IMANA Institute – Strategic Plan for the quadrennium 2026-2029



Malaga, September 28, 2026

Website: https://imana.es

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1. General Data.

Institute Name: Institute of Materials and Nanotechnology (IMANA**)**

Institution: University of Málaga (Universidad de Málaga, UMA)

Institute Type: University Research Institute

Ownership: Public (University of Málaga)

Year of Establishment: Approved by the Governing Council of the University of Málaga in 2022; officially accredited by the Regional Government of Andalusia in 2024.

General scientific Fields:

Materials Science • Nanotechnology • Analytical Sciences • Functional Materials • Advanced Characterisation • Green Chemistry • Sustainable Materials • Energy Materials • Environmental Technologies • Biotechnology • Smart Monitoring Technologies

Headquarters:

Faculty of Sciences, Avda. Luis Pasteur, 31. University of Málaga. Campus de Teatinos, 29071 Málaga, Spain

Management Body:

Director: Prof. Elisa Isabel Vereda Alonso. **Deputy Director(s):** Prof. Concepción Herrera Delgado

Secretary: Prof. Francisco Ávila Ferrer

Members-at-Large: Prof. Ezequiel Pérez de Inestrosa Villatoro and Prof. María del Mar López Guerrero

Scientific Committee:

Prof. Juan Carlos Otero Fernández de Molina
Prof. Elisa Isabel Vereda Alonso
Prof. José Miguel Vadillo Pérez
Prof. Tomás Cordero Alcántara
Prof. Javier Ramírez Aguilar
Prof. Luis José Alemany Arrebola
Prof. Aurelio Cabeza Díaz
Prof. Francisco de Paula Martín Jiménez
Prof. Francisco Ramón Sarabia García
Prof. Yolanda Vida Pol
Prof. José Manuel López Romero
Prof. María del Carmen Ruiz Delgado

Research Units:

UFILM – Functional Surfaces and Interfaces

UNASIS – Organic and Inorganic Nanosystems

UFAS – Advanced Functional Materials and Organised Systems

UMES – Structural Materials

UMAEn – Advanced Materials for Energy

UBIOTEC – Nanobiotechnology

Research Community:

Approximately 100 researchers, including permanent academic staff, postdoctoral researchers, doctoral candidates and research fellows, actively engaged in competitive national and international research programmemes, advanced training, and technology transfer.

1.1. Mission, vision and values.

1.1.1. Mission.

IMANA is committed to advancing scientific knowledge and technological innovation in the fields of materials science, nanotechnology, analytical sciences, and related disciplines. Through excellence in research, advanced characterisation, education, and knowledge transfer, IMANA aims to contribute to innovative solutions that address major societal challenges in sustainability, energy, health, environmental protection, digital transformation, and industrial competitiveness.

The Institute promotes collaborative and multidisciplinary research by integrating the complementary expertise and capabilities of its Research Units to generate high-impact scientific outcomes, attract competitive funding, and contribute to the socioeconomic development of Andalusia, Spain, and the international community. This commitment is underpinned by a strong dedication to education, innovation, and the effective transfer of knowledge and technology.

1.1.2. Vision.

IMANA aspires to become an internationally recognised reference centre in materials science and nanotechnology, distinguished by scientific excellence, technological leadership and societal impact. The Institute seeks to position itself among the leading European research centres in advanced materials by developing transformative research, attracting outstanding talent, strengthening international collaborations and creating innovative technologies that contribute to a sustainable and knowledge-based economy.

Through the strategic integration of its research capabilities, advanced infrastructures and partnerships with industry and public institutions, IMANA aims to establish a leading hub for materials and nanotechnology research addressing global challenges related to sustainability, circular economy, energy transition, health, environmental protection and climate emergency.

Looking towards 2030, the Institute aims to establish itself as a strategic node for advanced (high added-value but also cost-effective) materials and intelligent technologies and methods, with a strong capacity to attract outstanding researchers, coordinate high-impact international projects, and foster innovation ecosystems that effectively connect academia, industry, public institutions, and society.

1.1.3. Values.

The activities and strategic development of IMANA are guided by the following core values:

Honest Scientific Excellence: Pursuing the highest standards of quality, rigour, creativity, and scientific excellence in research and innovation, while promoting research outputs of the highest international visibility and impact.

Interdisciplinarity and Collaboration: Fostering active cooperation among researchers from diverse scientific disciplines and institutions, recognizing that the most complex scientific and technological challenges require the integration of complementary expertise, perspectives and infrastructures.

Sustainability and Social Responsibility: Committing to the development of materials, processes, and technologies that contribute to sustainable development, climate neutrality, circular economy principles, resource efficiency and environmental protection. Ensuring that scientific advances contribute to improving quality of life.

Innovation, Knowledge Transfer and Entrepreneurship: Facilitating the translation of research outcomes into practical applications, industrial partnerships, patents, and technology-based enterprises that enhance innovation and economic development.

Internationalization: Strengthening global scientific networks by promoting international collaboration, researcher mobility, and active participation in international consortia and large-scale research infrastructures.

Talent Development: Attracting, retaining, training, and empowering outstanding researchers and the next generation of scientific leaders by providing an inclusive, stimulating, and internationally oriented research environment.

Transparency: Promoting responsible research practices, open dissemination of scientific knowledge, sound data stewardship and governance, reproducibility, and transparency across all scientific activities.

Diversity, Equality and Inclusion: Recognising diversity as a key driver of excellence and innovation, while ensuring equal opportunities, inclusiveness, and mutual respect throughout all Institute activities.

2. IMANA historical outline.

2.1. Brief historical outline.

The Institute for Materials and Nanotechnology (IMANA) at the UMA is a cutting-edge scientific institution whose primary mission, in accordance with its regulations, is to "bring together researchers who consolidate and advance knowledge, development, and innovation in the emerging fields of nanoscience, nanotechnology, and materials science, providing an enabling infrastructure for fundamental and applied research in science and engineering, fostering regional socio-economic development through excellence in scientific research, technological development, and specialized education oriented toward technological advancement."

The project originated under the initiative and vision of Prof. José Ramón Ramos Barrado, Department of Applied Physics I, who in 2018, following the approval by the University of Málaga Governing Council of the Regulations for the Creation and Operation of University Research Institutes, promoted the formation of a committee to draft the proposal for the creation of a Research Institute in Materials and Nanotechnology. This committee was composed of representatives from 13 research teams recognised by the Regional Government of Andalusia under the Andalusian Plan for Research, Development and Innovation (PAIDI). These researcher groups belonging to the Departments of "Applied Physics I", "Physical Chemistry", "Analytical Chemistry", "Organic Chemistry", "Inorganic Chemistry, Crystallography and Mineralogy", and "Chemical Engineering", within the Faculty of Science. Among them, 11 belonging to the "Exact and Experimental Sciences (FQM)" area, one to "Production Technologies (TEP)", and one to "Natural Resources and Environment (RNM)."

The IMANA creation project concluded with its approval by the University of Málaga Governing Council on 17 June 2022. Sadly, Profs. José Ramón Ramos Barrado and Daniel Collado Martín passed away before the successful completion of the project. Following the approval by the University of Málaga Governing Council, the management committee, coordinated by Prof. Aurelio Cabeza Díaz, Department of Inorganic Chemistry, Crystallography and Mineralogy, continued working toward IMANA's accreditation as an Agent of the Andalusian Knowledge System. In November 2023, the Andalusian Universities Council issued favourable report supporting its establishment, and its definitive recognition by the Governing Council of the Regional Government of Andalusia was formalized through publication in BOJA, No. 141, on July 22, 2024. In December 2024, IMANA held its first elections for Director, electing Prof. Elisa Isabel Vereda Alonso (Department of Analytical Chemistry). In June 2025, IMANA held its first Workshop, during which the research groups presented their progress in different applied scientific and technological fields.

The Institute integrates researchers from different scientific disciplines within a collaborative framework that promotes interdisciplinarity, scientific excellence and internationalization. Its research activities span the entire innovation chain, from fundamental research and advanced materials design to characterisation, analytical technologies, prototype development and industrial applications, supported by state-of-the-art scientific infrastructures and strong national and international collaborations.

2.2. Past quantitative indicators.

2.2.1. Overview and institutional context.

Following its constitutional approval by the UMA in June 2022 and its subsequent accreditation by the Junta de Andalucía in July 2024, the IMANA has undergone an accelerated phase of growth and academic consolidation. This section describes the trajectory of the Institute across its core strategic metrics over the 2023–2025 triennium: scientific outcome volume, research quality, financial sustainability, and the attraction of talented human capital.

Over this three-year period, IMANA has demonstrated a robust capacity to convert competitive public and private funding into high-impact scientific knowledge while expanding its internationalization and attracting highly competitive research staff. Establishing itself as a benchmark centre for materials science and nanotechnology.

2.2.2. Key performance indicators (KPIs).

Table 1 synthesizes the quantitative metrics defining the operational evolution of IMANA during the analysed period.

Table 1. Yearly evolution of selected KPI of IMANA along the years 2023-2025.

	2023	2024	2025	Triennial Trend/Growth
Pillar 1: Scientific Production				
Total Peer-Reviewed Articles	72	75	79	**+8,9% (Steady Growth)**
Pillar 2: Research Excellence				
Q1 Journal Ratio (%)	75.0 %	81.3 %	88.6 %	**+18.1% (Quality Enhancement)**
Pillar 3: Financial Sustainability[$]				
Competitive Research Projects (€)	€1,052,176.56	€1,285,645.94	€2,361,815.53	**+124.5% (Outstanding)**
Corporate/ Industrial Contracts (€)	€103,415.14	€139,391.58	€130,257.11	**+25.9% (Consolidated)**
Total Funding Secured (€)	**€1,155,591.70**	**€1,425,037.52**	**€2,492,072.64**	**+115.6% (Overall Expansion)**

[*]The funding of projects and contracts are proportionally allocated to the execution years as detailed in the awarding documents, i.e. possible extensions are not taken into account.

Also, during the 2023–2025 period, IMANA researchers generated significant intellectual property assets, including the international patent application **WO 2025/074019** entitled "Fluorescent compounds based on symmetric bis(styryl)indolium derivatives with two-photon absorption properties, methods for their preparation and their use as mitochondrial markers", and were granted the European patent **EP4095097B1**, entitled "Metal-adsorbing composite material based on magnetic graphene oxide and method for obtaining same". The latter is currently being commercially exploited by **IMATECK Nanotechnologies, S.L.**, a UMA spin-off founded by IMANA members.

2.3. Strategic analysis of results.

Strategic Objective 1: Scientific Production Capacity

The institute has maintained a highly stable and prolific publishing output, yielding a total cumulative number of 226 peer-reviewed articles over the triennium. Production shifted from a steady baseline of 72 and 75 papers per annum in 2023 and 2024, respectively, to 79 papers in 2025. This steady volume reflects a mature, well-established research ecosystem that has successfully balanced quantity with a deliberate shift toward highly-reputed international venues.

Strategic Objective 2: Quality and Editorial Prestige (Q1 approach)

While the overall publication volume remained consistently high throughout the triennium, the quality profile of the scientific output showed a clear and sustained improvement. The percentage of articles published in top-tier journals classified within the First Quartile (Q1) grew consistently:

- 2023: 75.0% of publications achieved Q1 status.
- 2024: Raised to 81.3% during the year of regional accreditation.
- 2025: Reached an outstanding 88.6%, representing an absolute growth of +18.1% against the 2023 baseline.

This upward trend is illustrated in Figure 1 and confirms that the internal policies of IMANA successfully prioritized highly-reputed international scientific journals, substantially enhancing the global prestige and academic indexation of both the Institute and the UMA.

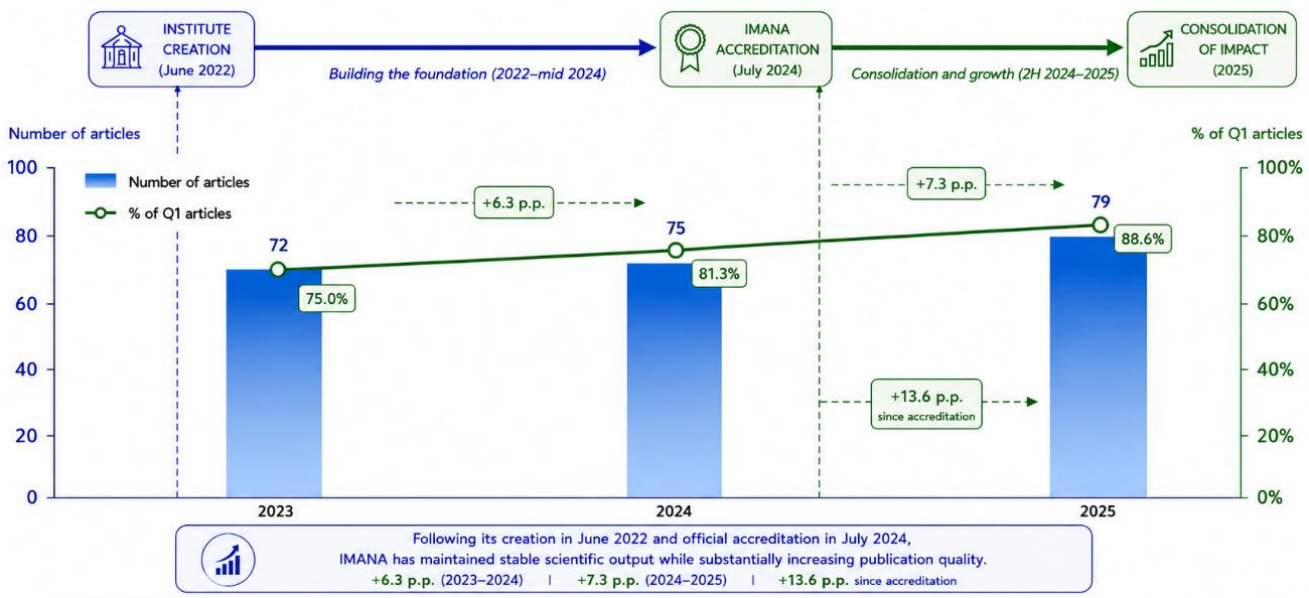


Figure 1. Evolution of scientific production and scientific publication 'quality' of IMANA

Strategic Objective 3: Financial Sustainability & Resource Attraction

The financial performance of IMANA serves as an indicator of its structural maturity and competitive edge. The overall budget secured grew by 115.6%, expanding from €1.15M in 2023 to nearly €2.49M in 2025, as illustrated in Figure 2.

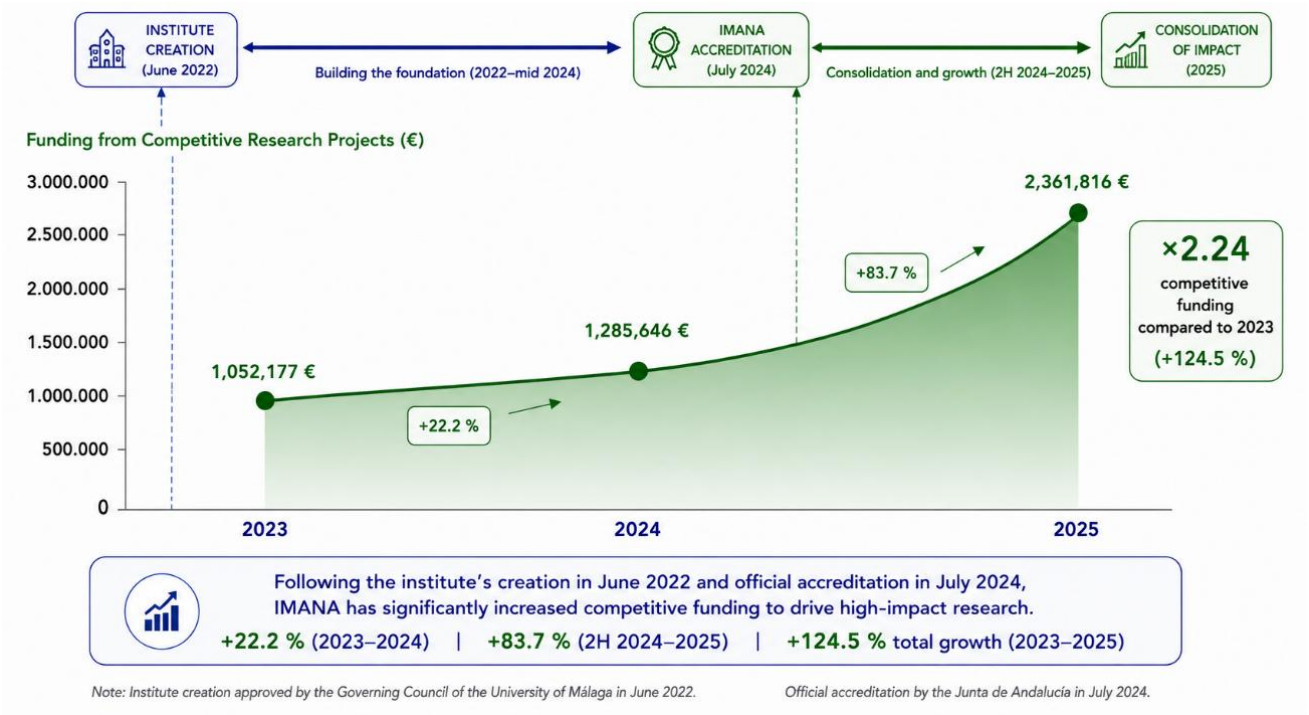


Figure 2. Attraction of competitive funding of IMANA in the 2023-2025 triennium.

- Competitive Public R&D Projects: Public funding through competitive research calls remains the primary engine of IMANA's budget. It underwent a remarkable 124.5% increase, jumping from €1.05M (2023) to €2.36M (2025). This massive surge in 2025 is directly correlated with the institutional milestone of achieving official accreditation from the Junta de Andalucía, which unlocked access to specialized regional and European infrastructure and research grants.

- Knowledge Transfer and Corporate Contracts: Private revenue through direct industrial contracts with companies grew by 25.9% overall, peaking at €139,391.58 in 2024 and stabilizing at €130,257.11 in 2025. This indicates a consistent capability to transfer nanotechnology solutions to the industrial sector, complementing public funds with private partnerships. Furthermore, IMANA researchers generated significant intellectual property assets, including the international patent application WO 2025/074019 and the European patent EP4095097B1, which is currently being commercially exploited by IMATECK Nanotechnologies, S.L. Together with the Institute's portfolio of OTRI-mediated contracts (Office for the Transfer of Research Results), these achievements demonstrate IMANA's strong capacity to transform scientific knowledge into innovative technologies, business opportunities, and socioeconomic value for the regional innovation ecosystem.

It is worth mentioning that IMANA researchers participate in three leading EU-funded R&D calls. In particular, the Institute manages the only ERC-AdG ever awarded to UMA.

Title: In situ imaging of low-carbon CEMent hydration with SYNchrotron X-rays'. Acronym: **syn4cem**. Overall funding: 2.49 M€. 'Grant Agreement': 101139298. Dates: 2025/01/01-2029/12/31; more info at https://cordis.europa.eu/project/id/101139298. It also internationally coordinates the EIC-'Pathfinder Challenges': Title: "Real-time X-ray diffraction and microstructure imaging: accelerating the transformation of cementitious materials into CO2 sinks". Acronym: **X-SeeO$_2$**. Amount: €4.043 million (€1.402 million UMA). Grant Agreement: 101220926. Partners: UMA-coordinator (Spain), University of Bath (UK), University of Manchester (UK), ESRF (France). Duration: 2025/10/01 to 2029/09/30; more info at https://cordis.europa.eu/project/id/101220926.

IMANA also participates in EIC "Pathfinder Challenges". Title: "Zero-loss Energy harvesting Using nanowire solar cells in Space". Acronym: **ZEUS**. Amount: 4.548 M€ (0.621 M€ UMA). Grant Agreement: 101161465. Partners: University of Lund (SE), University of Málaga (ES), Fraunhofer ISE (DE), Universidad Politécnica de Valencia (ES), Instituto Tecnológico del Embalaje, Transporte y Logísitica (ES), National Centre for Scientific Research – DEMOKRITOS (GR). Duration: 2024/09/01 to 2028/08/31. More info at: https://cordis.europa.eu/project/id/101161465

Figure 3 summarizes the overall evolution of IMANA.

Strategic Objective 4: Competitive Talent Attraction and Internationalization

A cornerstone of growth strategy of IMANA during the 2023–2025 period has been the recruitment of talented scientific talent through highly competitive national, regional, and international calls, effectively laying the groundwork for long-term research leadership:

- FY 2023 Cohort: IMANA secured 4 competitive research contracts with a duration of 1 to 2 years to reinforce ongoing experimental lines. Concurrently, the institute successfully hosts 1 long-term competitive contract with a 4-year tenure, ensuring sustained commitment to foundational research tracks.
- FY 2024 Cohort: The institute attracted 1 prestigious "Beatriz Galindo" senior international researcher. This milestone directly supported the institute's internationalization goals and coincided with its formal regional accreditation.
- FY 2025 Cohort: IMANA achieved an exceptional recruitment year by embedding 3 elite scientists via highly competitive programmes:
    - 1 "Ramón y Cajal" Researcher (5-year tenure), representing the highest tier of national research excellence and leadership.
    - 1 PAIDI Postdoctoral Researcher (3-year tenure), funded through the regional talent programme of Andalusia.
    - 1 "Juan de la Cierva" Postdoctoral Researcher, reinforcing specialized lines of analytical and materials research.

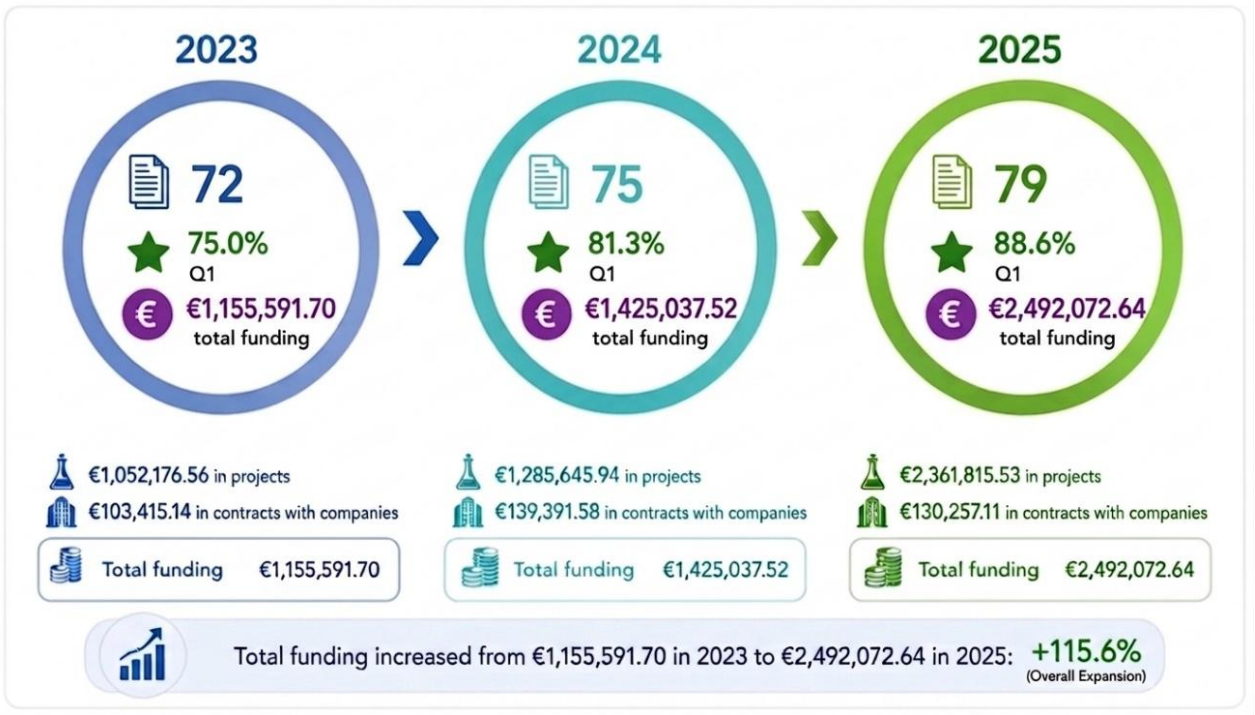


Figure 3. Overall evolution of IMANA (Annual summary)

Furthermore, IMANA has firmly established a globalized research environment. This is demonstrated by the integration of 6 non-Spanish born researchers contracted directly through competitive projects led by research groups of IMANA. This international framework is structurally supported by 2 permanent faculty members of IMANA who are international scholars, driving the integration of the institute into global scientific networks.

Key Conclusions.

The quantitative metrics for the 2023-2025 period demonstrate that IMANA has successfully completed its initialization phase. The data reveals an institute that is not only financially sound and increasingly capable of self-funding through public-private capital, but also highly efficient at translating economic capital into top-tier scientific excellence (>88% Q1 publications). This solid baseline positions the Institute ideally to undertake the ambitious growth targets outlined in the upcoming periods of this Strategic Plan.

Beyond scientific excellence and financial growth, IMANA has also demonstrated a significant capacity for knowledge transfer through industrial contracts, patent generation and participation in technology-based entrepreneurship initiatives, further consolidating its role as a strategic innovation actor within the Andalusian and Spanish research ecosystem.

3. Institute description.

The organizational structure of IMANA has been designed to promote scientific excellence, interdisciplinary collaboration and efficient governance while ensuring flexibility to respond to emerging scientific opportunities. The Institute is organised around a central Management Team, six interdisciplinary Research Units and a current network of twelve PAIDI research groups that constitute its scientific core.

The Management Team is composed of the Director, Deputy Director, Secretary and two elected permanent faculty members, who jointly coordinate the scientific, academic and administrative activities of the Institute. The Management Team is responsible for implementing the Strategic Plan, coordinating institutional initiatives, promoting interdisciplinary research, managing external relations and ensuring the efficient use of scientific and human resources.

Scientific activity is organised into six Research Units, each bringing together complementary research groups with shared scientific interests while promoting interactions across disciplinary boundaries.

UFILM – Functional Surfaces and Interfaces
UNASIS – Organic and Inorganic Nanosystems

UFAS – Advanced Functional Materials and Organised Systems
UMES – Structural Materials
UMAEn – Advanced Materials for Energy
UBIOTEC – Nanobiotechnology

These six Research Units integrate the twelve PAIDI research groups of the IMANA, see below, and constitute the operational framework through which research activities, infrastructure sharing, doctoral supervision and collaborative projects are coordinated. Their interactions naturally converge towards the five Strategic Research Areas defined in this Strategic Plan (Table 2), reinforcing interdisciplinarity while maintaining the scientific identity of each research group.

Table 2. Strategic Research Areas

Strategic Research Areas	Research Units
Materials for a sustainable and circular economy	**UMES**
Functional materials for health, environment and agriculture	**UNASIS, UBIOTEC**
Materials for energy efficiency, thermal management and electronics applications	**UFILM, UMAEn**
Advanced functional materials and organised systems	**UFAS, UMAEn**
Analytical science and intelligent monitoring technologies	**UBIOTEC, UFAS**

The Management Team is supported by the ***Institute Board***, which acts as the main governing body for institutional decision-making, and by the ***Scientific Committee***, which provides advice on scientific planning, research priorities and internal coordination among the Research Units.

In addition, IMANA relies on several transversal institutional functions supporting research excellence, including scientific infrastructure management, internationalization, technology transfer, doctoral and postdoctoral training, scientific communication and outreach, quality assurance and strategic planning. These activities are developed in close collaboration with the Central Research Support Services (SCAI) of the UMA and will progressively evolve towards a more professionalized research management model.

The current organizational model is conceived to combine efficient governance with scientific flexibility. While the Research Units provide stable scientific structures, interdisciplinary collaboration is primarily driven through the Strategic Research Areas and cross-unit initiatives, allowing researchers from different Research Units to participate jointly in collaborative projects, shared infrastructures and institutional strategic actions.

3.1. Current general organization.

The current general organization is shown in Figure 4.

Institute Board (Consejo del Instituto)**:** Governing and oversight body.

- Approves strategies, budgets, plans and annual reports.
- Approves the admission of new members.

Scientific Committee (Comisión Científica)**:**

- Ensures scientific quality.
- Approves research programmemes, budgets and activities.
- Scientific evaluation and advice.

Advisory Board (Consejo Asesor)**:** External experts of recognised prestige [*n.b. still not implemented*].

- Provides independent advice on scientific strategy, planning and collaborations.

Supervision and Follow-up (UMA): IMANA depends on the Rector.

- Annual monitoring and 4-year evaluation through the Research Committee and contract-programmeme.

Management Committee (Comisión de Dirección)**:** Delegated executive management and daily leadership.

- Director: Institutional leadership, strategic management and external representation.
- Deputy Director: Support to the Director, Scientific coordination and Institutional development.
- Secretary: Official records and Institutional documentation.
- Two Elected Permanent Faculty Members, appointed by the Scientific Committee.

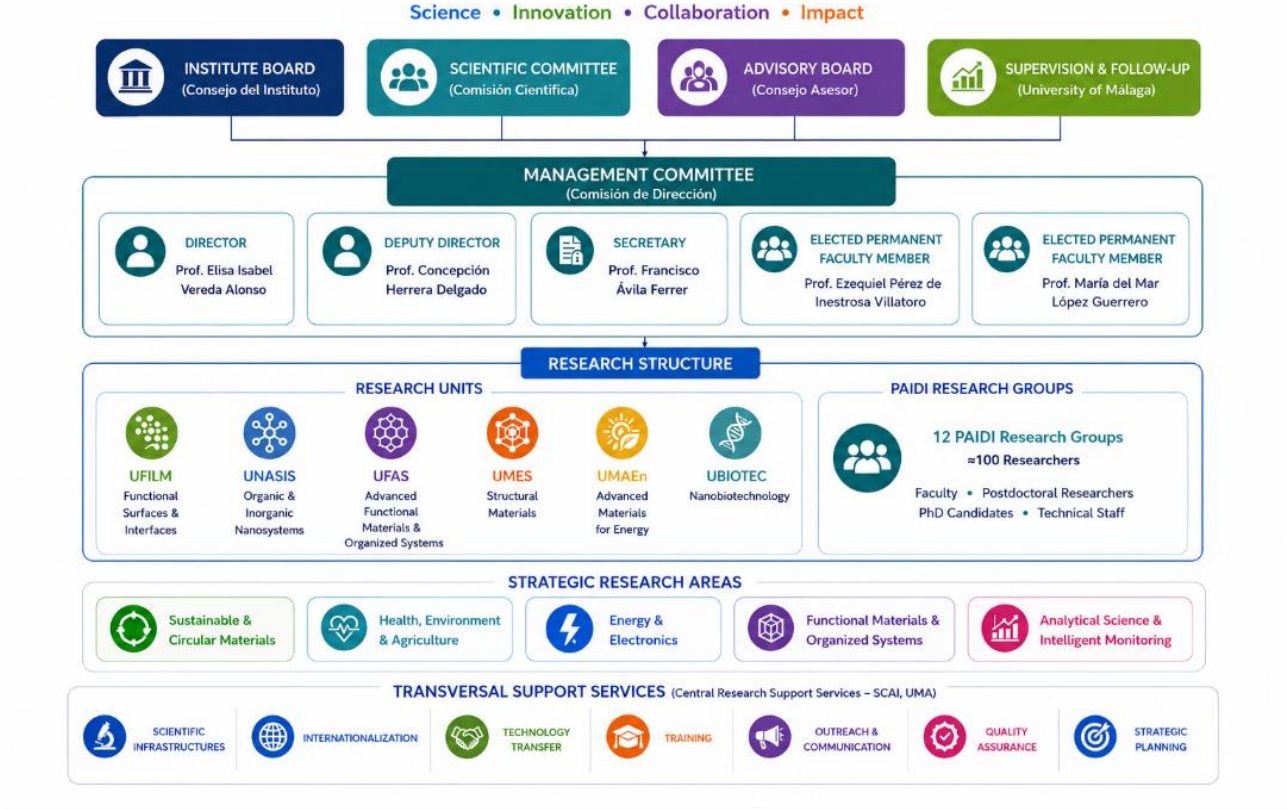


Figure 4. IMANA Organizational Structure.

3.2. Research Units.

UFILM - Functional Surfaces and Interfaces

2D layers with nanometric thickness are engineered and stacked to enable advanced energy, sensing, and microelectronic devices. Their performance depends on the quality of both internal and external interfaces, which are essential for photovoltaics, sensors, electrochemical systems, and modern microelectronics. Surface functionalization modifies the surface of a material through coatings, functional groups, or nanoparticles to tailor its chemical, optical, electrical, and mechanical properties.

UNASIS – Organic and Inorganic Nanosystems

The UNASIS provides IMANA with a transversal platform for the design, synthesis and functionalization of advanced organic and inorganic materials, supporting the scientific and technological activities of the Institute's other Research Units. Its expertise covers the development of molecular compounds, nanostructured materials and hybrid systems with tailored physicochemical properties, enabling applications in energy, environmental remediation, electronics and biomedicine.

The Unit develops innovative synthetic methodologies and contributes advanced spectroscopic characterisation to establish structure–property relationships and guide material optimization. These capabilities provide essential support for the development of materials for energy conversion and storage, waste valorisation, microelectronics, organic electronics, drug delivery and other application-oriented research carried out across IMANA.

UFAS – Advanced Functional Materials and Organised Systems

UFAS focuses on the design, synthesis and physicochemical characterisation of advanced functional materials for sustainable technologies. Building on the understanding of structure–property–performance relationships, the Unit develops innovative materials and processes for applications in sustainable catalysis, electrochemical energy conversion and storage, hydrogen technologies, carbon capture and utilization (CCU), renewable fuels, environmental remediation and resource-efficient chemical processes. This research activities contribute to addressing major societal challenges related to climate neutrality, circular economy and sustainable industrial development.

The Unit brings together multidisciplinary expertise spanning computational materials design, advanced synthesis, operando and *in situ* characterisation under relevant operating conditions, and process engineering.

This integrated approach accelerates the development of next-generation functional materials and sustainable technologies, fostering innovation, industrial collaboration and the translation of scientific knowledge into high-impact technological solutions.

UMES –Structural Materials

UMES focuses on the design and development of sustainable cementitious materials to support the decarbonization of the construction sector. Its research promotes the replacement of Portland cement clinker with low-carbon supplementary cementitious materials derived from industrial by-products and urban wastes, contributing to circular economy strategies. The Unit combines advanced characterisation techniques with artificial intelligence-based data analysis to understand hydration processes, CO_2 mineralisation processes, microstructural evolution, and material performance, accelerating the development of next-generation low-carbon construction materials.

UMAEn – Advanced Materials for Energy

UMAEn tackles global energy challenges by developing sustainable materials to boost energy efficiency and advance both energy harvesting and storage capabilities. Key efforts target molecular-based innovations (e.g., spintronics, organic photonics) and hydrogen technologies (water splitting, CO_2 hydrogenation), while avoiding critical raw elements and enabling cost-effective production for microelectronics. UMAEn unites multidisciplinary expertise from design to device fabrication and advanced characterisation combined with state-of-the-art quantum chemical calculations. The synergy between the Research Unit groups allows for rapid, accelerated development of next-generation energy solutions

UBIOTEC – Nanobiotechnology

The strategic line UBIOTEC is built on the premise that human health, animal health, environmental quality, and sustainable food production are deeply interconnected. Leveraging materials science, nanotechnology, and biotechnology, this initiative aims to provide integrated solutions to major societal challenges, such as antimicrobial resistance and food safety.

Advanced functional materials and nanoengineered systems serve as the technological core of this framework, enabling selective interaction with biological and environmental systems.

A graphic summary of the IMANA Research Units is given in Figure 5.

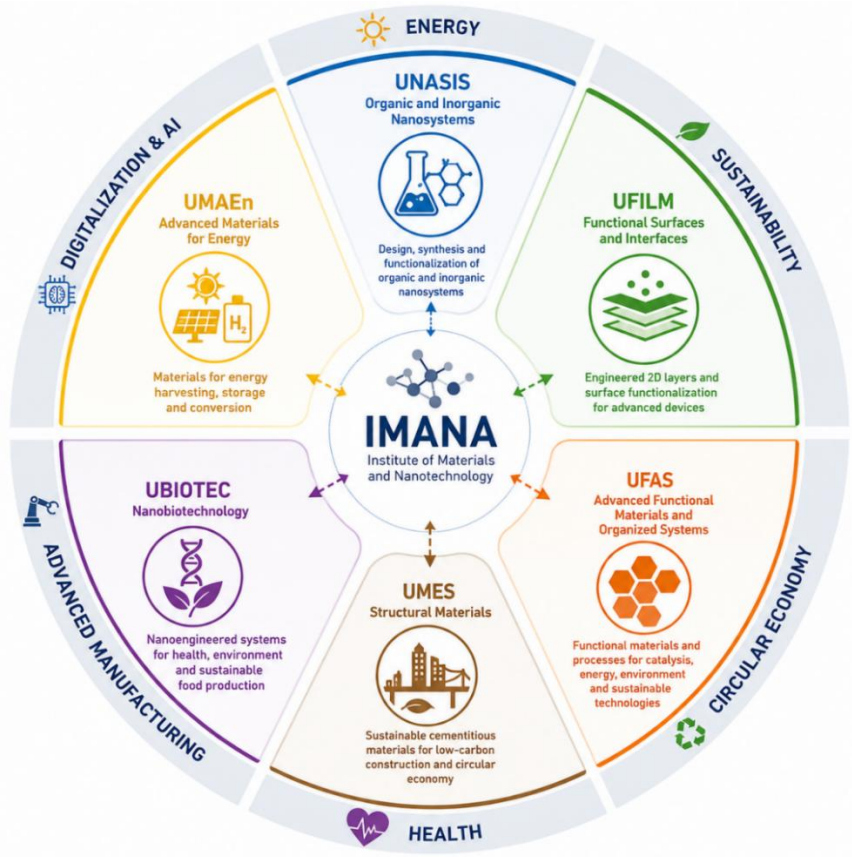


Figure 5. IMANA's Research Units

3.3. Research Groups

Table 3 shows IMANA's research groups, including the Research Unit in which participate.

Table 3. IMANA's research groups (n.b. PAIDI codes) naming the current PI and the Research Units where the group contributes.

	UFILM	UNASIS	UFAS	UMES	UMAEn	UBIOTEC
RNM 111: Tecnología de Procesos Catalíticos. I.P. Luis J. Alemany Arrebola			X		X	X
FQM 117: Análisis inorgánico I.P. Elisa Isabel Vereda Alonso		X	X			X
FQM 155: Nuevos materiales inorgánicos I.P. Pedro Maireles Torres	X	X	X		X	
FQM 103: Espectroscopia y Estructura Molecular. I.P. Juan Carlos Otero.	X	X	X		X	
FQM 192: Laboratorio de materiales y superficie. I.P. Francisco de Paula Martín	X	X	X		X	
FQM 159: Polímeros Conductores y Biopolímeros I.P. Juan Teodomiro López Navarrete	X	X	X		X	
FQM 113: Diseño Estructural de Materiales Inorgánicos I.P. Aurelio Cabeza Díaz		X	X	X	X	
FQM 017: Laboratorio de Dendrímeros biomiméticos y fotónica I.P. Ezequiel Pérez de Inestrosa		X	X			X
FQM 397 and 158: Productos Naturales, Síntesis de Fármacos y Nanotecnología. I.Ps. Francisco Ramón Sarabia García & José Manuel López Romero	X	X				X
FQM 156: Procesado y análisis de materiales con láser. I.P. José Miguel Vadillo Pérez	X	X		X	X	
FQM-395: Física de Moléculas I.P. Juan Casado Cordón	X	X			X	
REP184: Tecnología de Residuos y Medio Ambiente I.P. Tomás Cordero Alcántara	X	X		X	X	

4. Framing IMANA locally and nationally.

4.1. SWOT analysis.

STRENGTHS

- Scientific quality of the research groups and their multidisciplinary composition. Consolidated research experience in thematic areas of IMANA.
- Critical mass of established research staff, with the capacity to address complex and interdisciplinary projects.
- Close availability of excellent material characterisation techniques, both within the groups integrated in IMANA, at SCAI, and strong experience in the use of Singular Scientific and Technical Infrastructures (ICTS-Spain) and European Research Infrastructures and Technical Infrastructures.

- International projection of Málaga as a growing city, connected to an expanding technological development hub and offering a high quality of life, with high potential to attract talent.
- High capacity for training research personnel (access to master's and doctoral students). Participation in two interuniversity master's programmes: Applied Chemistry and Advanced Materials (attracting predoctoral researchers).
- Well positioned to profit from FP10.

WEAKNESSES

- Young institute. Low international visibility compared to already well-established centres.
- Infrastructures that are not strategically integrated. Lack of a dedicated physical space.
- Absence of an administrative structure and very limited core funding.
- Risk of thematic dispersion, which may dilute scientific impact, if prioritized strategic lines are not implemented, managed and the resulting KPIs critically analysed.
- Lack of a communication plan to promote the Institute and its capabilities.
- Low number of staff with competitive postdoctoral research contracts.

OPPORTUNITIES

- Strategic use of the environment of the Andalusia Technology Park (PTA/Imec) and companies in the agri-food sector.
- Growing demand for nanomaterials in key sectors (energy, biomedicine, electronics, etc.).
- Attraction of competitive funding in prioritised areas (energy, health, sustainability, circular-economy, etc.).
- Potential for technology transfer.
- To create a hub for materials for sustainability.

THREATS

- High competition from already established research centres in Spain and Europe, which already have networks, funding, and recognition.
- Difficulty in retaining talent, if measures are not implemented.
- High dependence on public funding.
- Lack of strong and continuous commitment from the University and the Regional Government of Andalusia to promote Institutes in general and IMANA in particular.

4.2. Comparison of IMANA with Related Andalusian and Spanish Institutes

The IMANA has been established within a highly competitive research landscape in which both Andalusia and Spain are internationally recognised for excellence in materials science, chemistry, nanotechnology, and advanced manufacturing. Over recent decades, the development of specialized research institutes/organizations has positioned Spain among Europe's leading contributors to the discovery, design, characterisation, and application of advanced materials for strategic sectors such as energy, health, electronics, aerospace, environmental technologies, and sustainable manufacturing. It should be noted that Andalusia's research ecosystem currently lacks centres structured like CERCA (Centres de Recerca de Catalunya) in Catalonia or BERC (excellence centres) Ikerbasque in the Basque Country.

At the regional level, IMANA joins a recognised network of Andalusian research institutes that includes the "Instituto de Ciencias de Materiales de Sevilla (ICMS)", the "Instituto de Investigaciones Químicas (IIQ)", the "Instituto de Investigación Biomédica de Málaga y Plataforma en Nanomedicina (IBIMA Plataforma BIONAND)", the "Instituto Químico para la Energía y el Medio Ambiente (IQEMA)", the "Instituto de Microscopía Electrónica y Materiales (IMEYMAT)", and "CIESOL", each contributing internationally recognised expertise in areas such as functional materials, catalysis, nanotechnology, biomedical applications, advanced characterisation, renewable energy, and environmental sustainability. Together, these institutes form a highly collaborative research ecosystem spanning fundamental science, technological development, and

knowledge transfer. However, the core funding levels remain below those sisters institutes within CERCA and BERC networks.

At the national level, this ecosystem is complemented by leading research centres such as the "Instituto de Ciencia de Materiales de Madrid (ICMM)", the "Instituto de Ciencia Molecular (ICMol)", the "Institut Català de Nanociència i Nanotecnologia (ICN2)", the "Institut de Ciència de Materials de Barcelona (ICMAB)", the "Centro Singular de Investigación en Química Biológica y Materiales Moleculares (CIQUS)", "CIC energiGUNE", "POLYMAT", the "Instituto de Tecnología Química (ITQ)", and the IMDEA Institutes (particularly IMDEA Materials, IMDEA Nanoscience, and IMDEA Energy). Collectively, these institutions reflect the breadth and international competitiveness of the Spanish research system. Should the opportunity arise, IMANA is willing to adapt its key performance indicators (KPIs) and metrics to a standardised framework that would allow for a robust comparison within the field of materials and nanomaterials research in Spain.

Within this landscape, IMANA occupies a distinctive position by integrating expertise in materials science, nanotechnology, analytical chemistry, physics, engineering, and computational methodologies within a single multidisciplinary institute. Its research strategy combines the rational design and synthesis of materials with advanced characterisation, analytical science, intelligent monitoring under realistic operating conditions, and data-driven methodologies, including artificial intelligence, to address challenges related to sustainability, circular economy, energy, health, environmental protection, agriculture, and advanced manufacturing.

Rather than duplicating existing capabilities, IMANA is designed as a cross-disciplinary platform that complements the specialized profiles of other institutes while fostering collaboration among research centres, hospitals, and industry. Through its multidisciplinary approach and commitment to knowledge transfer, IMANA strengthens the strategic role of the UMA and it has the vision to contribute to consolidating the leadership of both Andalusia and Spain in advanced materials, nanoscience, and sustainable technologies.

5. Strategic research lines, general and transversal objectives.

5.1.a. Strategic research lines.

5.1.1.a. Materials for a sustainable and circular economy in cementitious systems

This strategic research line addresses the critical challenge of contributing to decarbonizing the construction sector through a profound transformation in cementitious materials. In this context, 'sustainability' mainly means lower CO_2 footprints and energy requirements and 'circular economy' is addressed by upcycling by-products and residues. Therefore, and in order to comply with current codes of practices of this conservative sector (people live and work in the building and infrastructures), this line focuses on the partial replacement of Portland Cement (PC) clinker with innovative supplementary cementitious materials (SCMs) with (much) lower carbon footprints. Through advanced upcycling, the institute also aims to reframe industrial and urban waste not as environmental liabilities, but as secondary resources, aligning scientific output with global climate directives and sustainable development goals.

To address these objectives and to support the core research streams, described in the key actions below, the Unit utilizes and *develops* cutting-edge characterisation workflows, with a primary focus on in situ synchrotron and laboratory X-ray powder diffraction (XRPD) and in situ high-resolution imaging techniques, i.e. synchrotron and laboratory micro/nano computed tomography μCT. In-situ (i.e. time-resolved) XRPD allows quantitative tracking of mineralogical dissolution and precipitation processes in real time. Time-resolved SXRPD can precisely and accurately monitor early-age hydration kinetics, phase evolution, and the specific reactions occurring between PC and novel SCMs mapping the modifications induced by the presence of chemical admixtures. However, XRPD yields average results without any particle-size dependence. Therefore, the Unit also focussed on developing approaches for advanced time resolved S-μCT methods with the highest possible spatial and temporal resolutions visualizing large fields of views (for micro- nano-imaging). This allows the non-destructive multi-scale visualization of: (i) microstructure development, (ii) porosity evolution, and (iii) particle-size dependent hydration kinetics. Furthermore, time-dependent synchrotron [and laboratory in the near future] μCT produce vast amounts of data, i.e. 1-50 TB in a 3 days experiment at a synchrotron. Thus, AI algorithms are being integrated into the data processing and analysis pipeline with the vision to 'automate' the analysis/segmentation of complex 4D tomographic datasets. We envision that this AI-driven analysis enables rapid, unbiased quantification of microstructural features, pore connectivity, and phase distributions, accelerating the discovery loop for sustainable binder formulations.

5.1.2.a. Functional materials for health, environment and agriculture

The Functional Materials for One Health strategic line is founded on the recognition that human health, animal health, environmental quality, and sustainable food production are deeply interconnected and require integrated scientific and technological solutions. The One Health paradigm provides a unique framework for addressing these challenges through interdisciplinary approaches that bridge materials science, nanotechnology, biotechnology, environmental engineering, agrifood sciences, and biomedicine.

This strategic research line addresses major societal challenges arising from the interconnection between health, environment, and agriculture. Research activities encompass advanced diagnostics and monitoring, precision intervention technologies, environmental remediation, water and soil quality, food safety, antimicrobial resistance, and resource efficiency, contributing to the development of integrated solutions that enhance human and animal well-being, protect ecosystems, and promote resilient and sustainable agrifood systems.

Advanced functional materials and nanoengineered systems constitute the enabling technological platform underpinning this strategic line. Their ability to interact selectively with biological, environmental, and agrifood systems creates unique opportunities for developing innovative solutions in diagnostics, therapeutics, environmental monitoring, pollutant mitigation, resource recovery, and sustainable food production. This materials-driven approach provides a common scientific foundation that connects diverse disciplines and promotes interdisciplinary research within the One Health framework.

Research within this strategic line could be organised around three complementary priorities that serve as a nexus for collaboration among researchers addressing challenges at the interface between of health, environment, and sustainable agrifood systems:

Advanced Diagnostics, Monitoring and One Health Surveillance. Activities could include the development of advanced sensing and monitoring technologies for the detection, quantification, and assessment of biological, chemical, and environmental indicators relevant to human and animal health, food safety, and ecosystem quality. This priority covers biosensing, pathogen detection, antimicrobial resistance monitoring, environmental surveillance, and integrated One Health monitoring systems.

Precision Delivery and Functional Interfaces. Research could address controlled transport and targeted delivery strategies aimed at improving interactions between functional systems and biological environments. This priority covers therapeutic and regenerative medicine, RNA and biomolecule delivery, microbiome engineering, animal health, plant biotechnology, and precision agriculture, with the objective of enhancing efficacy while minimizing environmental impacts.

Environmental Quality and Sustainable Agrifood Systems. Activities could focus on technologies and approaches that contribute to environmental protection and the sustainability of agrifood systems. This priority covers pollutant mitigation, selective separation, resource recovery, water and soil quality improvement, greenhouse-gas mitigation, circular resource management, climate-resilient agricultural practices, and the control of emerging contaminants and antimicrobial resistance dissemination pathways.

Together, these priorities provide a common framework for integrating expertise and fostering interdisciplinary collaboration across the health, environmental, and agrifood sectors. This approach promotes the development of innovative and sustainable solutions to complex societal challenges within the One Health paradigm.

The strategic priorities described above converge into two complementary Key Actions that integrate expertise across multiple research areas while providing a flexible framework for the incorporation of new groups, capabilities, and collaborative initiatives. Together, these actions translate the One Health vision into interdisciplinary research programmemes driven by advanced functional materials and nanoengineered systems, creating synergies between diagnostics, therapeutic and delivery technologies, environmental quality, and sustainable agrifood systems.

5.1.3.a. Materials for energy efficiency, thermal management and electronic applications

Meeting the global energy challenge requires transformative advances in materials and technologies that enable sustainable, efficient, and scalable solutions. In that line, this research line is based on the following pillars: (i) harnessing energy from renewable and underutilized sources (*e.g.,* sunlight and wasted heat), (ii) improving energy storage and conversion systems, and (iii) reducing energy consumption through more efficient materials and fabrication processes.

Key research directions include the development of molecular based technologies (*e.g.,* spintronics and organic photonics) and hydrogen-based energy technologies (*e.g.*, water splitting and CO_2 hydrogenation), the design

of materials free from critical raw elements, and the advancement of low-energy, cost-effective manufacturing routes, particularly relevant for microelectronics.

The institute uniquely combines multidisciplinary expertise across materials design, synthesis, processing, and device fabrication, enabling a holistic approach from concept to application. The centre features specialised capabilities in the device fabrication of solar cell, organic transistor, fuel cell, electrolyser and thermoelectric systems. Furthermore, we possess outstanding experience in the characterisation of pristine materials and fully operational devices, supported by a broad array of experimental setups. These characterisation methods include vibrational, emission, and transient spectroscopies (covering both fs–ns and ns–ms timescales), impedance and photoelectrochemical spectroscopy and spectroelectrochemistry. These experimental techniques are tightly integrated with advanced quantum chemical calculations to evaluate the performance of molecular designs and devices. This synergy enables predictive design and accelerated optimization of materials and devices.

5.1.4.a. Advanced functional materials and organised systems

The strategic line focuses on understanding, controlling, and exploiting the relationships between composition, structure, organization, properties, and functionality in advanced materials and organised systems. This line provides the scientific foundations, methodologies, and conceptual frameworks required to develop next-generation materials capable of addressing challenges in energy, sustainability, environment, health, information technologies, and emerging applications.

The strategic vision is based on the premise that material performance emerges from the interplay between composition, architecture, interfaces, and dynamic processes occurring across multiple spatial and temporal scales. Understanding how materials are organised, interact, and evolve is therefore essential for creating systems with tailored catalytic, electronic, photonic, transport, mechanical, and biological functionalities.

Research within this line encompasses a broad spectrum of advanced materials and organised systems, including molecular and supramolecular architectures, functional polymers, porous and hybrid materials, nanostructured systems, catalytic materials, engineered interfaces, and molecular systems for electronic and photonic technologies. Despite this diversity, all activities share a common objective: understanding how organization and interactions across scales govern functionality and performance.

Research within this strategic line is organised around three complementary priorities:

Materials Architecture and Functional Organization. Research focused on the formation, assembly, functionalization, and hierarchical organization of advanced materials and nanostructures. This priority addresses the control of molecular organization, self-assembly, interfaces, defects, and complex architectures that determine functional behaviour.

Interfaces, Transfer Processes and Functional Properties. Research devoted to understanding the physicochemical processes governing functionality, including catalytic phenomena, charge and mass transport, ionic and electronic conduction, molecular recognition, adsorption processes, and light–matter interactions. Particular emphasis is placed on understanding how structure and organization determine functional performance.

Dynamic Behaviour and Performance under Relevant Conditions. Research aimed at understanding how materials evolve under realistic environments and operating conditions. This priority addresses active structures and interfaces, dynamic transformations, stability, degradation, regeneration, adaptive response, and the mechanisms governing long-term functionality and performance.

Together, these priorities provide a common framework for integrating expertise across chemistry, materials science, nanotechnology, catalysis, photonics, electronics, and engineering, fostering interdisciplinary collaborations and accelerating materials innovation. The strategic priorities described above converge into *two complementary Key Actions* that address fundamental scientific challenges in advanced materials and organised systems while providing a flexible framework for future research developments and collaborative initiatives.

5.1.5.a. Analytical science and intelligent monitoring technologies

This strategic research line establishes a core, cross-disciplinary technology platform within IMANA dedicated to the advanced design, automation, and digital integration of chemical and physical monitoring systems. Moving beyond classical laboratory boundaries, this transversal platform leverages state-of-the-art expertise in smart nanomaterials, graphene oxide derivatives, and magnetic composites. Guided by green chemistry principles, miniaturization, and high selectivity through surface nano-functionalization, the line pursues a dual vision: transforming high-precision laboratory automation and engineering autonomous in-situ diagnostic systems to address global challenges in water security, *water reuse*, circular bioeconomy, *critical raw materials*

recovery, resource efficiency, and environmental safety. Optical and mass analytical microprobes (ion and laser-excitation based) are also included within the areas of expertise in the current strategic line, with strong connections to the rest of strategic research lines.

Research inside this line is organised across the following pillars:

High-Precision Laboratory Automation and Ultra-Trace Screening: Transforming standard chemical testing through online, micro-fluidic preconcentration and automation blocks linked to advanced elemental and molecular spectrometry, optimizing high-efficiency coupling interfaces, ensuring analytical quality, metrological traceability, and reliable decision-making data.

Autonomous In-Situ Diagnostics and Portable Sensing Platforms: Fabricating low-cost, smart, and multiplexed sensor arrays, electrochemical diagnostic platforms on portable screen-printed substrates, and hybrid portable systems designed for real-time multi-analyte monitoring under harsh environmental conditions (including subaquatic, ultra-polluted/acidic/alkaline, high-temperature, non-terrestrial performed through bespoke instruments).

Data-Driven Workflows and Artificial Intelligence Integration: Implementing advanced data analytics, automated calibration systems, computational matrix-correction algorithms, and artificial intelligence for the assisted interpretation of spectroscopic signals and predictive process optimization, supporting robust environmental assessment and early-warning monitoring strategies.

Data fusion: Synergistic approaches coming from the fusion between techniques providing complementary information yielding to precise triage or specific decision trees to face complex analytical scenarios.

5.1.b. Selected actions for the strategic research lines

5.1.1.b. Key actions for 'materials for a sustainable and circular economy in cementitious materials'

Key Action 1. Portland cement clinker replacement investigations and residues upcycling: Developing eco-efficient blended cements by optimizing the substitution of PC with newly engineered, highly reactive SCMs. Here, mechanochemical activation of natural and artificial pozzolans will be a key target, which is in line with current investigations. This will be done by investigating the chemical (i.e. by CO_2 mineralization and not by the classic and highly contaminant acid treatment), thermal and mechanochemical activation of wastes (i.e. biochar, biomass ashes, metallurgical slags or industrial sludges) to maximize their performances as SCMs. The investigations will focus on maximizing the pozzolanic final features as well as the initial pozzolanic rate.

Strategic impact: to decrease the CO_2 footprint of cementitious materials and to increase the circularity.

Key Action 2. Mechanistic understanding of complex curing processes: Uncovering the fundamental chemical and physical interactions of chemical admixtures (such as superplasticizers, accelerators and strength-enhancing admixture) in highly substituted PC-SCMs blends to control hydration kinetics, workability, and early-age properties. It is also planned to research on the mechanisms of CO_2 mineralization in PC blends and in SCMs for enhancing the carbonation reactivity of SCM systems, including concrete waste and other residues. This allows to permanently sequester CO_2 within the matrices, further reducing the overall CO_2 footprint of the final shaped products. Here, the access at Large Facilities, mainly synchrotron beamlines, for in situ imaging and diffraction, is one of the strongest assets of the Unit. This action is backed by the state-of-the-art X-ray characterisation equipment of UMA at SCAI. It is noted that SCAI will have the first Mo$K\alpha_1$ diffractometer in Spain, equipped with a special cell and a large area detector to measure CO_2 mineralisation under moderated temperatures and pressures. Moreover, the AI algorithm integration into the data processing and analysis pipelines is key to contribute to close the discovery loop for sustainable formulations.

Strategic impact: to keep the Unit at the forefront of the 4D micro-, meso- and nano-structure understanding of water and CO_2 curing.

5.1.2.b. Key actions for 'functional materials for health, environment and agriculture'

Key Action 1. Precision Health, Advanced Therapeutics and Smart Nutrition for One Health (NanoHealth)

Building upon the priorities of *Advanced Diagnostics, Monitoring and One Health Surveillance* and *Precision Delivery and Functional Interfaces*, this action aims to advance innovative solutions for human and animal health through the integration of precision diagnostics, advanced therapeutics, functional biomaterials, smart nutrition strategies, and nanoengineered materials. The vision is to contribute to more predictive, preventive, personalized, and sustainable approaches to health, aligned with the One Health paradigm.

Research activities will include the development of advanced platforms for biomarker and pathogen detection, antimicrobial resistance monitoring, selective biomolecule capture, regenerative medicine, and functional biomaterials for healthcare applications. Attention could be devoted to nanoengineered materials capable of combining sensing, targeting, delivery, and therapeutic functionalities, supporting emerging approaches in precision diagnostics, theragnostic platforms, implantable medical devices, and personalized healthcare.

The action also promotes the development of nanoencapsulation and targeted delivery technologies for therapeutics, nucleic acids, bioactive compounds, and functional food ingredients. Representative examples include dendrimer-based nanomedicine platforms, metal–organic frameworks for selective capture and delivery, two-dimensional nanomaterials, quantum dots and hybrid nanostructures for sensing and theragnostic applications, liposomal systems, functionalized porous materials, zeolites, and hybrid nano-bio interfaces designed to improve stability, bioavailability, molecular targeting, and controlled release.

Strategic impact: *Development of diagnostic methods and clinical treatments that avoid invasive procedures and reduce adverse side effects.*

Key Action 2. Precision Agriculture, Environmental Quality and Circular Bioeconomy (SmartAgro–BioNanoProcess)

Building upon the priorities of *Precision Delivery and Functional Interfaces* and *Environmental Quality and Sustainable Agrifood Systems*, this action aims to develop innovative solutions that improve the sustainability, productivity, and resilience of agricultural and livestock systems while enhancing environmental quality. The vision is to support the transition towards climate-smart and resource-efficient agrifood systems through the integration of advanced materials, biotechnology, and environmental technologies within the One Health framework.

Research activities will include technologies for water and air quality monitoring and remediation, nutrient management, sustainable soil management, greenhouse-gas mitigation, resource recovery, and the optimization of biological and agro-industrial processes. Particular attention will be devoted to precision agriculture approaches that improve the efficient use of water, nutrients, and bioactive compounds while reducing environmental impacts.

Representative examples include nanoengineered and hybrid materials for controlled-release fertilizers and biostimulants, nanoencapsulation platforms for bioactive molecules, functionalized zeolites and layered/2D nanomaterials for nutrient retention and delivery, advanced systems for RNA-based plant protection, nature-inspired solutions for sustainable crop production, and technologies aimed at improving livestock sustainability through methane mitigation and enhanced resource efficiency. Additional applications may include environmental monitoring, emerging contaminant removal, carbon management, and circular nutrient recovery from agricultural and agro-industrial streams.

Strategic impact: *Development of solutions for environmental quality and precision agriculture that enable pollution prevention and remediation and the sustainable and efficient use of natural resources.*

5.1.3.b. Key actions for 'materials for energy efficiency, thermal management and electronics applications'

Key Action 1. Advanced Materials for Energy Harvest and Storage (AMEHS)

This action focuses on the fabrication and characterisation of advanced materials for energy harvesters and storage systems. For *Energy Storage*, we will focus on the fabrication and characterisation of materials such as mixed ionic-electronic semiconductors for fuel cells, paying special attention to the use of non-critical elements, and organic molecules for Molecular Solar Thermal Energy Storage (MOST). *On Energy Harvesting*, the IMANA will develop materials for solar energy conversion (particularly in solar cells) and heat (through the fabrication of thermoelectric materials). As a transversal line for this key action, we will perform advanced characterisation of charge generation using electrical and optical methods, applied to all systems, alongside advanced theoretical calculations to support the experimental data.

Strategic impact: advancing efficient and sustainable energy systems with clear pathways toward device integration.

Key Action 2. Advanced Materials for Energy Efficiency (AMEE)

An indirect approach to obtaining energy is to reduce its consumption. In this line, this action involves the development of more efficient *fabrication methods* using advanced deposition techniques such as electrospinning, electrospray, screen printing, spin-coating, doctor blading, etc. This action also involve***s high-efficiency functional materials*** either by functionality or by fabrication/manufacturing with organic

electronics for photonics and microelectronics, electrode and/or electrolyte (ceramic/coordination polymer-based proton conductors) materials for fuel cells and electrolysers, gas separation membranes and sensors, as well as carbon quantum dots for energy applications.

Strategic impact: enabling energy savings both during device operation and fabrication, with strong industrial relevance.

Key Action 3. Two-dimensional (2D) structures (2DS)

The study of 2D structures (as isolated layers or multilayer stacks) is essential for energy, sensing, and microelectronics. *Growth* of 2D materials by CVD, ALD, or sputtering. These methods allow the *precise tuning* of these nanometric films enable tunable composition and crystallinity, and with that, the fine tuning of their properties such as band alignment, charge transfer, stability, and degradation. *Applications* include photovoltaics, sensors, fuel cells, supercapacitors, and microelectronic devices (transistors, organic transistors and memristors).

Strategic impact: establishing a strong position in interface engineering as a key enabler of future electronic and energy technologies.

Key Action 4. Surface functionalization (SF)

Surface functionalization modifies a material's outermost layer via inorganic, organic, or hybrid coatings, and through grafting of functional groups or nanoparticles. This tailors chemical, optical, electrical, and mechanical properties—enhancing stability, charge transfer, catalytic activity, or adhesion—without altering the bulk. Applications include batteries, supercapacitors, photocatalysis, sensors, and microelectronics. By precisely engineering interfacial behaviour, surface functionalization provides a versatile platform for designing next-generation devices across energy, environmental, and electronic technologies.

Strategic impact: unlocking performance improvements through interface control, a critical factor in advanced device design.

5.1.4.b. Key actions for 'Advanced functional materials and organised systems'

Key Action 1. Functional Architectures and Emergent Properties

How can we create and understand new functionalities through the organization of matter?

Building upon the priorities of *Materials Architecture and Functional Organization* and *Interfaces, Transfer Processes and Functional Properties*, this action focuses on conceiving, designing, and understanding advanced materials and organised systems whose functionality emerges from the controlled organization of matter across multiple length scales.

The central scientific challenge is to understand how composition, architecture, interfaces, and collective interactions generate functional properties that cannot be predicted from individual components alone. Particular attention is devoted to self-assembly processes, hierarchical organization, molecular confinement, interfacial interactions, cooperative phenomena, and spatially controlled functionalities that give rise to emergent catalytic, electronic, photonic, transport, sensing, and adaptive behaviours.

Research activities encompass organised superstructures, molecular and supramolecular systems, porous and hybrid architectures, functional polymers, engineered surfaces, advanced interfaces, and molecular materials for electronic and photonic technologies. Key challenges include controlling organization across scales, engineering cooperative effects, integrating multiple functionalities within a single architecture, and creating adaptive systems capable of responding to external stimuli.

The ultimate goal is to establish fundamental design principles that enable the rational creation of advanced functional materials and organised systems, opening new opportunities for emerging technologies and next-generation materials platforms.

Strategic impact: advancing the fundamental understanding of how matter organization across scales generates emergent functionalities will enable the rational design of next-generation materials

Key Action 2. Operando Materials Science and Predictive Performance

How do those functionalities arise, evolve, and perform under real operating conditions?

Building upon the priorities of *Interfaces, Transfer Processes* and *Functional Properties and Dynamic Behaviour and Performance under Relevant Conditions*, this action focuses on understanding, predicting, and optimizing the behaviour of advanced materials and organised systems during operation.

The central scientific challenge is to uncover the mechanisms that govern functionality and performance under realistic environments and to establish predictive relationships linking structure, properties, and behaviour. Particular emphasis is placed on understanding how active structures, interfaces, and functional states evolve under thermal, chemical, electrochemical, photonic, mechanical, or biological conditions.

Research activities include the identification of active structures and interfaces, the investigation of charge, mass, and energy transfer processes, the study of transient and metastable states, and the elucidation of mechanisms governing activity, selectivity, stability, durability, and adaptive response. Advanced operando and multimodal approaches are employed to reveal the dynamic processes that determine the real-world performance of catalytic, electronic, photonic, porous, hybrid, and nanostructured systems. The ultimate goal is to establish a predictive science of materials in operation, enabling the accelerated development of robust, efficient, and adaptive materials for future technological applications.

Cross-Cutting Activities. Advanced characterisation, operando methodologies, modelling and simulation, artificial intelligence, machine learning, automation, and data-driven approaches will provide transversal support to all priorities and key actions of this strategic line. These enabling tools will accelerate materials discovery, strengthen mechanistic understanding, and foster predictive materials science across multiple length and time scales.

Strategic impact: establishing a predictive understanding of how materials and functional systems behave under real operating conditions will enable the development of more efficient, robust, and durable technologies.

5.1.5.b. Key Actions for 'Analytical science and intelligent monitoring technologies'

Key Action 1. High-Precision Laboratory Automation and Spectroscopic Screening Platforms: Developing a robust technological pipeline for the design, standardization, and validation of automated analytical fluidic assemblies and advanced laser interfaces. This action centres on the fabrication of automated inline kinetic/extraction micro-reactors and online magnetic solid-phase extraction (MSPE) modules utilizing magnetic nanoadsorbents for the isolation, speciation, and ultra-trace quantification of target pollutants and strategic raw materials. Concurrently, it optimizes high-efficiency coupling interfaces with molecular mass spectrometry (HPLC-MS/MS, HRMS) and advanced atomic spectroscopy (ICP-MS, CS-HR-GFAAS). Expanding applicability from emerging organic and inorganic pollutants in wastewater and water reuse systems to the monitoring of critical raw materials, trace elements in industrial processes, and high-value resource recovery and recycling loops. Positioning IMANA as an international benchmark for automated matrix-separation and high-sensitivity environmental forensics.

Strategic impact: To accelerate the transition towards automated, high-throughput analytical methodologies that enhance environmental monitoring, critical raw materials recovery, and industrial sustainability.

Key Action 2. Autonomous in-situ Diagnostics, Intelligent Sensing, and Data AI Integration: Engineering low-cost, smart, and multiplexed sensor arrays coupled with data-driven workflows for real-time multi-analyte monitoring under dynamic environmental and industrial conditions. For field deployment, this action focuses on building versatile electrochemical diagnostic platforms by integrating customized nanostructured composites onto portable screen-printed substrates, utilizing surface-tailored nanomaterials and molecularly imprinted polymers (MIPs). Parallelly, these devices are integrated into hybrid sensing systems that combine portable laser-based spectroscopic validation tools for rapid, non-destructive, and spatially resolved characterisation. To maintain accuracy under changing environmental factors (pH, salinity, temperature), the action incorporates automated calibration systems and computational matrix-correction algorithms directly into sensor software, implementing AI for assisted signal interpretation, spectroscopic technique fusion, and predictive monitoring. Special emphasis is placed on the generation of trustworthy analytical data through embedded quality-control routines, uncertainty estimation, and adaptive calibration strategies, enabling reliable deployment in environmental surveillance, industrial process control, and early-warning systems.

Strategic impact: To drive the digital transformation of analytical science through intelligent sensing systems that deliver reliable, real-time data for sustainable environmental and industrial management.

5.2.a. Key general objectives for the strategic axes.

5.2.1.a. Research excellence

At the core of our strategic vision, the Institute is committed to fostering research excellence as the primary driver for transformative breakthroughs in advanced materials. Excellence will be fostered through an interdisciplinary research environment that integrates chemistry, physics, materials science, engineering, computational modelling, and data-driven approaches, enabling researchers to tackle increasingly complex

scientific problems and societal challenges. The institute will cultivate a dynamic, collaborative, and merit-based research ecosystem that provides scientists with access to state-of-the-art infrastructures and advanced instrumentations. Strategic international collaborations with top universities, research centres and networks will further enhance visibility and scientific leadership. *Evaluation mechanisms*, aligned with international standards, will ensure quality and accountability while supporting long-term scientific vision. Key objectives include fostering a competitive and merit-based research environment, encouraging ambitious projects, and ensuring the consistent production of high-impact publications, patents and breakthrough discoveries. The Institute will also promote a culture of scientific integrity, open science aligned with the European motto "*as open as possible and as close as necessary*", responsible research practices, and reproducibility, ensuring that excellence is accompanied by transparency and accountability.

5.2.2.a. Technology transfer

The Institute is committed to contribute to bridge the gap between laboratory discoveries (TRL=4) and market realities (TRL=9), transforming pioneering materials science into tangible socio-economic value. Our key objectives focus on establishing an agile innovation framework that proactively protects intellectual property, fosters a culture of entrepreneurship, and incentivizes the creation of high-tech spin-offs and startups. The Institute will establish a communication channel to actively nurture current industrial partners based in our region and promote new long-term strategic partnerships across sectors including energy, healthcare, electronics, advanced manufacturing, mobility, and environmental technologies, facilitating the development of novel materials, processes, and products that respond to current and emerging technological needs. The institute will also encourage an entrepreneurial culture among researchers, providing training, consulting, support, and incentives in areas such as patenting, business development, and access to investment opportunities. In parallel, participation in regional, national, and European innovation ecosystems will be actively promoted to maximize impact and funding opportunities. Through these actions, the institute aims to become a key driver of knowledge-based innovation and competitiveness.

5.2.3.a. Talent attraction

Attracting, developing, and retaining outstanding talent will be a fundamental objective of the institute's strategic plan, recognizing that today human capital is the cornerstone of research excellence and innovation. The institute will implement competitive, transparent, and international recruitment processes, aligned with the UMA's HRS4R (Human Resources Strategy for Researchers) principles and code, to attract excellent researchers at all career stages, from doctoral candidates and postdoctoral fellows to established principal investigators. The institute will also promote diversity, inclusivity, and gender balance, creating a dynamic and supportive working environment that fosters creativity and collaboration. In addition, the IMANA will leverage strategic partnerships with selected universities and global research networks to foster talent circulation. The Institute will also implement a structured communication and onboarding strategy to ensure the successful integration of new researchers. A comprehensive career development plan will provide training in both transversal and technical skills through professional development initiatives and specialized micro-credential courses, fostering excellence and long-term career growth. Thanks to the city's outstanding quality of life access to state-of-the-art facilities, and a stimulating scientific environment, the institute aims to build a highly motivated research community with the vision to have IMANA as a preferred destination for world-class talent in advanced materials research.

5.2.b. Selected general actions for the strategic axes.

Research excellence:

1. *Strengthening interdisciplinary research structures.* Promote interdisciplinary research between the IMANA Research Groups (see subsection 3.3) and Research Units (see subsection 3.2) if they are aligned with the Strategic Research Lines (see subsection 5.1.a).

2. *Promotion of scientific excellence through highly competitive funding*. To establish a programme to enhance the Institute's capacity to secure highly competitive national and international funding, including prestigious institutional recognitions (e.g., Programmea de Apoyo a Unidades de Excelencia [Junta de Andalucia], María de Maeztu [Spanish Government]), individual excellence grants (focusing on Pillar-1: ERC and Marie Skłodowska-Curie Actions), and collaborative excellence grants (focusing on Pillar-3: EIC).

3. *Scientific quality assurance and evaluation*. To establish a system of continuous evaluation that includes the yearly assessment of strategic research priorities, KPIs and other outputs by an independent Scientific Advisory Committee, in order to ensure external and independent evaluation in line with international standards.

4. *Develop and maintain highly-competitive research infrastructures*. Ensure access to advanced scientific equipment, shared facilities and prioritize investment in state-of-the-art (and unique) research infrastructures and equipments to sustain cutting-edge research capabilities.

5. *Foster an excellent and collaborative scientific environment*. Promote scientific dissemination, international collaborations, leadership of research consortia and participation in global research networks.

Technology transfer:

1. *Promotion of an Innovation-Oriented Culture*. Establish and communicate clear guidelines for knowledge transfer, supported by incentive mechanisms that encourage active participation of IMANA staff and young researchers in seminars and training actions coordinated by the UMA Technology Transfer Office regarding IP management.

2. *Protection and Valorisation of Research Results*. Promote patenting and intellectual property management as integral to research. Support the identification, evaluation, and commercialization of results by including a dedicated agenda item in the regular meetings of the Scientific Board of IMANA and the sponsored scientific meetings. Encourage the creation of spin-offs and technology-based companies by providing mentoring and guidance from IMANA members with proven experience in technology transfer, entrepreneurship, and innovation.

3. *Strengthening Industry Partnerships*. Develop strategic collaborations with industry in areas of high technological relevance, fostering joint research and long-term cooperation. Particular emphasis will be placed on establishing/strengthening partnerships with leading institutions/companies based in Andalusia, such as IMEC, Moeve, Coosur, Airbus, Vorotatim..., leveraging the Institute members' existing networks and long-standing collaborations.

4. *Knowledge Exchange within the Innovation Ecosystem*. Organize technology showcases and matchmaking events and enhance the visibility of the Institute's technological capabilities to attract partners, through the participation of the Institute in R&D&I, knowledge transfer events and forums, such as TRANSFIERE.

5. *Development of Entrepreneurial Capacity*. Provide training in entrepreneurship and innovation management and support participation in collaborative R&D&I programmes with industry.

Talent attraction:

1. *International Recruitment*. Ensure open, transparent merit-based recruitment to attract excellent researchers. The positions in IMANA groups will be advertised as broad as possible, following the best European codes of practices (e.g., EURAXESS Jobs Portal, LinkedIn, etc.). The national and international networks of IMANA collaborators will also be employed to disseminate the job positions as much as possible.

2. *Career Development and early-career support*. Attract and support early-career researchers through competitive start-up packages, structured mentoring, and leadership training. To ensure effective integration, the Institute will provide a Welcome Package, including relocation and administrative support and housing guidance. A welcome club will be settled where newcomers will profit from the experience of researchers recently recruited.

3. *Diversity and Inclusion*. The institute fully adopt the UMA Equality Plan and a Code of Ethics to foster an inclusive, gender-balanced and transparent research environment.

4. *Advanced Training Programmes*. Reinforce doctoral programmes through interdisciplinary training and increased international mobility. The institute will regularly organize seminars, workshops and micro-credentials as training activities for young researchers (Master and PhD students as well as postdoctoral researchers). The IMANA will promote the participation of the members in COST actions, Erasmus and ERA-NET calls, etc.

5. *Attractive Research Environment*. Promote talent retention through competitive working conditions, access to state-of-the-art research facilities, and mainly the recognition of excellence. The institute will provide financial support for organizing team-building activities. IMANA will award an annual prize to the best PhD student and the best postdoctoral researcher in accordance with the rules to be drawn up shortly.

5.3.a. Key transversal objectives for the horizontal pillars.

Scientific excellence in materials science and nanotechnology increasingly depends not only on the quality of research itself but also on the institutional capacity to integrate cross-cutting practices that enhance collaboration, efficiency, sustainability, openness and societal impact. Beyond the scientific priorities described in the Strategic Research Areas, IMANA recognizes that several transversal dimensions are essential

to create an internationally competitive research environment and to consolidate the Institute as a leading multidisciplinary centre. These transversal strategic axes provide the institutional framework supporting most of the research activities across the Institute. They promote common standards, facilitate interactions among Research Units and strengthen scientific excellence.

The transversal objectives are fully aligned with the principles promoted by the European Research Area (ERA), Responsible Research and Innovation (RRI), Open Science, FAIR data management, Horizon Europe, the Human Resources Strategy for Researchers (HRS4R), and the United Nations Sustainable Development Goals (SDGs). Rather than constituting independent research lines, these strategic axes operate horizontally across all scientific activities, reinforcing IMANA's capacity to generate excellent science with societal, environmental and economic impact.

IMANA has identified and is being focussed on four transversal strategic axes:

- *Data Management and Artificial Intelligence*, promoting FAIR research data, digital transformation and data-driven research methodologies across all scientific disciplines.

- *Sustainability and Circularity*, integrating environmental responsibility, resource efficiency and circular economy principles throughout research activities and laboratory management and practices.

- *Outreach,* strengthening communication with society, industry, public administrations and educational institutions to maximize the visibility and societal impact of IMANA's scientific achievements.

- *Training,* fostering the development of highly skilled researchers through interdisciplinary education, international exposure and continuous professional development and mentoring of young researchers.

Together, these strategic axes will contribute to creating a modern research ecosystem in which scientific excellence, innovation, responsible research and international competitiveness reinforce one another.

5.3.1.a. Data management and AI

The transversal objective regarding data management and AI focuses on accelerating the discovery cycle of new materials and optimizing physical and chemical monitoring systems through digitalization and data-driven workflows. IMANA seeks to systematically integrate AI algorithms into its research lines to automate the fast, unbiased processing, analysis, and segmentation of massive and complex datasets, such as tomographic (i.e. 4D data generated in synchrotron imaging experiments) and spectroscopic mapping. Likewise, it aims to implement AI for the assisted interpretation of spectroscopic signals, the development of automated calibrations, computational matrix correction, and the fusion of complementary analytical techniques in complex scenarios. This pillar promotes robust data stewardship practices that ensure metrological traceability, data mining and preservation and the reproducibility of all the Institute's scientific production.

5.3.2.a. Sustainability and circularity

IMANA considers sustainability and circularity as fundamental components of its scientific identity. Owing to its multidisciplinary expertise in advanced materials, nanotechnology, analytical sciences, green chemistry, environmental technologies and resource recovery, the Institute is uniquely positioned to contribute to the transition towards a more sustainable and circular society. Consequently, sustainability is not regarded as a single research topic but as a transversal principle underpinning all strategic research lines.

The fundamental objective of this horizontal pillar is to imbue all of IMANA's activities and research with the principles of green chemistry, circular economy, resource efficiency, and social responsibility. The Institute strategically commits to the design and development of eco-efficient materials, interfaces, and processes that actively contribute to decarbonization, greenhouse gas mitigation, and the transition toward climate neutrality. To this end, the objective is oriented toward reducing carbon footprints through the substitution of critical elements with non-critical raw materials, the development of permanent CO_2 sequestration technologies within material matrices, and the advanced upcycling of by-products, such as bio-ashes and industrial or urban sludge, transforming them into valuable secondary resources instead of environmental liabilities. Likewise, this pillar promotes sustainability within agro-food systems and water reuse processes, minimizing any adverse environmental impact within the conceptual framework of the circular economy.

5.3.3.a. Outreach.

Scientific excellence is maximized when knowledge extends beyond the research community to benefit society, industry, policymakers, and future generations of scientists. IMANA therefore considers outreach as a strategic pillar for increasing the visibility, accessibility and societal impact of its research while fostering public trust in science and innovation.

The Institute will promote an integrated outreach strategy aimed at communicating scientific achievements to diverse audiences through public engagement activities, collaboration with schools and educational institutions, participation in science fairs and outreach events, digital communication, and interaction with industry and public administrations. These activities will contribute to strengthening scientific culture, inspiring young researchers and facilitating knowledge transfer to society.

Outreach will also reinforce IMANA's visibility by disseminating its scientific advances, technological capabilities and societal contributions. Through this transversal strategic axis, IMANA seeks to establish effective and continuous dialogue between science and society, ensuring that research outcomes generate lasting scientific, economic and social impact.

5.3.4.a. Training

The long-term success of IMANA depends not only on scientific excellence but also on its capacity to attract and retain highly qualified researchers capable of addressing the complex challenges of materials science and nanotechnology. Training is therefore considered a strategic pillar that supports research excellence, innovation, and international competitiveness across all scientific activities of the Institute.

IMANA is committed to providing an interdisciplinary training environment that combines scientific knowledge, advanced experimental techniques, and transferable skills. The Institute will contribute to undergraduate, master's and doctoral education and training and mentoring of postdoctoral researchers. These actions include the active participation and even leadership of early-career researchers in national and international research projects.

Beyond scientific specialization, IMANA will foster continuous professional development by encouraging the acquisition of transversal competencies, including research integrity, research data management, AI, entrepreneurship, project management, science communication and technology transfer. International mobility, collaboration with leading research centres and participation in international scientific networks will further strengthen the training experience and promote the development of globally competitive scientific careers.

Training activities will also promote interdisciplinary interactions among the Institute's Research Units, creating opportunities for knowledge exchange, shared use of scientific infrastructures and collaborations in research. By integrating education, research and innovation within a common institutional framework, IMANA aims to cultivate a new generation of researchers equipped with the scientific, technical and professional skills required to lead future advances in materials science and nanotechnology.

5.3.b. Selected transversal actions for the horizontal pillars

To translate the transversal strategic axes into measurable and accountable institutional progress, IMANA will implement a coordinated portfolio of transversal actions that will support all Research Units and strategic research lines. These actions are conceived as institute-wide initiatives designed to strengthen research quality, improve operational efficiency, promote responsible research practices, and reinforce IMANA's international competitiveness.

5.3.1.b. Data Management and Artificial Intelligence

IMANA will progressively establish a common institutional framework for research data management, ensuring that scientific data generated within the Institute comply with the FAIR principles (Findable, Accessible, Interoperable and Reusable). Standardized procedures for data storage, documentation, sharing and long-term preservation will be promoted to improve reproducibility and facilitate interdisciplinary collaboration.

The Institute will also develop and implement AI and machine learning algorithms, within the Institute's processing platforms, for instance to automate the segmentation and quantification of complex 4D tomographic data. This action will also drive the optimization of processes and the assisted interpretation of spectroscopic signals. Strong collaboration with SCAI-UMA is foreseen here as the amount of data generated by SCAI equipments are skyrocketing and new procedures are need to efficiently analyse and connect these data.

IMANA will encourage the adoption of digital tools and AI throughout the research cycle to increase efficiency. Particular attention will be given not only to the application of machine learning but also to advanced data analytics and computational methodologies for materials discovery, analytical sciences, intelligent monitoring systems, advanced characterisation and predictive modelling. Specific training activities will support researchers in incorporating these digital methodologies into their scientific workflows while ensuring compliance with ethical principles, research integrity, and national and European regulations.

5.3.2.b. Sustainability and Circularity.

IMANA will integrate sustainability principles into both its research activities and institutional management. The Institute will establish strict green chemistry criteria in the synthesis tasks of the Research Units, prioritizing the development of resource-efficient processes and the reduction of residual environmental impacts. The use of materials free of critical/hazardous elements/compounds and the design of solutions aligned with climate neutrality will be transversally promoted.

IMANA will also promote collaborative multidisciplinary research focused on the upcycling of byproducts and residues.

At the institutional level, the IMANA will progressively implement laboratory practices aimed at reducing the environmental footprint of research activities. These measures will include the promotion of sustainable procurement, responsible chemical management, optimization of energy and water consumption, improved laboratory waste segregation and recycling. Sustainability criteria will progressively become part of research planning and institutional decision-making.

5.3.3.b. Outreach

IMANA will develop an integrated outreach programmeme to strengthen its communication to the appropriated stake holders. Dissemination activities will target multiple audiences, including schools, university students, industry, public administrations and the general public, using both face-to-face and digital channels. Within the budgetary constraints, the Institute will actively participate in science festivals, public lectures, laboratory open days, educational programmemes, and outreach initiatives. Particular emphasis will be placed on promoting scientific vocations among young students, increasing the visibility of women in science and communicating the societal impact of research in advanced materials and nanotechnology. Collaboration with industrial stakeholders and public institutions will further reinforce knowledge transfer and public engagement. In this way, IMANA will systematically contribute to activities aimed at society, such as workshops to young students, participation in Researchers' Night, and science outreach events in civic settings.

To support these activities, IMANA will elaborate a structured communication plan and a digital brand identity to address the initial lack of visibility. The institute will also promote the capabilities locally, regionally and nationally. International dissemination and communication activities will be mainly carried out thought digital channels, which contributes to have the Institute CO_2 footprint as low as possible.

5.3.4.b. Training

First, IMANA will enhance the attraction of predoctoral talent by providing institutional support to the three interuniversity master's degrees in Applied Chemistry, Chemical Engineering and Advanced Materials, all taught by Faculty members of IMANA. Structured access to analytical and advanced characterisation facilities, coordinated with the SCAI-UMA, will be provided to strengthen students' practical training and facilitate their integration into research activities.

Second, IMANA will strengthen the attraction of postdoctoral talent by establishing an institutional programmeme to host outstanding national and international researchers. Priority will be given to candidates applying for very competitive fellowships (e.g., Marie Skłodowska-Curie Postdoctoral Fellowships, Ramón y Cajal, Juan de la Cierva, Emergia and Talentia programmemes), offering mentoring during proposal preparation, integration into multidisciplinary research teams and access to IMANA's state-of-the-art research infrastructures.

The IMANA will also consolidate a comprehensive professional development programmeme covering all stages of scientific careers but focusing in the early stages. Continuous training will be delivered through specialised courses, workshops and seminars addressing both scientific and transferable skills. The programmeme will be organised in collaboration with other units of the UMA, including the OTRI, the Faculty of Science and the Vice-Rectorate for Innovation, Entrepreneurship and Business Relations. Training activities will cover advanced characterisation techniques, research data management, AI applied to specific problems, Open Science, research integrity, project management, intellectual property and patenting, entrepreneurship, technology transfer, science communication, and the preparation of competitive national and international research proposals.

International mobility, interdisciplinary mentoring and participation in collaborative research networks will be actively promoted to broaden researchers' experience, strengthen international collaborations and increase the global visibility and career prospects of early-career researchers.

6. Selected Key Performances Indicators with target values for the quadrennium 2026-2029.

The KPI targets will naturally depend upon the funding secured by the Institute. In fact, the top KPI for these years is to secure one 'Excellence Stamp' with its associated funding.

6.1. Scientific Leadership and International Impact.

This block intends to measure the global prestige, publication quality, and competitive international positioning of the institute. The data for 2025 and the target values for the quadrennium are given in Table 4.

6.1.1. Prestigious International Research Grants: Number of active *ERC grants* (Starting, Consolidator, Advanced) hosted by the institute.

6.1.2. Global Funding Share: Percentage of total yearly budget sourced from international competitive programmes (e.g., Horizon Europe, etc.).

6.1.3. Top-Tier Publications: Annual number of peer-reviewed papers in D1 journals (JCR, *10% top-tier*) within the Institute sub-categories.

6.1.4. High-Tier Publications: Annual number of peer-reviewed papers in Q1 journals (JCR, *25% top-tier*) within the Institute sub-categories.

6.1.5. Global Academic Governance: Number of researchers serving as Editors-in-Chief, Editorial Board Members of Q1-Q2 journals [as given in JCR, data science and scientometrics] or chairs of international conferences within IMANA fields and subfields.

Table 4. Scientific Leadership and International Impact KPIs for 2025, and target values for the quadrennium 2026-2029.

KPIs	2025	2026	2027	2028	2029
6.1.1 – ERC grants (units)	1	1	1	2	2
6.1.2 – Percentage of intern. funding (%)	50.7	51	51.5	52	52
6.1.3 – Number of D1 publications (units)	26	27	27	28	29
6.1.4 – Number of Q1 publications (units)	53	55	56	57	58
6.1.5 – Global governance (units)	5	5	5	6	6

6.2. Knowledge Transfer and Economic Impact

This block is designed to evaluate the direct socioeconomic contribution to the region, aligning with Andalusian smart specialization strategies, and National and European guidelines. The data for 2025 and the target values for the quadrennium are given in Table 5.

6.2.1. Prestigious International Innovation Grants: Number of active *EIC grants* (Pathfinder, Transition, Accelerator) hosted by the institute.

6.2.2. Industrial R&D Revenues: Annual funding secured through *research contracts with private sector*.

6.2.3. Patent Strength: Annual number of European (EPO) or international (PCT) *patents* filed and successfully granted by IMANA.

6.2.4. Deep-Tech Venture Creation: Number of active *spin-offs or start-ups* incubated or created by institute researchers using centre-owned intellectual property.

Table 5. Knowledge Transfer and Economic Impact KPIs for 2025, and target values for the quadrennium 2026-2029.

KPIs	2025	2026	2027	2028	2029
6.2.1 – EIC grants (units)	2	2	2	2	3
6.2.2 – Industrial R&D revenues (k€)	130.2	132	136	140	143
6.2.3 – Patent strength (units)	2	2	3	3	3
6.2.4 – Deep-Tech venture creation (units)	1	1	2	2	3

6.3. Human Capital, Training and Talent Attraction

This category reviews the capacity to recruit global talent and train the next generation of scientists. The data for 2025 and the target values for the quadrennium are given in Table 6.

6.3.1. International Recruitment: Percentage of Principal Investigators and Postdoctoral fellows recruited from outside Spain.

6.3.2. Elite Talent Fellowships: Number of active prestigious research contracts (e.g., MCSA-PF, *RyC, JdC*, and Andalusian *Emergia*, and equivalents).

6.3.3. Advanced Degree Training: Total number of PhD theses defended annually under the co-direction of institute permanent research staff.

6.3.4. Diversity Balance-1: Female-to-male ratio across research leadership roles, Public Grants PIs.

6.3.5. Diversity Balance-2: Female-to-male ratio across research leadership roles, OTRI Contracts PIs.

Table 6. Human Capital, Training and Talent Attraction KPIs for 2025, and target values for the quadrennium 2026-2029.

KPIs	**2025**	**2026**	**2027**	**2028**	**2029**
6.3.1 – International recruitment (%)	4	4	5	5	5
6.3.2 – Elite talent fellowships (units)	6	7	7	7	8
6.3.3 – Advanced degree training (units)	6	6	7	7	8
6.3.4 – Diversity balance-public grants (%)	52	50	50	50	50
6.3.5 – Diversity balance-contracts (%)	50	50	50	50	50

6.4. Self-evaluation of the S.P. achievement based on the KPI

Table 7 gives the criteria and values for the self-evaluation of the degree of accomplishment of this strategic plan over the four years, i.e. 2026-2027.

Table 7. Quantitative description of the quantitative values assigned to each subsection to determine the degree of achievement of the KPIs of this strategic plan. The values given below will be accounted for if the targets have been obtained. If the values are below the targets, the assigned number will be zero (i.e. there is not a 'percentage of success'). Our metric is relatively easy: achieved or not achieved. If achieved, the marks given below are computed

Points	**2026**	**2027**	**2028**	**2029**
To obtain an 'Excellence Stamp"	-	-	30	30
6.1.1. Prestigious International Research Grants:	15	15	10	10
6.1.2. Global Funding Share	5	5	4	4
6.1.3. Top-Tier Publications:	10	10	7	7
6.1.4. High-Tier Publications:	5	5	4	4
6.1.5. Global Academic Governance	5	5	3	3
6.2.1. Prestigious International Innovation Grants:	15	15	10	10
6.2.2. Industrial R&D Revenues:	5	5	4	4
6.2.3. Patent Strength:	5	5	4	4
6.2.4. Deep-Tech Venture Creation:	5	5	3	3
6.3.1. International Recruitment:	10	10	7	7
6.3.2. Elite Talent Fellowships:	5	5	4	4
6.3.3. Advanced Degree Training:	5	5	4	4
6.3.4. Diversity Balance-1:	5	5	3	3
6.3.5. Diversity Balance-2:	5	5	3	3
Total:	100	100	100	100