Title: Engineering Stealth Nanoparticles: Cell Membrane Coatings for Targeted Cancer Therapy

Abstract: The development of nanotechnological platforms for cancer therapy offers distinct advantages over traditional diagnostic and therapeutic methods. However, achieving efficient and specific biointerfacing between nanomaterials and biological systems remains a major challenge. In this context, nanoparticle (NP) surface engineering plays a critical role in modulating biological interactions, biodistribution, and therapeutic efficacy. In this study, we explored the impact of various NP surface coatings, including polyethylene glycol, bovine serum albumin, chitosan, and cancer cell membranes, on the physicochemical properties, cellular interactions, and immune responses of polystyrene nanoparticles. Each coating influenced colloidal stability, protein corona formation, mechanical properties, and cellular uptake, with membrane-coated NPs exhibiting superior internalization in cancer cells. Building on this, we further investigated the potential of glioblastoma multiforme (GBM) cell membrane-coated nanoparticles (G-NPs) to enhance targeted therapy for brain tumors. Using membranes derived from U87-MG human GBM cells, we established a scalable and efficient isolation method and fabricated G-NPs with robust colloidal stability under physiological conditions. Compared to uncoated NPs, G-NPs showed significantly enhanced uptake by GBM cells, selective tumor targeting over non-cancerous cells, and increased permeability across an in vitro blood brain barrier model. Altogether, our findings highlight the critical role of biomimetic coatings in improving nanoparticle biointerfacing, tumor targeting, and immune compatibility. These insights contribute to the rational design of next-generation nanomedicines with improved specificity, stability, and translational potential in complex biological environments.

Short bio:

Dr. Paola Sánchez Moreno is a researcher with a multidisciplinary background in Nanomedicine, Nanotoxicology, and Nano-biointeractions. She holds a PhD in Biomedicine from the University of Granada and she conducted her postdoctoral research at institutions including Politecnico di Milano, IRCCS Ospedale Policlinico San Martino, and the Istituto Italiano di Tecnologia (Italy). She is currently a Tenured Assistant Professor at the Department of Applied Physics, University of Granada, and co-PI of the BIOTHERA-Lab. Her research focuses on the design and physicochemical characterization of nanoparticles and biomaterials for biomedical applications.