ACCELERATE

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Contents

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Introduction

The Handbook of Commercial Access has been designed in two main parts. The first part consists on a booklet for industry (“CERIC Booklet for Industry”, chapter 2 of the present document) to be used as a marketing tool to attract industrial users. In the booklet CERIC, the Partner Facilities and the services and solutions offered are presented according to main industrial sectors.

In the second part (“CERIC Internal Procedure Handbook”, chapter 3 of the present document) it has been defined the internal procedure and coordination steps to be carried out by CERIC and its Partner Facilities once a request for commercial access is received.

Both parts have been designed taking into account the opinion and suggestions of the Innovation Advisory Board of Accelerate.

CERIC Booklet for Industry

1. CERIC

CERIC includes a combination of methods spanning NMR, X-ray electron spectroscopy and light scattering, ion beam analysis, high resolution electron microscopy, X-ray electron spectroscopy, materials analysis using synchrotron radiation and neutron beams. Industry can access to the instruments and know/-how of the facilities and collaborate with them through different services.

2. CERIC Offer

CERIC Partner Facilities offer high level expertise on structural, molecular and atomic investigations on materials, biomaterials and nanomaterials. Their state-of the-art instrumentation can provide information on behaviour, capabilities and limitations of such materials that supports the development of enhanced properties. The particular strength of the CERIC portfolio lies on structural and dynamic characterisation and also analysis of damages and defects under extreme condition of various types of materials, including:

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- Micro and nanostructured materials
- Thin layers, surfaces, interfaces and complex systems as multi-phase systems (e.g. alloys, emulsions)

Through these capabilities CERIC supports the development of key enabling technologies in the area of nanomaterials and advanced materials with the characterisation and behavioral studies of advanced systems for, but not limited to, these industries:

- *Metals and Alloys* for Automotive/Aerospace, Metallurgy, and Cultural Heritage industries
- *Catalysts* for Chemical, Automotive-Aerospace, Medical-Pharmaceutical and Environmental industries
- *Composites and ceramics* for Automotive-Aerospace and Chemical industries
- *Polymers* for Chemical, Automotive-Aerospace, Textile industries
- *Electrochemical systems, semiconductors, batteries and fuel cells* for Optoelectronics, Automotive-Aerospace, and Energy industries
- *Thin films/layers and coatings* for Automotive-Aerospace, Optoelectronics, Environmental, Cultural Heritage and Paint and Coatings industries
- Drugs, drug delivery systems, DNA, medical devices for Medical-Pharmaceutical industry
- *Proteins* for Medical-Pharmaceutical and Food industries

2.1. Services

CERIC and its Partner Facilities offer the opportunity to industry to improve their innovation capacity and results through the access and collaborations with cutting edge research infrastructures, in the field of materials science and development. In the following section a brief description of the services offered is presented.

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Research and development services

- **Access to Instrumentation (Proprietary Research)**: Through one or multiple state of the art techniques, industrial users can find easy solutions to issues related to their materials: CERIC's research infrastructures offer access to advanced analytical methods for materials. A request can be sent, then it will be analysed. The industrial user will be contacted in order to define properly the needs and the kind of analytical services which fit them best. The Access to instrumentation could be requested for:
  - ***Specific measurement/s***, when, in the initial request from a Third Party, is clear which kind of technique is needed and the specific kind of measurement.

    \- OR
  - As ***outsourced proprietary research*** when the Third Party will present a request and CERIC and its Partner Facilities have to analyse it and define which is the best technique or techniques to accomplish with the request.

- **Contract Research**: CERIC offers the opportunity to take part in advanced development research on topics of interest for industry. The wide know-how and expertise of its Partner Facilities is available to develop innovative solutions.

- **Joint Application in Projects:** CERIC is active in participating and building consortiums for financed projects. It offers the opportunity to be part of this kind of projects, help to find the proper partners and support in writing proposals for specific financing instruments.

Other On-Demand Services

Other services which could be requested, such as training on state of the art techniques and how to benefit from them for industrial applications.

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3. Facilities

SYNCHROTRON BEAMLINES

DXRL
Deep X-ray lithography synchrotron radiation beamline

IUVS
Offline inelastic scattering with ultraviolet radiation

Materials Science synchrotron (MSB)

MCX
Materials Characterisation by X-ray diffraction

SISSI
Synchrotron Infrared Source for Spectroscopy and Imaging

XRD1
X-ray Diffraction

SuperESCA
High resolution core-level photoemission spectroscopy

Nanospectroscopy

Spectromicroscopy

DLS
Dynamic Light Scattering

UARPES
Ultra Angle Resolved Photoelectron Spectroscopy

SISSI
Offline Infrared Source for Spectroscopy and Imaging

SAXS
Small Angle X-ray Scattering

BaDEIPh
Band Dispersion and Electron-Phonon coupling

GasPhase
*Gas Phase Photoemission

SYRMEP
Synchrotron Radiation for MEdical Physics

XAFS
X-ray absorption spectroscopy

TwinMic
Soft X-ray Transmission and Emission Microscope

Esca Microscopy

SLS
Static Light Scattering

PEEM/XAS
Photoemission Electron Microscopy / X-ray Absorption Spectroscopy

ACCELERATOR/ION BEAM

PIXE/RBS/PIGE
Particle induced x-ray emission and Rutherford backscattering

TOF-ERDA
Time-of-flight Elastic Recoil Detection Analysis

IBAD
Ion beam assisted deposition

RBS channeling
Dual beam irradiation and Rutherford backscattering Channeling

Irradiation
Irradiation and Detector Testing

IRRADIATION
with light and heavy ions

Nuclear microprobe

SURFACE SCIENCE LABORATORY

FESEM
Field Emission Scanning Electron Microscope

NAP XPS
Near Ambient Pressure X-ray photoelectron spectroscopy

XPD
X-ray Photoelectron Diffraction

NMR SPECTROMETER

David
800 MHz NMR spectrometer

Lara
600 MHz NMR spectrometer

Magic
600 MHz NMR spectrometer

Odie and Ajax
300 MHz NMR spectrometers

NEUTRON RESEARCH BEAMLINES

BIO
Biological irradiation facility

MTEST
Material test diffractometer

TOF
Time-of-flight diffractometer

PGAA
Prompt gamma activation analysis

PSD
Neutron diffractometer with a Position Sensitive Detector system

SANS
Small angle neutron scattering diffractomete

RNAA
Ko - Neutron activation analysis

GINA
Neutron reflectometer with polarisation option

TAST
Thermal neutron three-axis spectrometer and neutron holographic instrument

RAD
Thermal radiography station

ELECTRON SPIN RESONANCE AND ELECTRON MICROSCOPY

EPR
Electron Paramagnetic Resonance

HRTEM
High Resolution Transmission Electron Microscopy

SUPPORT LABORATORIES

NanoInnovation Laboratory

Structural Biology Laboratory

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4. Solutions for Industries

4.1. Automotive and Aerospace

CERIC Partner facilities support aerospace and automotive industry on advanced materials and devices to meet critical safety and performance requirements, assessing the capabilities and limitations of materials even in extreme conditions.

Examples of potential solutions

Components

- Composition analysis of tires
- Irradiation damage analysis of electronic components used in airplanes for failure analysis when subjected to cosmic rays.
- Imaging of engine system components
- Investigation of surface roughness
- Residual stresses and irregularities in components
- 2D and 3D imaging of components (it can be done during operation)
- Information about deep layers of matter, even from the inside of a container or a machine, being able to analyse different kind of materials in solid, powder, liquid and pressurized gas form where no reference materials exist

Manufacturing

- Study of the inside of large pieces of equipment, and inside vessels that have different conditions of pressure, temperature and environment applied for material manufacturing and testing (glass, ceramic, alloys).
- Fabricating high precision components that have to be coupled with precision systems, such as microgears, microparts for watches, microturbines and microfluidic channels.

Coatings, paintings and thin films

- Analysis of dispersion of pigments for coatings and paintings
- Analysis of inorganic pigments in paintings

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- Depth profiling with depth scale of several microns for the analysis of the thin and multilayer films for process control monitoring, composition analysis and contaminant control
- Depth studying of coatings or thin layers up to micro and nano size

Catalysts, batteries and fuel cells

- Surface and interface study on heterogeneous catalysis e.g. for energy conversion by hydrogen fuel cells and electrolyzers
- Study of how properties of catalysts, batteries and fuel cells can vary during operation and follow the evolution of components. Study of electronic behaviour of fuel cells during operations
- Understanding the diffusion behaviour of molecules in microporous materials for the design of membranes for separations for catalysts e.g. in petrochemical industry
- New materials for Li-ion batteries: composition of materials impurities, mixtures of polymorphs
- Average or local elemental composition of bulk samples in a non-destructive way especially for hydrogen and boron elements through in-situ or under operando experiments, e.g. fuel cells
- Analysis of the changes of catalysts during chemical reactions
- Study of electronic behaviour of fuel cells during operations
- Analysis of traces (ppm ppb) – Catalysis
- Probing new catalysts at atomic level

Electrochemical systems and semiconductors

- Studies of electronic structure phenomena such as electronic phase transitions and the electronic structure of small – down to sub-micrometer size – objects
- Study of electronic properties of materials such as semiconductors, high-temperature superconductors, topological insulators, low-dimensional materials providing composite image of the electronic properties of investigating materials. Imaging of the electronic properties of semiconductor materials and devices, such as in photovoltaics
- Understanding at the distribution of chemistries across a surface such as in operando electrochemical systems and semiconductors

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- Analysis of the surface behaviour and in surfaces interactions in electrochemical systems and semiconductors under realistic conditions. Up to nanoscale.

Composition, microstructure characterisation and behaviour of metals

- Microstructural and morphological characterisation of nanostructured metals, defining the composition, crystal structure, shape at nanometric scale
- Sensitive analysis of metals microstructure and their thermal behaviour through residual stress test
- Aggregation and microstructural defects (dislocations, planar defects, precipitates) down to atomic resolution
- Study orientational disorder, determine cation distributions and localise light atoms in crystal structures.

Composition, microstructure characterisation and behaviour of alloys

- Microstructural and morphological characterisation of alloys and new alloys, defining the composition, phases crystal structure and shape down to nanometric scale
- Following the evolution of alloys composition and microstructure during operation (stress or temperature from 77K up to 1000 °C)
- Study orientational disorder, determine cation distributions and localise light atoms in crystal structures.
- Determining the texture of alloys components
- Quantitative elemental analysis of alloys samples
- Study of distribution of two phase systems (such as metal alloys)

Polymers, composites and ceramics

- Composition, crystal and molecular structure of materials such as ceramics and plastics, aggregation and microstructural defects definition (dislocations, planar defects, precipitates) down to atomic resolution in order to solve issues related to materials characteristics and why problems related to their functioning occur
- Surface structure and structural dynamics to study synthetic polymers in solution and in bulk. Definition of thin film structure in polymers surfaces.

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- Understand the properties and behaviour of modern smart materials which all have nanoscale structure (composites, polymers with or without nanofillers)
- Study surfaces interactions in nanocomposites

Defects and damages

- Analysis of inhomogeneity of casted materials, water uptake of solids, analysis of artefacts and machines and also dynamic measurements to follow time-dependant processes
- Intolerance of shot blasting systems to metalworking fluids
- Depth profiling with depth scale of several microns for the analysis of the thin and multilayer films for process control monitoring, composition analysis and contaminant control
- Characterisation of individual aerosol particles collected on filters.
- Characterisation of novel detector structures with the particular focus to the radiation hardness tests (e.g. wideband gap semiconductors, novel diamond detectors including 3D structures)
- Corrosion of metals applied in extreme conditions
- Monitoring radiation damage and compounds deposition
- Microstructural defects (dislocations, planar defects, precipitates) down to atomic resolution of materials such ceramics
- Definition of defects, precipitates (size, composition, shape)

Main beamlines, instruments and laboratories: MCX, PSD, XAFS, Irradiation, DXRL, TOF-ERDA, HR-TEM, PIXE/RBS/PIGE, MTEST, TAST, PGAA,SANS, GINA, RAD, DLS, Nanospectroscopy beamline, SuperEsca, SPL-MSB, FESEM, XPS and XPD, XAFS, Spectromiscroscopy beamline, TOF-ERDA, Nuclear Microprobe

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4.2. Metal/Metallurgy

The continuing drive for miniaturisation provides an opportunity to build on current micro and nano-manufacturing capabilities related to metals. Among others, developing intelligent multi-functional surface properties for metal components and solutions is key for metal industry. CERIC can support the study of these properties and define new grades of metals and alloys with higher strength, formability and corrosion resistance.

Examples of potential solutions

Microstructures characterisation and behaviour of metals

- Microstructural and morphological characterisation of nanostructured metals, defining the composition, crystal structure, shape at nanometric scale
- Sensitive analysis of metals microstructure and their thermal behaviour through residual stress test
- Aggregation and microstructural defects (dislocations, planar defects, precipitates) down to atomic resolution
- Study orientational disorder, determine cation distributions and localise light atoms in crystal structures.

Composition and structures/microstructures of alloys

- Determining the composition and microstructure of new alloys (composition, phases, etc)
- Microstructural and morphological characterisation of nanostructured alloys, defining the composition, crystal structure, shape at nanometric scale
- Quantitative elemental analysis of alloys samples
- Determining the texture of alloys components
- Following the evolution of alloys composition and microstructure during operation (stress or temperature from 77K up to 1000 C)
- Study of distribution of two phase systems such as metal alloys

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Defects and damages

- Analysis of inhomogeneity of casted materials, water uptake of solids, analysis of artefacts and machines and also dynamic measurements to follow time-dependant processes
- Corrosion of metals applied in extreme conditions
- Intolerance of shot blasting systems to metalworking fluids

Main beamlines, instruments and laboratories: MCX, MTEST, RAD, GINA, SAXS, HR-TEM, TOF, PGAA, NAA, PEEM, XAS

4.3. Optoelectronics

The Opto-electronics industry has been growing exponentially in the last decades. Main emphasis of technology trends is to have great efficiency that too with greatly reduced size of apparatus. Enhanced conductive and magnetic properties of materials and miniaturisation are the areas where the industry is focusing its efforts in order to come up with better innovations and inventions. CERIC Partner facilities can offer an extensive knowledge and a wide range of solutions for materials development in this area.

Examples of potential solutions

Structure and behaviour of electrochemical systems and devices, semiconductors, superconductors and graphene systems

- Analysis of the surface behaviour and in-surface interactions in electrochemical systems and semiconductors under realistic conditions. Up to nanoscale.
- Study of electronic properties of materials such as semiconductors, high-temperature superconductors, topological insulators, low-dimensional materials providing composite image of the electronic properties of investigating materials. Imaging of the electronic properties of semiconductor materials and devices, such as in photovoltaics
- Study of electronic structure phenomena such as electronic phase transitions and the electronic structure of small – down to sub-micrometre size – objects
- Surface morphology, roughness, mechanical and biomechanical behaviour of samples up to micro and nanoscale, permitting also impedance and capacitive measures
- Magnetic ordering and crystalline structure in superconductors
- Effect of electric field on different types of electronic devices such as transistors

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- Charge transport phenomena occurring in finished devices and probe electronic transport at different sample depths
- Study of surface and interface phenomena obtaining morphology, chemical (elemental sensitivity) and magnetic properties with lateral resolution of few dozen of nanometres for e.g. composites, clusters, giant magneto-resistive materials, metal-semiconductor spintronic materials.
- Magnetic mapping of several types of surfaces in real time with a spatial resolution up to 20 nm e.g. to establish the stability of magnetic memories and graphene based sensors.
- Graphene acquisition of functionalities beyond its intrinsic properties for possible spintronic applications
- Induced superconductivity in graphene

Composition, structure and microstructural defects of thin films/thin layers

- Structure measuring of thin films or liquid surfaces providing detailed information about on the near-surface structure, including thin films layered on the substrate. Multilayers (up to several thousand) can be investigated. Depth profiling with depth scale of several microns for the analysis of the thin and multilayer for UV mirrors, giant magnetic resistance and magnetic recording
- Study of surface and interface phenomena obtaining morphology, chemical (elemental sensitivity) and magnetic properties with lateral resolution of few dozen of nanometres for thin films and their deposition
- Characterisation of thick and thin films, their quality, composition and microstructural defects in semiconductors.

Main beamlines, instruments and laboratories: Nuclear Microprobe, RBS, GINA, PEEM, UARPES, XPS, Nanospectroscopy beamline, XAS, PSD, TOF-ERDA, Gas phase photoemission beamline, Spectromiscroscopy beamline, BaDElPh, TWINMIC, SuperESCA, NanoInnovation laboratory

4.4. Energy

Energy demand from developed and developing countries grows, together with concerns on the detrimental effects that an energy economy based on fossil fuels has on the environment.

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Materials research is fundamental in order to develop energy and storage systems, as advances in materials science that may boost the transition to more sustainable energy consumption. Studies are being carried out including the development novel materials with advanced properties to be applied on solar and fuel cells and batteries and CERIC can offer solutions for main topics related to materials applied to the newest systems.

Examples of potential solutions

Catalysts, batteries and fuel cells

- Surface and interface study on heterogeneous catalysis e.g. for energy conversion by hydrogen fuel cells and electrolyzers
- Study of how properties of catalysts, batteries and fuel cells can vary during operation and follow the evolution of components. Study of electronic behaviour of fuel cells during operations
- Understanding the diffusion behaviour of molecules in microporous materials for the design of membranes for separations for catalysts e.g. in petrochemical industry
- New materials for Li-ion batteries: composition of materials impurities, mixtures of polymorphs
- Average or local elemental composition of bulk samples in a non-destructive way especially for hydrogen and boron elements through in-situ or under operando experiments, e.g. fuel cells
- Analysis of the changes of catalysts during chemical reactions
- Study of electronic behaviour of fuel cells during operations
- Analysis of traces (ppm ppb) – Catalysis
- Probing new catalysts at atomic level

Electrochemical systems and semiconductors

- Study of electronic properties of materials such as semiconductors, high-temperature superconductors, topological insulators, low-dimensional materials providing composite image of the electronic properties of investigating materials. Imaging of the electronic properties of semiconductor materials and devices, such as in photovoltaics
- Studies of electronic structure phenomena such as electronic phase transitions and the electronic structure of small – down to sub-micrometer size – objects

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- Understanding the distribution of chemistries across a surface such as in operando electrochemical systems and semiconductors
- Analysis of dichalcogenides applied in innovative solutions

Renewable

- Information on nanoparticle sizes, shape and size distributions in the 1 nm to 0.1 µm range
- for the development of solar cells and organic solar cells

Oil

- Analysis of the change in the absorbers during oil press process.
- high quality data for e.g. the analysis of oil and oil samples for the petrochemical industry

Main beamlines, instruments and laboratories: HRTEM, EPR, Nuclear Microprobe, NMR, XAFS, MTEST, SAXS, SLS, SPL-MSB, FESEM, XPS and XPD, SuperESCA, TOF-ERDA, Spectromiscroscopy beamline, BaDElPh, ESCA, TAST, PGAA, UARPES

4.5. Chemical

The traditional chemical industry has become a mature industry, new products and market opportunities will come from advanced chemicals with new properties: controlling structures at the micro- and nano-levels is therefore essential to develop new products, meanwhile almost all chemical industries nowadays rely on development, selection, and application of catalysts. CERIC Partners facilities can offer their expertise on this "hot topics" for Chemical industry.

Examples of potential solutions

Chemicals structures and dynamics

- Study of surface and interface phenomena obtaining morphology, chemical (elemental sensitivity) and magnetical properties with lateral resolution of few dozen of nanometres for e.g. composites, clusters
- High quality data from different types of compounds for the analysis for example of fertilizers.

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- Determination of the local structure, dynamics, reaction state and chemical environment within molecules
- Graphene functionalisation beyond its intrinsic properties for possible spintronic applications
- Detect trace elements at high resolution
- Analyse the shape, size and density of nanoparticles.

Catalysts characterisation and behaviour

- Analysis of the changes of catalysts during chemical reactions. Study of how properties of catalysts can vary during operation and follow the evolution of components
- Understanding the diffusion behaviour of molecules in microporous materials for the design of membranes for separations for catalysts
- Surface and interface study on heterogeneous catalysis
- Analysis of traces (ppm ppb) – Catalysis
- Probing new catalysts at atomic level

Polymers, composites and ceramics

- Composition, crystal and molecular structure of materials such as ceramics and plastics, aggregation and microstructural defects definition (dislocations, planar defects, precipitates) down to atomic resolution in order to solve issues related to materials characteristics and why problems related to their functioning occur
- Surface structure and structural dynamics to study synthetic polymers in solution and in bulk. Definition of thin film structure in polymers surfaces
- Understand the properties and behaviour of modern smart materials which all have nanoscale structure (composites, polymers with or without nanofillers)
- Study surfaces interactions in nanocomposites

Main beamlines, instruments and laboratories: NMR, SAXS, NAA, PEEM, XAFS, EPR, MTEST, HRTEM, GINA, XRD1, SANS, SISSI, XPS, Nanospectroscopy beamline, SuperEsca, SPL-MSB, FESEM, XPS and XPD

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4.6. Pharmaceutical, Medical and Biotech

CERIC techniques can offer solutions to critical issues to industry, obtaining much more precise information of the molecular structure and behaviour offering the possibility to understand unsolved issues so far. Among others, CERIC Partner facilities help to understand variability in drugs and their behaviour, critical to address the problem of failing to identify effective drug, or to study biosimilars that are also new target for industry as they present an affordable option to the consumer and a potential hit for manufacturing companies.

Examples of potential solutions

Drugs and drug delivery systems

- Identification of Active Pharmaceutical Ingredient (API) and of the interactions between API and excipients within formulation
- Development of drug formulations and their release in solid, liquid-crystal (lipid nanoparticles formulation) and liquid state (oral dosage form formulation)
- Definition of local structure and symmetry, presence of local strains, mechanism of structural and chemical transformations in the development of new pharmaceutical compounds.
- Structural investigation of composites, polymers with or without nanofillers, micellar solutions, emulsions, biological macro molecule and drug delivery systems
- Identification of proteins size and agglomeration, in order to determine the dispersion of particles in tissues for drug delivery applications
- Study of new contrast media for the definition of new protocols in the medical field and in drug delivery.
- Study orientational disorder, determine cation distributions and localise light atoms in crystal structures.
- Information on nanoparticle sizes, shape and size distributions in the 1 nm to 0.1 µm range

Proteins

- Identification of proteins size and agglomeration, in order to determine the dispersion of particles in tissues e.g. for drug delivery applications
- Proteins identification in the field of biosimilars

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- High throughput production of recombinant proteins and test of biochemical and enzymatic activities on the proteins where inhibitors are being tested
- Study the way to optimise the fabrication of protein nanoarrays
- Characterisation of protein molecules and their aggregates, precrystallisation processes and structures of protein-surfactant complexes.

DNA

- Control on DNA replication, genome stability and cell signalling to prevent cellular abnormalities**,** genetic diseases and the onset of cancer**.**
- Study of pharmaceutical compounds and their interaction with DNA

Medical and medical devices

- Enhanced Tomography to study of human organs (e.g. kidney) stones composition, mammographic imaging with resolution of few to hundreds of microns
- Study new types of scaffolds functionalised with different types of cells
- Irradiation in atmosphere (e.g. for living cells and seeds for mutation studies)

Catalysts characterisation and behaviour

- Analysis of the changes of catalysts during chemical reactions. Study of how properties of catalysts can vary during operation and follow the evolution of components
- Surface and interface study on heterogeneous catalysis
- Analysis of traces (ppm ppb) – Catalysis
- Probing new catalysts at atomic level

Biotechnology

- Defining performances of biocompatible materials for virology, cellular biology or cancer research
- Biological irradiation studies
- Testing of biosensors' bio-functionalisation
- Contrast matched measurements, which reveal particular details on multicomponent systems

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Main beamlines, instruments and laboratories: DLS, IUVS, NMR, XRD1, HRTEM, Nanoinnovation laboratory, Structural Biology, Irradiation, SANS, SAXS, SLS, SYRMEP, , Nanospectroscopy beamline, SuperESCA, SISSI, EPR, BIO, TOF, XAS

4.7. Food

Technology is taking an increasingly important role in food production. Advances are required from across the full spectrum of food research, and CERIC Partner facilities can support from the molecular and microstructural definition and the raw material processing and novel processing methods, to quality control, microbiological safety issues and advances in preservation.

Examples of potential solutions

Composition, microstructures characterisation and behaviour of food

- Very specific information about the relative concentration of the components (e.g. in edible fats and oils)
- Pore structure of samples, for example, freeze-dried vegetables.
- Determination of the dispersion of particles in emulgens
- Trace elements composition, map molecular groups and structures on the nanoscale
- Diffusion behaviour of molecules in microporous

Proteins

- Specific interactions of proteins embedded in matrixes (e.g. glassy sugar matrices)
- Determine proteins size and agglomeration of proteins

Defects and damages

- Monitoring radiation damage in different materials including food

Main beamlines, instruments and laboratories: EPR, DLS, IUVS, SISSI, NAA

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4.8. Environmental

Issues of environmental protection are gaining an increasing importance. Every aspect of materials usage, from extraction to production, and disposal is now related to environmental considerations. CERIC Partner facilities also collaborates on systems and processes for analysis, monitoring and control of contaminant particles, nanoparticles and trace elements too.

Examples of potential solutions

Composition, structures and characterisation in environmental studies

- Detecting trace elements and map molecular groups and structures up to micro and nano resolution in environmental studies such as in plastic pollution
- High resolution studies of electronic band structure (e.g. for ozone studies)
- High quality data from different types of materials for the analysis for example of soil and fertilizers.
- Studies to define the distribution of the absorption of light metals
- Depth profiling with depth scale of several microns for the analysis of the thin and multilayer films for process control monitoring, composition analysis and contaminant control

Removal solutions

- Characterisation of individual aerosol particles collected on filters.
- Evaluating effectiveness of pollutants removal solutions

Main beamlines, instruments and laboratories: IUVS, MCX, XAFS, BaDElPh, PIXE-RBS-PIGE, TOF-ERDA, TWINMIC, RBS, GINA, MTEST, Gas phase photoemission beamline, NAA, XAS

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4.9. Cultural Heritage

CERIC Partner facilities can support cultural heritage conservation offering a wide complementary set of characterisation techniques, essential due to the complexity and heterogeneity of the samples, through low or non-destructive analytical methods and providing information from atomic to the structural level of the samples.

Examples of potential solutions

Characterisation

- Characterisation of the metal threads from liturgical vestments and folk costumes in order to define appropriate treatment for cleaning and conservation
- Analysis of inorganic/metal pigments in the paintings and composition of antique coins
- 3D tomographic imaging of several objects with resolution of few to hundreds of microns and
- 3-D imaging by thermal neutrons for bulky objects in a non-destructive way providing high-quality imaging inside objects
- Non-destructive bulk or local elemental composition measurement for provenance studies
- Unique combination of element analysis and imaging for the easier interpretation of structure and materials.
- Material surfaces studied at atomic level

Damages and treatments

- Characterisation of the metal threads from liturgical vestments and folk costumes in order to define appropriate treatment for cleaning and conservation
- Monitoring damages in materials done by exposition to radiation

Main beamlines, instruments and laboratories: PIXE-RBS-PIGE, EPR, Twin-mic, SYRMEP, RAD, MCX, PGAA, TOF

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4.10. Textile

High tech solutions have become prominent in the textile sector over the last decade. Delivering enhanced performance, exceptional protection and premium function is the focus of the textile sector. New polymers with enhanced properties and nanomaterials are nowadays basic materials for the smart textile sectors and CERIC partner facilities can support research in this area.

Examples of potential solutions

Polymers and smart materials

- Study of polymers, polyamides and other materials for high quality application, as well as to solve issues related to their technical characteristics;
- Surface structure and structural dynamics to study synthetic polymers in solution and in bulk. Definition of thin film structure in polymers surfaces
- Understand the properties and behaviour of modern smart materials which all have nanoscale structure

Defects and Damages

- Monitoring radiation damage and compounds deposition (down to submicrometric resolution) in textiles used in high risk sites

Main beamlines, instruments and laboratories: SISSI, EPR, TwinMic, PIXE-RBS-PIGE, SANS

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4.11. Paint and Coatings

Paint and coatings manufacturers are constantly seeking for long lasting solutions easy to use and with enhanced properties in the area of dirt, rain and environmental contaminants repellants materials, focusing, in particular on their micro and nano-scale structure as is directly linked to their end-use properties at the macro-scale. CERIC Partners have facilities and skills to help refine production and manufacturing processes and understand micro- and nano-structure in these materials for higher end-product performance.

Examples of potential solutions

- Depth studying of coatings or thin layers up to micro and nano size
- Depth profiling with depth scale of several microns for the analysis of the thin and multilayer films
- Analysis of dispersion of pigments for coatings and paintings
- Analysis of inorganic pigments

Main beamlines, instruments and laboratories: PGGA, DLS, PIXE/RBS

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5. CERIC role

CERIC wants to act as a support instrument for every Partner Facility and help to boost or consolidate their relationship and collaboration with industry.

CERIC is working on presenting the potential industrial applications and services that Partner Facilities can offer to different sectors. Workshops, events and other dissemination tools will be used and the Partner Facilities will be involved in these activities in order to reach the maximum benefit for them.

All of the opportunities of collaboration with industry that have been detected by CERIC and will be detected in the future will be presented to the Partner Facilities in order for them to evaluate and eventually exploit them.

CERIC's activities will be recognised by its Partner Facilities in their annual report, listing all the opportunities, entities introduced to them by CERIC and, if any, describing the type of collaboration and benefits (monetary and/or non-monetary) that CERIC's Industrial Liaison Office (ILO) activities have brought to them.

CERIC will act as a liaison, **collecting the information and needs from Third Parties and distributing them to the Partner facility or Partner Facilities** selected (with a previous opinion from the Industrial Liaison Committee in some cases, see chapter 3.2 of the present document). CERIC will then be responsible of putting in contact the Partner Facilities with the Third Party, coordinating the first approach and the exploratory meeting with all of the Partner Facilities or the Representing Entities involved in order to decide if the need can be solved. CERIC will be also in charge of collecting the solutions proposed by the Partner Facilities and eventually merging all of the information to be sent to the Third Party. **In case needed, and explicitly asked by the Partner Facilities involved, CERIC can support the negotiation process and coordinate between the Partner Facilities and the Third Party** until the agreements (contracts or quotes) are signed. One NDA (non-disclosure agreement) involving all the parties, including CERIC, will be prepared and coordinated by CERIC, meanwhile **the agreements for services (quotes or contracts) will be signed directly by the Partner Facility or the Representing Entities (according to their internal rules) and the Third Party.**

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In case the need implies the collaboration of more than one Partner Facility, CERIC, under the request of the Third Party, can act as a "Coordinator": CERIC will coordinate the negotiations between the Partner Facilities and the Third Party and follow-up on the development of the services by coordinating all of the necessary meetings between the parties, collecting the information (technical and/or administrative) of the service/s' progress, acting as "one door" for the Third Party. **The coordination service will be contracted between CERIC and the Third Party.**

The Partner Facilities will be in charge of providing CERIC with administrative, technical and logistic information when requested and according to the type of service requested by the Third Party. The agreements regarding the development of **the services can be signed directly by the Partner Facility or the Representing Entities involved and the Third Party, and CERIC will be in charge of collecting the different agreements and sending to the Third Party. If the Third Party requests to deal with just one agreement, CERIC will sign separate agreements with the Partner Facility or the Representing Entities in order to provide the service and a unique agreement will be signed between CERIC and the Third Party**. CERIC will be in charge to coordinate the development of the whole service provided and responsible for the reporting to the Third Party.

CERIC will be in charge, in collaboration with its partner facilities, to look for other external partners in case needed to solve a request from a Third Party.

Any specific request by Partner Facilities regarding constrains that may prevent them from following of the procedure will be taken into account and analysed case by case by CERIC.

6. Access Procedures to the Services

6.1. Procedure for access to instrumentation through specific measurement/s

In case, from the first approach, is clear the specific kind of measurement/s needed, and a specific instrumentation is requested, CERIC will contact the Director of the facility/facilities and the Industrial Liaison responsible directly, without undergoing the opinion of the Industrial Liaison Committee (see chapter 3.2).

The responsible of each technique involved has 6 working days to analyse the request and eventually ask for more information in order to evaluate it, and a maximum of 8 working days to send an answer if the service could be offered.

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If the measurements requested were not feasible, the facility shall communicate to CERIC the reasons for refusal and whenever possible, suggest alternative solutions.

In case of positive feedback, CERIC will organise the meetings between the Partner Facilities involved and the Third Party in order to define more in depth the technical details and the type of collaboration that can be established between the Parties.

One NDA (non-disclosure agreement) involving all the parties, including CERIC, will be prepared and coordinated by CERIC.

Once all the details are clarified between the Partner facilities and the Third Party, if a consensus with this latter is reached, **the negotiation will be followed by the Partner Facilities involved or their Representing Entities. CERIC's role can be considered accomplished at that stage, unless additional support on the negotiation phase is asked by the Partner Facilities or a coordination service is required by the Third party.**

6.2. Procedure fro access to instrumentation through outsources proprietary research, contract research and other on demand services.

Industrial Liaison Committee

An Industrial Liaison Committee (hereinafter the Committee) will be established in order to evaluate the needs and requests coming from industry through CERIC and its industrial liaison activities, unless the Third Party asks for specific measurements. Each Partner Facility will appoint up to two representative persons that will be members of this committee.

The aim of the committee is to **evaluate the requests, define the feasibility (if the requests may be solved by CERIC's Partner Facilities) and suggest a list of possible CERIC techniques that can be suitable to solve the needs**. In case the requests cannot be solved by the Partner Facilities, the Committee will be in charge of suggesting other options outside CERIC's Partner Facilities, if any, in order to meet with the request.

Committee procedure and information process to the Partner Facilities

CERIC will collect all of the information needed. Once all the information is obtained, CERIC will send it to the Committee to analyse which is the best technique or techniques that can solve the Third Party's need.

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CERIC will set a meeting (conference or skype call) with the members of the Committee at the latest 7 working days after the request is sent to them, always according to the availability of all the members. In the meeting, the committee will propose and reach a consensus on a list of possible CERIC techniques and the related Partner Facilities and eventually other techniques that can solve the Third Party's needs.

Once the final list is defined, the directors of each of the concerned Partner Facilities will be informed, and the responsible of each technique will be contacted and informed by CERIC regarding the Third Party's request in order for them to analyse it internally within 6 working days (from the establishment of the list of the techniques).

Feedback from the Partner Facilities and agreements definition

The responsible of each technique involved has 6 working days to analyse the request and eventually ask for more information in order to evaluate it, and a maximum of 8 working days to send an answer if the service could be offered / the need could be solved by them.

If they cannot provide the solution, they have to explain the reasons and if they can, suggest alternative solutions.

Once the feedback is received, and if positive, CERIC will organise the meetings between the Partner Facilities involved and the Third Party in order to define more in depth the technical details, assure that the need can be solved, and the type of collaboration that can be established between the Parties. One NDA (non-disclosure agreement) involving all the parties, including CERIC, will be prepared and coordinated by CERIC.

Once all the details are clarified between the Partner facilities and the Third Party, if a consensus with this latter is reached, **the negotiation will be followed by the Partner Facilities involved or their Representing Entities as CERIC's role can be considered accomplished at that stage, unless additional support on the negotiation phase is asked by the Partner Facilities**.

Feedback from Partner Facilities and agreements definition when the Third Party contracts the coordination service from CERIC

If Partner Facilities can provide the service, and in case the Third Party contracts CERIC as a coordinator, **the Partner Facilities involved have to appoint a person that will be in charge of delivering the service and coordinating the technical communication with CERIC and the**

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Third Party, and appoint a person that will be in charge of the administrative communication with CERIC and the Third Party, the same person can be appointed for both roles.

Once a consensus between the Third Party and Partner Facilities is reached, **Partner Facilities have a maximum of 7 working days to elaborate a full proposal** including the detailed description of the services, the price, timings, deliverables and other relevant conditions, then **send the full proposal to CERIC.**

CERIC will be in charge of collecting all of the proposals, and eventually calculating any other added value by CERIC and sending them to the Third Party or to include them in the whole CERIC proposal to the Third Party within 6 working days from the reception of the proposals from the Partner Facilities.

In case the Third Party will contract the coordination service from CERIC, CERIC will be in charge of organising the kick-off meeting in order for the Partner Facilities to present the details of the service and eventually define with the Third Party additional details and specifications. The kick-off meeting will be not necessary in case a specific measurement will be requested.

In case other partners external to CERIC are involved in carrying out part of the service, they will be invited to the kick-off meeting as well.

The Partner Facilities will be in charge of managing all the technical questions directly with the Third Party, while keeping CERIC in copy of every written communication with the Third Party.

Partner Facilities involved in the services offered will provide any information, both administrative and technical, when requested by CERIC or the Third Party. If any problem or issue related to the development of the service occurs, the Partner Facilities involved have to inform CERIC as soon as possible in order to solve it promptly.

The Partner Facilities shall provide to CERIC every eventual mid-term and the final deliverables/results agreed on. CERIC shall review it and if necessary, ask for additional information to integrate the final version of the report to be delivered to the Third Party.

CERIC will be in charge of organising, according to the availability of all parties, any review meeting during the service provision, and if requested by Third Party, a final meeting between the Partner Facilities and the Third Party a maximum of 15 working days after the reception of the final report/ results by the Third Party. During meetings, the results will be

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presented by the Partner Facilities in order to answer any final question by the Third Party. In case any change on the report is needed, it will be agreed on during the meeting along with the timing for delivering the changes. The delivery of changes will follow the same procedure as the one followed for the final report.

6.3. Procedure for joint application in projects

Procedure when a request is submitted

Committee procedure and information process to the Partner Facilities

Once a request for a Joint Application for a project is received, CERIC will be in charge of analysing it and asking for all the information needed in order to have all the data regarding the Third Party's project proposal. Once all the information is obtained, it will be sent to the Committee to analyse the most suitable Partner Facilities that can participate in the project.

CERIC will set a meeting with the members **of the Committee, at the latest 7 working days after the request is sent to them according to their availability**. **In the meeting, the committee will propose and reach a consensus on a list of possible Partner Facilities that are suitable for the project and eventually other external partners**. **If not already suggested by the Third Party, CERIC and the Committee members will propose possible financing instruments**.

Once defined, CERIC will inform the directors of each Partner facilities and all the information regarding the possible project will be sent to them in order to analyse it internally.

Feedback from the Partner Facilities on their participation to the project

After receiving all the information regarding the possible joint application, the **Partner Facilities selected will have up to 15 working days to ask for additional information on the project, approve internally their participation to the project proposal and elaborate a first draft idea of their role in it.**

During this period, meetings between the Partner Facilities and the Third Party will be set by CERIC when needed.

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Formation of the Consortium and set-up of the Coordinator role

After receiving all the feedback from the Partner Facilities, CERIC will set a meeting with the Third Party and the Partner Facilities participating into the proposal within 7 working days, according to the availability of all parties, in order to approve the composition of the project's consortium, the finance instrument and eventually the need of other partners**. During this meeting, and if possible, it will be established which entity will take the role of Coordinator in the project.**

6.4. Procedure for contracts with external partners to accomplish a request from a Third Party

In case a contract with an external partner to CERIC's consortium is needed to complete the accomplishment of a request, **CERIC will be in charge of finding the proper partner, with the support of the Partner Facilities involved in the service provision. The Partner Facility shall suggest options during the Committee meeting, and CERIC will eventually be in charge of finding other candidates.** The request from the Third Party will be sent by CERIC to the candidates who will have to send an answer regarding the feasibility within 10 working days. **CERIC, together with the Partner Facilities, will analyse the proposals in order to decide which the most suitable ones are.** In case needed, CERIC will be in charge of organising meetings with the Partner Facilities, external partners and the Third Party contracting the services. Afterwards, the negotiation will remain between the Partner Facilities involved, their Representing entities and the external partners, as CERIC's role can be considered accomplished at that stage, unless explicit support phase is asked by Partner Facilities or by the Third Party.

To fulfil the whole request

CERIC will then set a meeting with the members of the Committee, according to their availability, at the latest 7 working days after the request is sent to them. In this meeting, the committee will propose external partners that can solve the Third Party's needs in case the need cannot be accomplished by CERIC's Partner Facilities.

CERIC will be in charge of sending the information to the Third Party regarding any entity that could fulfil its needs.

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7. Intellectual property framework

The collaboration within the CERIC-ERIC framework shall not alter the ownership rights on any Intellectual Property or similar assets of the Partner Facilities or their Representing Entities owned previously to any agreements with Third Parties. For the foreground developed from any service provision an Intellectual Property policy framework is established:

- In the case of agreements on **access to instrumentation** through **Specific Measurement** the disclosure of results and the ownership and protection of eventual new Intellect Property developed by the use of CERIC-ERIC and Partner Facilities' resources should be of the Third Party.
- In the contracts signed **for access to instrumentation through outsourced proprietary research**, it will be considered by Partner Facilities to eventually propose a clause to reserve for themselves **a royalty-free right to identify, make, have made, use and have used of the foreground for any research or educational purpose.**
- In the case of agreements on **contract research** the disclosure of results and the ownership and protection of eventual new Intellect Property developed by the use of CERIC-ERIC and Partner Facilities' resources will be regulated by the specific contractual arrangements involving the Third Party.
- **In case of contract research**, in order to ensure that the ownership, protection and defence of a jointly generated IP is correctly allocated, it is important to put in place appropriate contractual arrangements. The Intellectual Property will be owned by the Third Party and the Partner Facilities or CERIC according to the contribution to the IP generated. In this case, it will be clearly described in the agreements which Intellectual Property is going to be shared, and it will be clearly stated which percentage of the IP is owned by each party. Moreover the agreements should address:

    - ***Conditions of use***: as for proprietary research, Partner Facilities should reserve for themselves the **royalty -free right to identify, make, have made, use and have used of the foreground at least for any research or educational purpose.**
    - ***Conditions of exploitation***: the agreements shall address which party will be in charge of the eventual exploitation of the results obtained (if either parties or just one), and which will be the compensation for each party according to their contribution to obtaining the results and on the exploitation actions.

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- ***IP protection and maintenance***: the agreements should address how the rights will be protected and which of the parties will cover the protection costs and the maintenance of the protection costs.
- ***Governing law, jurisdiction***: the agreements shall address under which government law and jurisdiction they are assigned.

It is considered that in Intellectual Property rights' joint ownership, a joint decision is required by all parties for practically any or all disposal of the Intellectual Property rights. It may mean that any exploitation right must be handled contractually, for example, with written consent needed from one party for the other party to enforce its rights, with perhaps some limitations specified for the sub-licensing and/or licensing of rights and with an obligation to share licence revenues. For this reason, when possible and considered convenient in a contract research, CERIC and its Partner Facilities will try to licence their rights to the Third Party or acquire the whole ownership of Intellectual Property rights of the results.

- **Ownership of Intellectual Property resulting from joint funded research** will be shared according to the agreement signed for the funded project and in conformity with the requirements of the funding agency.
- **Material created** such as reports, documents, graphic designs, written presentations (e.g. power point presentations), etc., during the development of the service and in order to accomplish the contracts, shall remain the property of the Partner Facilities (or CERIC if elaborated by CERIC), but the Third Party shall be permitted to use such material for internal research and administrative purposes.

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8. Pubblication policy framework

In the case of the access to instrumentation and contract research services, the disclosure of results and the ownership and protection of eventual new Intellectual Property developed by the use of CERIC-ERIC and PF resources will be regulated by the specific contractual arrangements involving the Third Party.

In any case, the following clause should be included in any contractual arrangements:

- "Each Party agrees that it can make the existence of a collaboration between the Parties public, but will not refer to the terms of this Agreement. Neither Party will use any trade name, trade mark, trade device, service mark or symbol owned by the other Party without prior approval of such use from the other Party."

According to the negotiation, different options can be included in the agreements with Third Party.

In access to instrumentation and contract research services, the Third Party should acknowledge the Partner Facilities and CERIC interest in publishing and presenting the results of the research in order to obtain recognition within the scientific community and to advance the state of scientific knowledge. However, any publication or presentation of Confidential Information, Joint Know-How, and/or any information arising from the project or service should be made solely with a written agreement of the Parties.

In any contract, except for disclosures permitted regarding background, **either Party, including its employees or consultants, wishing to make a publication or presentation containing Confidential Information, Joint Know-How, and/or any information arising from the service or project developed under the agreements, should deliver to the other Party a copy of the proposed written publication or an outline of an oral disclosure at least 20 working days prior to submission for publication or presentation**. The reviewing Party shall have the right (a) to propose modifications to the publication or presentation for patent reasons, trade secret reasons or business reasons and/or (b) to request a reasonable delay in the publication for the preparation and filing of patent.

Publication of results arising from a joint funded research will be shared according to the agreement signed for the funded project and in conformity to the requirements of the funding agency.

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