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seminar

Wednesday, 16th June, 9.30am, Online

Host: Dr. Susana Velasco

Protein-hybrid nanomaterials for biomedical applications

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Nanomaterials present unique physical and chemical properties that are very different from bulk metals or classical nanoparticles. Although nanomaterials synthesis has attracted broad interest, the standard inorganic synthesis procedures require extreme reaction conditions, organic solvents, toxic reagents, and post-synthetic steps for their biological application. Taking inspiration from nature, over the past two decades, the bio-templated synthesis of inorganic nanomaterials has flourished as a field. However, the replacement of traditional organic methodologies to more sustainable routes results in a significant decrease in the quality of nanomaterials, which mainly present low stability and biocompatibility. To address this challenge, we have recently investigated the design and incorporation of metal coordination sites into engineered repeat protein scaffolds for the sustainable synthesis of different biocompatible protein-hybrid nanomaterials for biomedical applications. The resulting protein-hybrid nanomaterials present excellent stability and biocompatibility and they show great promise for biomedical applications. In addition, we developed a simple, modular, and versatile strategy to design custom protein-hybrid nanomaterials. This approach combines for the first time the engineering of a therapeutic protein module with the engineering of a nanomaterial-stabilizing module within the same molecule, resulting in a multifunctional hybrid nanocomposite unachievable through conventional material synthesis methodologies. As the first proof of concept, a multifunctional system was designed *ad hoc* for the therapeutic intervention and monitoring of myocardial fibrosis. This engineered protein-hybrid nanomaterial actively reduced myocardial fibrosis and heart hypertrophy in an animal model of cardiac remodeling. In addition to the therapeutic effect, the metal nanocluster allowed for in vitro, ex vivo, and in vivo detection and imaging of the fibrotic disease under study. This study evidences the potential of combining protein engineering and protein-directed nanomaterial engineering approaches to design custom nanomaterials as theranostic tools, opening up unexplored routes to date for the next generation of advanced nanomaterials in medicine.