Cured hams from different geographical origins and at different curing stages were characterised in order to identify potential biomarkers useful for ham traceability. The evolution of Zn and Fe species in hams from Spain and Italy at different times during the curing process was obtained at ALBA and the results enabled Spanish hams to be distinguished from Italian ones.

HOW TO OBTAIN THE VELVET EFFECT OF CHOCOLATE

The crystallisation of various polymorphic forms of cocoa butter was studied at ALBA using chocolate and metal substrates under different heat treatments. The results demonstrated that by reducing the substrate temperature below 16 C, a velvety texture widely used in gourmet chocolate products was created and this texture improves when using a chocolate substrate.

ENVIRONMENT

WHAT CAN **BE STUDIED?**

- POLLUTED WATER AND SOIL
- PROCESSES AT THE WATER-SOIL INTERFACE
- SOILS, FERTILIZERS, CONTAMINANTS AND HARVEST PRODUCTS
- POLLUTION AND DECONTAMINATION OF WATER AND SOIL
- AIR POLLUTANTS
- MINERAL PROCESSING
- NATURAL PHENOMENA
- MINING INDUSTRY WASTE MATERIALS
- INTERSTELLAR AND INTERPLANETARY MATERIAL

WHAT INFORMATION **CAN BE OBTAINED?**

- Identification of different chemical species in very low concentrations and their distribution in plants, microorganisms, and animal tissues.
- In situ observation of phase transformation of materials at high pressure and high temperature.
- Chemical characterisation to improve nuclear and mining waste management.
- Evaluation of the exploitation of mining areas by analysing minerals.
- Characterisation of the planting and harvesting conditions.
- Study of the structure and composition of meteorites and interplanetary dust.
- Toxicological effects of chemicals, corrosion, pollution, etc.

WHAT **ALBA DOES**

WHAT ARE THE INNER MATERIALS OF EARTH LIKE?

Perovskite materials are part of the composition of the lower part of the Earth's mantle and are thought to be related to earthquakes when subjected to high pressures. ALBA studied the structural phase changes of perovskites under high pressures and discovered new ordered phases with novel structures and properties.

ANALYSING CONTAMINATED SOILS

The analysis of the chemical species in samples from a closed mine revealed the presence of low amounts of scorodite, an arsenic species that can pass from contaminated soils to surface waters through showers. These results, collected at ALBA, indicate an appropriate treatment to prevent scorodite contamination in surface waters near the mine.

HOW DO PLANTS GROW?

Auxins are plant hormones that induce a response factor which controls root initiation, cell growth, flowering and other factors that determine the size and structure of plants. The 3D macromolecular structure of auxin response factors bound to DNA obtained at ALBA explained why certain auxins are able to activate the set of genes that causes major changes in plant growth.

AUTOMOTIVE AND AEROSPACE

WHAT INFORMATION **CAN BE OBTAINED?**

- Chemical and structure characterisation of catalysts under operating conditions.
- Characterisation of rechargeable batteries and their degradation mechanisms.
- Analysis of fuel cell membranes during the hydration, oxidation/reduction and ageing processes.
- Characterisation of metals in fuel cells (Pd, Pt, Rh, Ru, etc.).
- Analysis of automotive components such as plastic, fabric or metal parts to improve performance, safety and comfort.
- Frictional mechanism characterization of surfaces with lubricants and additives.
- Residual stress analysis in alloys.

WHAT CAN **BE STUDIED?**

- **CATALYSTS FOR REDUCING EMISSIONS**
- **LIGHTWEIGHT AND HEAVY PLASTIC MATERIALS**
- **HYDROGEN POWERED VEHICLES**
- **ELECTRIC VEHICLES**
- **OILS AND LUBRICANTS**
- **STABILITY OF COATINGS**
- **FUEL CELLS**

WHAT **ALBA DOES**

BATTERIES FOR ELECTRIC VEHICLES

Structural changes during the charge and discharge cycle of high performance lithium batteries have been investigated at ALBA. Different cathode manufacturing methods showed an influence on the electrode performance during cycling. These results serve as the basis for improvements in the lifetime of lithium batteries.

AEROSPACE MATERIALS

Metallic glasses are used for aerospace applications among many other applications. Surface treatments that led to the enhancement of their mechanical behaviour, wettability and corrosion performance were correlated with structural changes at the atomic level detected at ALBA providing insights for further improvements.

CATALYSTS FOR VEHICLES

Removing soot is critical to minimise the environmental impact of combustion engines. Ceria-based catalysts are very efficient for diesel soot removal. The catalytic mechanism has been characterised at ALBA in operando conditions which may lead to the discovery of improved catalysts for less contaminant vehicles.

ENERGY

WHAT CAN **BE STUDIED?**

- SOLAR CELLS
- BATTERIES
- ZEOLITES
- PETROCHEMISTRY AND TRANSPORT OF HYDROCARBONS
- MATERIALS FOR FUSION REACTOR VESSELS
- MATERIALS FOR THERMAL ENERGY STORAGE
- MATERIALS FOR HYDROGEN STORAGE

WHAT INFORMATION **CAN BE OBTAINED?**

- Compositional and micro-structural characterisation of rechargeable batteries, their materials and their degradation mechanisms.
- Characterisation of zeolites to improve, among other benefits, oil catalytic cracking.
- Rock fossil characterisation to improve the extraction of fossil fuels.
- Elemental analysis of crude oil.
- Formation and stability of emulsions to improve oil transport.
- Characterisation of photovoltaic cell crystal structures and metallic impurities.
- Characterisation of materials for energy storage.

WHAT **ALBA DOES**

ZEOLITES FOR PETROLEUM REFINING

The structure of a new zeolite synthetised by using amino-phosphonium cations has been solved thanks to the high resolution diffraction instruments available at ALBA. This advanced characterisation tool helps researchers to determine the structure of new zeolitic catalysts and therefore to determine their future applications such as improved petroleum refining performance to obtain high-quality petrol.

INCREASING BATTERY LIFE

Two lifetime degradation mechanisms of commercial rechargeable lithium batteries were characterised at ALBA, namely anode aggregate growth and cathode micro-cracks. ALBA techniques allowed the study of these electrochemical processes while voltage was applied to the electrochemical cells. This finding may help to increase the lifetime of batteries and therefore of most of the electronic devices used in our daily life.

SOLAR CELLS

Self-assembly ionic liquids present unique properties making them suitable for dye-sensitised solar cells. Results obtained at ALBA provided an understanding of their self-assembly behaviour revealing a dependence on structure, composition and temperature. It could lead to improving their performance in industrial applications.

CULTURAL HERITAGE & FORENSIC SCIENCE

WHAT INFORMATION **CAN BE OBTAINED?**

- Study of the composition of historical and artistic objects to prevent degradation.
- Non-destructive studies on the degradation of materials.
- Studies on bones and fossilised remains from paleontological sites.
- Studies of the products used for the conservation of artworks.
- Studies on the degradation of artworks: non-destructive characterisation of deep buried layers and characterisation of its chemical composition.
- Information on the techniques used in the production of artworks, raw materials, etc.
- Examination of forensic samples from crime scenes: inks, material related to firearm use (bullets, cartridges, etc.), fingerprints, fibre and paint sample identification.

WHAT CAN **BE STUDIED?**

- **ANCIENT MATERIALS**
- **ARTISTIC PAINTINGS**
- **ARTISTIC CERAMICS**
- **CULTURAL HERITAGE**
- **ARCHAEOLOGICAL REMAINS**
- **FORENSIC SCIENCE OBJECTS**
- **ARCHAEOLOGICAL SITES**

WHAT **ALBA DOES**

UNRAVELLING THE MANUFACTURE OF ANCIENT CERAMICS

The determination of the micro and nanocrystalline structure as well as the chromium chemical species was performed at ALBA to identify the dyeing technology used to produce opaque materials in historical ceramics belonging to different regions and historical periods: Spain (14th-16th centuries) and Syria and Egypt (7th-8th centuries).

RESTORING MURAL PAINTINGS FROM THE MIDDLE AGES

The very small and extremely bright beam of the ALBA synchrotron light made it possible to study very thin layers of medieval paintings affected by black spots. Acid salts generated by fungi centuries ago were identified as the cause of the dark spots. With these results, the paintings can be properly restored and preserved.

CONSERVATION OF STAINED GLASS

ALBA synchrotron techniques enabled the production of stained glass windows in Spanish cathedrals dating from the 16th-19th centuries to be characterised. The results obtained proved that master glaziers were able to reduce the firing temperatures of glass produced in the 17th, 19th and 20th centuries by increasing the amount of lead at the same time as adding borax to the glass.

TECHNICAL **LABORATORIES**

In addition to synchrotron light laboratories, ALBA has a set of **highly specialised technical laboratories** supporting synchrotron techniques and particle accelerator developments also able to offer their expertise in these fields.

Magnetic measurements laboratory

SERVICES

- Accurate magnetic measurements (100 ppm) of high magnetic fields of big structures (up 2 m long).
  - Measurement of coils for motors or other applications.
  - Measurement of field maps of any type of magnetic structure.
  - Measurement of multipole magnets (quadrupoles, sextupoles, etc).
  - Measurement of pure permanent magnetic blocks, isolated or assembled in holders, and sorting and shimming for constructing insertion devices.
- Modelisation and optimisation of magnetic designs using 3D simulation tools.
- Calculation of the main features of measured magnetic fields (integrals, high order harmonics and fiducialisation of magnetic fields with respect to mechanical references).

Radiofrequency laboratory

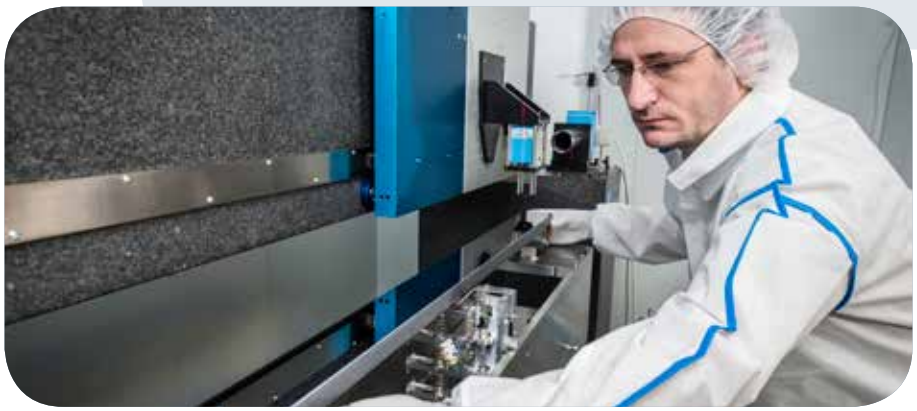
SERVICES

- Tests and calibration of RF subsystems: LLRF, calibration, waveguide components tests.
- Amplifiers acceptance tests.
- High power cavity conditioning.
- Other RF high power components functionality tests: input couplers, circulators, loads, etc.
- Design and tests of low level RF control systems (LLRF).

Optics and metrology laboratory

SERVICES

- Optimisation of figures of error.
- Calibration of mechanical benders.
- Assembly and installation of optical parts.
- Design of optical elements.
- Acceptance testing of optical elements and materials.
- Two-dimensional characterisation of flat surfaces with high speed and high accuracy.
- One-dimensional characterisation of flat and curved surfaces in different work orientations with nanometer accuracy.



Vacuum laboratory

SERVICES

- Surface preparation, cleaning and conditioning for components used in ultra-high vacuum working conditions.
- Assembly of ultra-high vacuum systems.
- Vacuum acceptance tests: visual inspection, outgassing, ultimate pressure, leak detection and residual gas analysis.
- Maintenance and operation of vacuum installations.
- Calibration of vacuum instrumentation.
- Design and dimensioning of vacuum systems.

Electronics laboratory

SERVICES

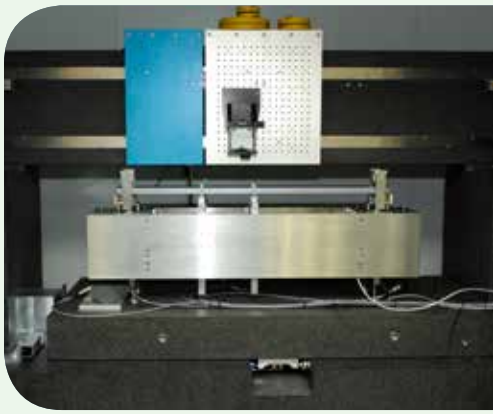
- Characterisation of semiconductor devices.
- Low level current and voltage measurements.
- High Impedance characterisation.
- High accuracy synchronization timing systems (sub nanosecond range).
- FPGA programming: high speed digital bus, embedded data processing.
- Full-custom electronics design.

Knowledge transfer

ALBA is continuously developing new technological solutions to guarantee that the synchrotron provides an optimal service. Our intent is to foster **industrial competitiveness and innovation** through the transfer of these new developments to the industrial community to be exploited commercially.

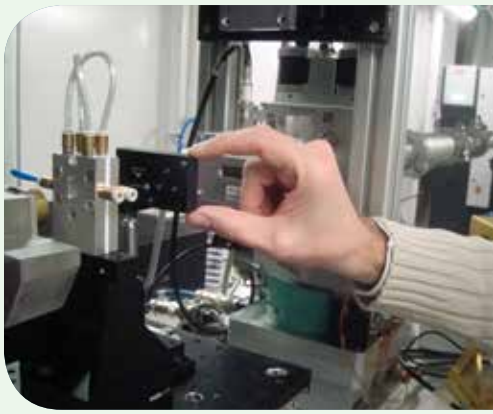
Find our new developments and technology offers at:
https://www.albasynchrotron.es/en/industry/technology-transfer

The ALBA Synchrotron and the company SENER sign a technology transfer agreement



SENER is devoted to engineering and construction. The agreement enables the commercialisation of a technological solution developed at ALBA: a new system to bend X-ray mirrors with high precision at a competitive price.

ALBA and Alibava sign a license agreement for commercialising an X-ray detector



ALBA, Alibava Systems and the Institute of Microelectronics of Barcelona (IMB-CNM CSIC) have developed a radiation detector aimed at measuring the intensity of the beam with high precision when performing an experiment at a synchrotron facility. This new detector allows the experiment to be developed correctly, ensuring the quality of the obtained data and reducing the timescale of the experiment.

Collaboration agreement between HENKEL and ALBA Synchrotron

Henkel has been the first company signing a R&D collaboration agreement with ALBA regarding industrial applications of synchrotron techniques. The goal is to reinforce Henkel's already proven capabilities on R&D as well as to support the ALBA Synchrotron capacities.

Multinational company Henkel and ALBA mantain a long-standing collaboration agreement based on research and development projects of new products using synchrotron light techniques.

Henkel, worldwide leader in the production of lines of laundry and home care, beauty care and adhesive technologies, is very interested in applying to its developments the advanced characterisation and analysis techniques that offers synchrotron light. This aspect, together with the know-how of scientists and technologists from both organisations, reinforce and expedite the innovation process of its products.

For ALBA, this agreement means the definitive confirmation of the huge contribution that this kind of large scientific and technological facilities can offer to industry and society. It is not only a key factor in competitiveness of leading companies in research, development and innovation, like Henkel, but it also turns into a major attraction for future advanced technological companies.

SAMTACK benefits from synchrotron light for improving food packaging

The company is analysing nanoparticles contained in a new food packaging system that will prevent food oxidation and extend its lifetime.

Samtack, founded in 1988 and based in Esparreguera (Barcelona), is a manufacturer of glues and adhesives specialized in the sector of graphic arts and packaging. Samtack has developed a new flexible multilayer system, in collaboration with the University of Zaragoza and the Complutense University of Madrid, that contains Selenium nanoparticles and is capable to increase food shelf life.

Free radicals are formed spontaneously from oxygen, moisture and UV radiation and initiate oxidation reactions quickly. As free radicals are very small, they are capable of traversing the plastic layers. The new multilayer system developed by Samtack contains Selenium nanoparticles in one of the layers, and these Selenium nanoparticles are capable to absorb free radicals and therefore to prevent food from oxidation.

ESTEVE, UAB and ALBA Synchrotron join efforts to investigate the mechanism of action of new inhibitors against pain

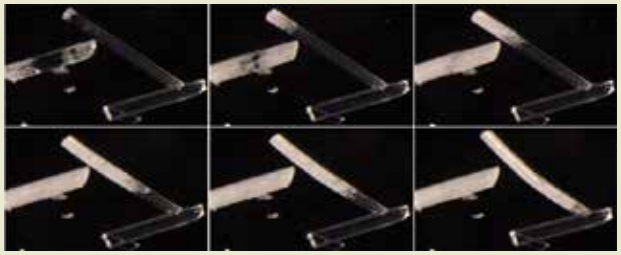
The pharmaceutical company has developed new inhibitors against pain. This collaboration project, with the joined efforts of ESTEVE, the Protein Production Platform-PPP of the UAB and ALBA, will offer new information about the interactions, active site and mechanism of action of the developed drugs and the therapeutic target.

ENANTIA uses ALBA's X-rays to detect crystalline impurities in drug products

This company collaborates with pharmaceutical companies in the identification and detection of different crystalline phases in drug substances and products.

The majority of drugs are administered as solids and solid state properties influence significantly their performance. The optimal solid form should have chemical and crystalline stability, the right pharmacokinetic profile and be easy to process. When the solid active ingredient exhibits crystalline structure transformations, they need to be taken into account for performance and intellectual property considerations. In the case of generic drugs, the presence or absence of a specific polymorph, and/or the formation of specific hydrates or solvates could determine the feasibility of launching a certain product.

In comparison with conventional radiation, synchrotron light is better as it is much more intense and monochromatic, and its wavelength can be finely tuned. This implies an enhanced signal-to-noise ratio (so smaller peaks can be detected), a shortening of the measurement time, the possibility of acquiring data from very small amounts of sample, and the possibility of discerning close peaks alongside with a more precise determination of peak intensity ratios.

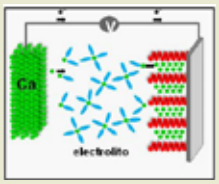


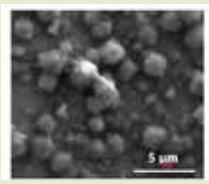
ARTAX BIOPHARMA is using the XALOC beamline for drug design

The pharmaceutical company has successfully solved the crystal structure of its target protein by using X-ray diffraction at the ALBA Synchrotron.

Artax is developing a new generation of oral compounds against autoimmune diseases. Autoimmune diseases cause the immune system to function abnormally, attacking body tissues and organs that it considers "foreign". Current treatments have two big pitfalls: their administration is mostly by intravenous route, they have low specificity and exert an immunosuppressant action. Hence, currently available treatments severely interfere with the immune system, decreasing their activity, which in turn reduces their effectiveness against infections by viruses and bacteria.

Instead, Artax compounds prevent T lymphocytes from responding against antigens but preserves their protective role against infection by pathogens. Such modulatory control of T cells allows the development of new treatments for a wide range of inflammatory and autoimmune diseases. Artax is using X-ray crystallography to study the atomic structure of the target protein and their inhibitors. This information is very relevant to understand the active center of the target protein as well as the interactions between the inhibitors and the protein.





TOYOTA and CSIC proved viability of calcium-based batteries

The Spanish Research Council (CSIC) in collaboration with TOYOTA Motor Europe (TME) demonstrates the viability of Calcium rechargeable batteries using ALBA techniques.

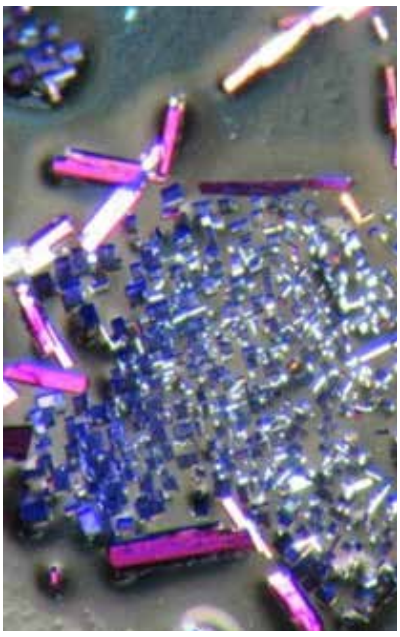
Calcium, a much more abundant and cheaper element than lithium, can act as negative electrode in rechargeable batteries. This is shown in a study elaborated by researchers of Spanish Research Council at the Institut de Ciència de Materials de Barcelona (ICMAB) in collaboration with Toyota Motor Europe (TME), and with the support of the results obtained at ALBA Synchrotron.

This study proves that calcium can be used as negative electrode in rechargeable batteries of high energy density and that they are compatible with electrolytes commonly used in lithium ion technology. These results are the basis of two filed patents and from now on researchers will direct their efforts to the development of materials for the positive electrode able to operate at a high potential to achieve high energy density batteries.

BASF, UPC and ALBA propose a methodology for producing better additives for concrete technology

Using synchrotron light, they have determined how clays and superplasticizers interact in cement pastes. These results pave the way for improving the design of new superplasticizers more resilient to the clays that usually accompany the sands used in concretes as aggregates.

Polycarboxylate (PCE) superplasticizers make concrete more fluid with less water, resulting in a substantial enhancement in workability, allowing the reduction of the water content of the paste. However, polycarboxylate superplastizers are very sensitive to the clays that may contain the sand used for the production of mortars and concretes. Therefore it is of prime importance to understand the interaction between polycarboxylate superplastizers and clays to improve the performance of this complex mixtures.



CRYSFORMA (ICIQ) characterizes polymorphs for the pharmaceutical industry at the ALBA Synchrotron

The company is using X-ray powder diffraction to solve different issues concerning the characterization of the solid state of Polymorphs of Active Pharmaceutical Ingredients.

Polymorphism is the ability of a solid substance to crystallize in more than one crystalline structure, resulting from a different arrangement of the molecules within the crystal lattice. Each of these different crystalline phases are known as polymorphs. Polymorphs of Active Pharmaceutical Ingredients (APIs), although being the same chemical entity, can have different physicochemical properties, which can affect the bioavailability of the final drug, or its processability during the manufacturing process. For this reason polymorphs are of special interest in the pharmaceutical industry.

CRYSFORMA is a unit from the Institute of Chemical Research of Catalonia (ICIQ) managed by Dr. Jordi Cerón that provides complete scientific support to the pharmaceutical and fine chemistry industry in the field of pharmaceutical solid state development.

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