

Cluster 3 Engineering and Technology for Sustainable Development

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University of Extremadura Competence Analysis Based on open call to research

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Example of relevant research topics

#1 Electronics

- ✓ Electronic aspects for miniaturised and intelligent medical devices.
- ✓ Robotics for smart farming.
- ✓ Digital twins and Artificial Intelligence applications for manufacturing processes maintenance and industrial logistics.

#3 (Smart) materials

- ✓ Material structure recognition using Artificial Neural Networks.
- ✓ Automation of material characterization processes using Machine Learning methods.

#2 Wastewater/water treatment

- ✓ Nature-based and technological solutions for wastewater and water management.

#4 Resilient energy systems and renewable energies

- ✓ Energy conversion and storage.
- ✓ Geothermal and Solar Energy Use for Sustainable Eco-agricultural Farms in Rural and Remote Areas.
- ✓ Ground Coupled Heat Pumps of High Technology.

#5 Circular economy and smart industries:

- ✓ Sustainable supply chains and logistics.
- ✓ Circular economy in built environment.
- ✓ Digital Transformation & Emerging Technologies e.g., Embedded AI & ML for medical devices.
- ✓ Supply Chain Analytics for Circular Economy.
- ✓ Machine Learning applications for Sustainable Management of Industrial Equipment.
- ✓ Modelling and simulation of systems, decision systems based on fuzzy sets.
- ✓ Artificial Intelligence applications for manufacturing processes maintenance and industrial logistics.
- ✓ Manufacturing processes automation based on the industry 4.0 concept.

#6 Environmental impact assessment

- ✓ Quality of environment, soundscape, social acceptance, environmental psychology.



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Cluster 3 Engineering and Technology for Sustainable Development Matching EU Green and European Research Calls

| EU GREEN | CONVOCATORIAS |
|--|--|
| Electronics | European Partnership for Key Digital Technologies (KDT) |
| Wastewater/water treatment | HORIZON-CL6-2024-ZEROPOLLUTION-01-2 Ej: Best available techniques to recover or recycle fertilising products from secondary raw materials |
| Circular economy and smart industries: | European Partnership Made in Europe |
| Environmental impact assessment | Processes4Planet – Transforming the European Process Industry for a sustainable society Partnership |

- **Engineering and Technology**
- **Sustainable solutions**
- **Decarbonisation**
- **Energy supply**
- **Mobility**
- **Circular economy**
- **Materials research**

#1 QSM Group

WHO WE ARE

The QSM group (Sustainable and Environmental Chemistry) has extensive experience in carbonaceous materials research. In addition to their preparation and characterisation, we use them as catalysts in the synthesis of fine chemicals and as adsorbents of pollutants. We generally use agricultural or forestry waste as raw material as we are also interested in the circular economy. The results obtained have been published in high impact scientific journals.

WHAT WE OFFER

Extensive experience in the preparation and characterisation of carbonaceous materials, without ruling out other solids that can be used as adsorbents or heterogeneous catalysts. We have the means to carry out a complete characterisation of these materials. In addition, we can test catalysts in reactions to obtain fine chemicals and adsorbents in the removal of organic and inorganic pollutants from the aqueous phase. We also have experience in photocatalysis for the removal of pollutants.

OUR INTERESTS

- We are interested in the circular economy, as we understand that our planet's resources are limited, and we cannot exploit them without limits. That is why we try to recover and reuse different types of waste.
- Water treatment. Drinking water will be one of the resources that will cause most social and economic tensions in the coming decades. Any technology that allows its purification, reuse or reduction of consumption will be important in the coming years.
- Fine chemicals. Many products of the chemical industry (pharmaceuticals, food additives, cosmetics, etc.) are included in this group. They are characterised by the fact that their synthesis is complex, costly and highly polluting. The use of heterogeneous catalysis can reduce these problems, leading to more sustainable industrial processes.

OUR priority interest in research collaboration

- Water purification, using adsorption, photocatalysis or other processes.
- Heterogeneous catalysts for the synthesis of fine chemicals.
- Biochar for the improvement of agricultural and forestry soils.

#5 QUOREX Group

WHO WE ARE

We are a small-sized group (acronym: QUOREX) involving 6 Faculty staff members, devoted to teaching and research, the latter focused on enabling and sustainable methodologies. QUOREX has proven enough training capability over the years, especially supervision of master and doctorate students, who often pursued postdoctoral activities in European and American universities and now hold academic positions. The group is credited with publications in well-reputed journals, often in collaboration with external researchers. Our research has regularly been funded by regional and national grants.

WHAT WE OFFER

Our expertise lies largely in synthetic organic chemistry, with progressive incorporation of green chemistry tools during the past two decades, both application of nonconventional activation techniques and use of renewable materials and catalysts. The group has also research capability in computational chemistry. Laboratories at the Department Unit are well equipped, and major infrastructure (including human resources) is available from SAIUEX (Servicio de Apoyo a la Investigación) through more sophisticated instrumentation for bioscience and materials characterization. computational resources are provided by the supercomputing facility Lusitania-II. All services require payment of fees.

OUR INTERESTS

- Safety and sustainable by design: chemicals and materials. Bio-based economy and circular production; Upcycling of secondary resources and wastes.
- We are particularly interested (within the goals of this EU-Green cluster) in the development of materials from renewable feedstocks and carbonaceous catalysts, tailored for applications, like organic synthesis and functional-group manipulations (in line with our expertise), but also water splitting, gas uptake, and photo/thermal processing. Application of enabling techniques, ranging from microwaves/sonication to mechanochemistry are considered in the context of clean processes towards climate/energy neutral and zero waste.

OUR priority interest in research collaboration

Joint effort and synergy in the above-mentioned topics, focused on novel materials and catalysts. Mutual benefits in terms of skills/expertise exchange, and know-how transfer for large-scale applications

#2 TELCO Group

WHO WE ARE

The Telecommunications Group is a research group composed of six professors with a PhD, 4 postdoctoral researchers and 2 predoctoral researchers.

The group has long experience in the development of electromagnetic (EM) analysis methods that they have applied to the design of antennas and passive microwave circuits, and to the analysis and synthesis of on-board antennas, EM characterization of nanomaterials and plasmonic structures. Also, the group has experience in the experimental design of active circuits in PCB technology for microwave bands, and in integrated circuit technologies for the millimeter and submillimeter-wave bands.

WHAT WE OFFER

The group has its own EM simulation software and high-performance computing facilities. They also have 5 licenses of CST Microwave Studio Suite. They have the RF Prototyping and Measurement Lab available, which includes an LPKF Protolaser S4 machine together with an LPKF electroplating system as well as other smaller-scale equipment. Also, they have two network analyzers from Keysight Technologies (N9912A and N9918A) and an N9010B EXA signal analyzer. For permittivity measurements, there is a Keysight coaxial probe N1501A. The group has experience in the whole development cycle of RF technology, from the development of efficient software up to the application of experimental techniques.

OUR INTERESTS

- Development of efficient computational software for Electromagnetic analysis and design.
- Analysis and synthesis of on-board antennas.
- Experimental design of passive and active circuits in the microwave and millimeter-wave bands, antennas and antenna arrays.

OUR priority interest in research collaboration

- We are open to receive proposals that match our research interests.

#6 Acoustic Group

WHO WE ARE

We are a group of researcher of the University of Extremadura, coming from different disciplines (Acoustics, Environmental Studies, Chemistry, Computer Science, Statistics, Telecommunications...) that in the last years have been working on the proposal of new construction materials coming from the recycling of used cigarette butts.

WHAT DO WE OFFER

- Our research group has previous experience in the preparation of samples with used cigarette butts and cork.
- Besides, we have developed a sustainable chemical procedure to eliminate the toxic residues of the cigarette butts (to be published proximately)
- We can offer our experiences in measurements with an impedance tube (determination of acoustical absorption, flow resistivity, transmission loss...)
- Additionally, for higher sampler, random absorption coefficient could be measured in our normalized reverberation chamber.

WHAT ARE WE LOOKING FOR:

- With experience in the use of sustainable binders to be used.
- That could complement the acoustical characterization of the samples with other characterization such as thermal, mechanical, resistance to fire...

#3 Bayesian Inference and Decision Research Group

WHO WE ARE

The Bayesian Inference and Decision Research Group was created in 1999 to contribute to the development and application of new techniques in the area of Bayesian statistics. Later, the scope of action was extended to mathematical and statistical techniques in general, that allow the resolution of real problems in different fields of knowledge, including engineering and bioengineering. The research group is composed of 9 members (mathematicians and computer scientists) with permanent positions (3 full professors and 6 associate professors), 4 pre-doctoral students and one project manager.

WHAT WE OFFER (expertise, infrastructures and skills offered – maximum 700 characters with spaces)

The group has expertise in Bayesian inference, decision making under uncertainty, machine learning techniques, mathematical and statistical modelling, operation research as well as in data analysis in several knowledge fields.

The developed techniques are designed, implemented, and applied for specific problems such as computer-aided diagnosis systems to detect voice-related diseases and sensor-based systems to monitor the beehive health status and improve pollination, among other engineering and technology sustainable solutions for digital transformation in circular economy and smart industries.

The research group has workstations with GPU graphics cards and access to other computing facilities.

OUR INTERESTS

- Machine learning for smart industries
- Computer-aided diagnosis systems
- Precision agriculture

OUR priority interest in research collaboration

We are open to receive proposals that match our research interests.

#7 PEandES Group

WHO WE ARE

The Power Electrical and Electronic System Group is composed by six Doctors and four predoctoral researchers.

The group has long experience in the application of Power Electronics applied to Electric Systems, dealing with hot topics as Smart Grids, Microgrids, Energy Communities, Renewable Energy, Electric Vehicles, Energy Storage or Green Hydrogen.

WHAT WE OFFER

His large experience in building power electronics converters, developing control algorithms for these converters and simulation and managing of electrical systems.

OUR INTERESTS

- Measuring, evaluation and study of control systems for the quality electrical supply
- Injection systems for the electrical supply of the energy produced by renewable energy plants
- Electrical and electronic mechanisms. Development of the associated software for the control of processes and installations
- Storage, adaptation and distribution of the electrical energy for vehicles
- Drive system / Electric propulsion in vehicles

OUR INTEREST

To participate in projects related with Energy Transition, Energy Storage or Energy Digitalization.



**University of
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#4 Microelectronics Group

WHO WE ARE

The Telecommunications Group is a research group composed of six professors with a PhD, 4 postdoctoral researchers and 2 predoctoral researchers.

The group has long experience in the development of electromagnetic (EM) analysis methods that they have applied to the design of antennas and passive microwave circuits, and to the analysis and synthesis of on-board antennas, EM characterization of nanomaterials and plasmonic structures.

Also, the group has experience in the experimental design of active circuits in PCB technology for microwave bands, and in integrated circuit technologies for the millimeter and submillimeter-wave bands.

OUR EXPERTISE

- Energy harvesting systems, with special emphasis in photovoltaic panels, including battery energy storage, optimization by means of MPPT and emulation of programmable electrical loads
- Micro-energy harvesting systems in CMOS technology, including the design of full-custom high-performance integrated circuits (integrated photovoltaic transducers based on photodiodes, capacitive DC-DC converters, low-dropout voltage regulators,...) for supplying wireless sensor nodes
- Monitoring and control of renewable energy generation systems by means of virtual instrumentation such as LabView
- Telemetry systems for industrial and domestic energy consumption
- Management of Li-ion cells and batteries, including charge, discharge and protection circuits, BMS, impedance measurement
- Implementation of different prototypes in 180 nm CMOS technology of LDOs and voltage references for micro-energy harvesting
- Design and monitoring of a cost-effective photovoltaic system for hot water production
- Green energy generation within the project ECLOSION, participating in the hybridation of Li-ion cells and supercapacitors
- Implementation of a telemetry system for monitoring gas, electricity and water consumption