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MSCA Postdoctoral Fellowships 2026

EXPRESSION OF INTEREST – CANDIDATE FOR PF GLOBAL

Researcher Profile:

Name and Surname: **JUAN MANUEL CASARES LÓPEZ**
Position: **PhD / Full Time Researcher (PCI)**
Department/Unit/Centre: **Biomedical Sciences / Radiology and Physical Medicine Area / Faculty of Medicine and Health Sciences (jmcasares@unex.es)**

a) **Describe your qualifications and experience. Provide information regarding your level of experience on the research topic proposed and your track record of publications, invited talks, and conference participation relative to your career stage (e.g., papers, projects, main international collaborations, patent etc.), highlighting which scientific, technical and soft skills you will transfer to the TC Hosting Institution during the implementation of the Outgoing Phase in your research project.**

My research background is positioned at the interface between biomaterials science, surface physics and nanobiotechnology, with a strong specialization in the physicochemical and nanomechanical characterization of biointerfaces through advanced atomic force microscopy (AFM)-based methodologies. I currently work as a full-time researcher at the Biosurfaces and Interfacial Phenomena Research Group, in the Applied Physics Department in the Faculty of Sciences together with the Biomedical Sciences Department in the Faculty of Medicine and Health Sciences, and the University Institute of Biosanitary Research of Extremadura (INUBE), in the University of Extremadura, where I develop research focused on multifunctional biodegradable biomaterials for biomedical applications.

My academic training includes a BSc in Physics, an MSc in Research in Sciences (Physics specialization), and a PhD focused on multimodal AFM nanocharacterisation of PLA-based biocomposites. My expertise encompasses nanoscale topographical, mechanical and electrical surface characterization, Kelvin probe force microscopy (KPFM), 3D optical profilometry, interfacial free-energy analysis, electrokinetic characterization and advanced AFM measurements in liquid environments. During my doctoral research, I specialized in the study of biodegradable polymeric and metallic biomaterials enriched with antibacterial active compounds, including magnesium, quercetin, biosurfactants and zinc-based systems, under physiologically relevant and diabetic-mimicking environments.

My international experience includes a predoctoral research stay at the Molecular and Nanoscale Physics Research Group, School of Physics and Astronomy, University of Leeds (UK), under the supervision of Prof. Dr. Simon Connell, where I further developed expertise in advanced AFM nanomechanical measurements in liquid media using lipid bilayer membrane models under ionic and diabetic-like environments. This experience strengthened my capacity to operate in multidisciplinary and international research environments integrating nanophysics, biomaterials science and biological modelling.

Despite my early career stage, my publication record already includes several first-author and co-author papers in high-impact international journals (7 articles and 1 book chapter) such as Applied Surface Science, International Journal of Biological Macromolecules, Polymer Testing, Surfaces and Interfaces and Journal of Functional Biomaterials. My contributions have addressed biodegradable PLA-based biocomposites, UV-responsive antibacterial materials, green-solvent processing strategies, biodegradable magnesium alloys and biointerface characterization through AFM and KPFM approaches. In particular, I have led studies focused on nanoscale electrical surface characterization of UV-exposed PLA/quercetin/magnesium systems and the development of UV-shielded antibacterial biopolymers.

I have actively participated in 4 competitive research projects funded by regional and national agencies, including projects focused on biodegradable antibacterial coatings for orthopedic implants, sustainable polymer processing and multifunctional biodegradable biomaterials for diabetic-associated infections. These projects allowed me to consolidate expertise in experimental design, interdisciplinary research coordination and advanced surface characterization methodologies applied to clinically relevant biomedical challenges.

My scientific dissemination activity includes invited talks, oral communications and poster presentations at international conferences such as the European Colloid and Interface Society (ECIS), AFM BioMed, the International Conference on Polymer Science and Composite Materials, and the Symposium on Biodegradable Metals for Biomedical Applications, where I delivered a keynote presentation on biodegradable magnesium alloys under diabetic conditions. These activities have strengthened my communication skills and my ability to present complex multidisciplinary concepts to diverse scientific audiences.

My research profile has been built through extensive collaboration with multidisciplinary and international teams, including collaborations with the University of Leeds (UK), CENIM-CSIC, Polytechnic University of Madrid, University Hospital La Paz-IdiPAZ and clinical researchers from orthopedic surgery and biomedical sciences. These collaborations have provided experience integrating materials science, nanotechnology, microbiology, electrochemistry and clinical perspectives into translational biomedical research.

In parallel with my research activity, I have maintained a continuous commitment to scientific outreach and public engagement for nearly a decade through participation in initiatives such as the European Researchers' Night, Science Week of Extremadura and multiple educational dissemination programmes coordinated by the University of Extremadura. I have acted as scientific coordinator and instructor in outreach activities focused on physics, biomaterials and atomic force microscopy, promoting scientific literacy among students and the general public through interactive workshops, laboratory demonstrations and educational events. These experiences have strengthened my communication, leadership and science-transfer abilities, particularly regarding the dissemination of complex scientific concepts to non-specialised audiences.

During the outgoing phase of the proposed project, I will contribute to the TC Hosting Institution through a highly interdisciplinary combination of scientific, technical and transferable skills. Scientifically, I will provide expertise in biodegradable biomaterials, antibacterial and antibiofilm surface engineering, polymeric biointerfaces, UV-responsive systems and diabetic-mimicking degradation models. Technically, I will transfer advanced competencies in AFM and KPFM operation, nanomechanical characterization in liquid environments, nanoscale electrical measurements, surface physicochemical characterization, profilometry, wettability analysis and bacteria–surface interaction studies. I will additionally contribute methodological know-how related to reproducible biointerface characterisation under physiologically realistic conditions, including dynamic liquid-environment AFM protocols developed during my recent research activities, which has also allowed me to implement some derived AFM-parameters to use them as a newly developed biomarkers for detecting biological consequences of rare diseases.

Beyond technical expertise, I will contribute strong interdisciplinary integration skills acquired through continuous collaboration across physics, engineering, biomaterials science and biomedical research. My experience in international dissemination, public scientific engagement, mentoring activities and collaborative project environments has reinforced my scientific communication, adaptability and teamwork capacities. The combination of advanced surface nanocharacterisation expertise with a translational biomedical perspective positions me to contribute effectively to the host institution while simultaneously strengthening long-term international research collaborations and knowledge exchange.

b) Show your level of independence and demonstrated capacity for leading projects, for example by securing funding, and mentoring students.

My research trajectory demonstrates a progressive transition towards scientific independence through the development of specialized research lines, active participation in competitive projects and the consolidation of an interdisciplinary profile positioned at the interface between physics, biomaterials science and nanobiotechnology. Since the beginning of my doctoral stage, I have been continuously involved in publicly funded regional and national research projects focused on biodegradable biomaterials, antibacterial surfaces and advanced biointerface characterization. These projects have provided extensive experience in experimental planning, methodological optimization, data interpretation and collaborative research management within multidisciplinary teams.

I have also demonstrated initiative in developing emerging research directions involving AFM characterization in liquid environments, nanomechanical analysis of biological systems and diabetic-mimicking degradation models, including international collaborative work carried out during my research stay at the University of Leeds. This experience required a high degree of autonomy, rapid methodological adaptation and independent problem-solving in highly specialized experimental environments. My capacity for leadership and knowledge transfer is additionally reflected in my sustained participation in scientific dissemination and educational activities over nearly ten years.

Furthermore, my involvement in collaborative research with clinicians, engineers, physicists and biomaterials scientists from multiple institutions has reinforced my ability to coordinate interdisciplinary tasks and contribute proactively to collective scientific objectives. Altogether, these experiences have provided a strong foundation for progressing towards independent research leadership, particularly regarding the identification of emerging scientific opportunities, the preparation and development of competitive research proposals and the acquisition of research funding within multidisciplinary and international environments. Simultaneously, the combination of advanced technical expertise, collaborative research experience and long-term involvement in educational and outreach activities has strengthened my capacity to mentor, supervise and train undergraduate, MSc and PhD students, facilitating both scientific knowledge transfer and the development of critical and interdisciplinary thinking skills.

Project idea, if any (scientific requirements, topic, discipline):

The proposed research project aims to develop a new generation of adaptive biodegradable biointerfaces capable of dynamically modulating their physicochemical, nanomechanical and antibacterial properties in response to pathological microenvironments. The project would focus on the rational design and nanoscale characterization of multifunctional polymeric and hybrid biomaterials based on biodegradable systems enriched with bioactive compounds, metallic nanostructures and stimuli-responsive components for biomedical applications associated with infection-prone and metabolically altered environments, particularly diabetes-related conditions.

The central scientific objective would be the establishment of quantitative correlations between nanoscale surface properties and biological responses under physiologically realistic conditions through the integration of advanced atomic force microscopy methodologies, surface nanophysics and biomaterials engineering. Particular emphasis would be placed on the development of in situ and liquid-environment AFM approaches capable of monitoring dynamic biointerface evolution in real time, including bacterial adhesion processes, extracellular matrix interactions and degradation-induced surface transformations. This strategy would enable the identification of critical nanoscale parameters governing bacterial colonization, biofilm development and cell–material communication.

One particularly innovative aspect would involve the incorporation of environmentally responsive functionalities capable of altering surface electrical charge, adhesion energy or stiffness in response to local biochemical conditions, such as oxidative stress, ionic imbalance or diabetic-associated metabolic environments. These adaptive responses could provide passive antibacterial protection without relying on conventional antibiotic release approaches.

A major methodological innovation would consist of integrating multimodal AFM characterization with electrokinetic analysis, nanoscale electrical mapping through Kelvin probe force microscopy (KPFM), liquid-environment nanomechanics and biointerface modelling under dynamic physiological conditions. The possibility of studying bacterial interactions directly in liquid media with controlled ionic compositions would provide highly relevant mechanistic information regarding the early stages of bacterial adhesion and interfacial adaptation. This approach would contribute to bridging the gap between simplified in vitro models and the complex physicochemical environments encountered in clinical scenarios.

The interdisciplinary nature of the project strongly aligns with emerging European priorities related to sustainable biomaterials, antimicrobial resistance, personalized medicine and advanced nanobiotechnology. The use of green-solvent processing methodologies and biodegradable polymeric systems derived from sustainable approaches would additionally contribute to Safe-and-Sustainable-by-Design strategies for next-generation biomedical materials. The project would ultimately establish a predictive experimental framework for designing adaptive antibacterial biomaterials through nanoscale physicochemical engineering, contributing to the development of safer biodegradable medical devices and advanced biointerfaces with controlled biological functionality.

The proposed research would particularly benefit from a hosting institution with expertise in advanced microscopy, soft matter physics, biomembrane modelling, nanobiotechnology or translational biomaterials research, allowing the establishment of synergistic collaborations capable of expanding both the experimental complexity and translational impact of the work.