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Rafael obtained his BSc in Materials Engineering from his native country, Venezuela. He has experience in polymers and his interest spans across many disciplines. More specifically, he is interested in the use of macro-biomolecules as scaffolds to grow hierarchically organized inorganic materials, to confer improved or new properties (i.e. optical, mechanical, electronic). Rafael has previously worked in the synthesis of hydrogels for drug delivery applications, but more recently he has been working in synthetic biology and mesostructured materials for CO_2 capture and storage.

"Conciliating bottom-up and top-down approaches: Molecularly engineering silk fibroin for biomaterials fabrication"

The field of tissue engineering and regenerative medicine has seen outstanding progress in the understanding of the effect of several variables on the culture and development of tissue in vitro. Nevertheless, the clinical outcomes from these studies are very limited. One of the main reasons behind this, particularly for osteochondral applications, is the deficient mechanical performance of the developed materials. Most of these materials suffer from a significant mismatch of mechanical properties with their host environment. When using metal implants, these have elastic moduli a few orders of magnitude higher than the bone surrounding it, resulting in the weakening of the tissue. On the other hand, sponges and hydrogels systems are greatly studied for their similarity with natural tissue, but these often have elastic moduli a few orders of magnitude lower than cartilage. These limitations are hard to overcome, as the material selection for clinical applications is very limited; the selected material should have regulatory approval for clinical applications. In view of these limitations, here we study the possibility of using silk fibroin extracted using a proprietary method to fabricate and characterize new materials. Given the new nature of the material, a brief characterisation of it will be presented and placed in context with other regenerated silk fibroins; showing the improved mechanical properties, albeit new processing challenges too. Later the fabrication of multiphasic materials intended to replicate tissue stratification (osteochondral junction) will be introduced and some early cell culture results will be presented.