Biomimetic Magnetic Hydrogels for Translational Research

The use of magnetic nanomaterials in Translational Research is a hot topic today due to its multiple applications in biomedicine and valuable contributions in terms of improving people's quality of life. The goals posed by Tissue Engineering (functional vascular networks, interfaces, structural hierarchy and functional characteristics) are perhaps the most complex and ambitious scientific challenges for the next generation of biomaterials. This translates into the need to establish gradients or subcompartments of composition, temporal changes, and use of cells to drive tissue and organ morphogenesis. In this scenario, the manufacture of hybrid and biomimetic biomaterials, made up of biopolymers, magnetic nanomaterials and cells, which can be distributed and structured in real time and remotely using external magnetic fields, allows the manufacture of biomaterials that serve as cellular support for the regeneration of tissues. Following this approach, the interest behind magnetic biomaterials lies in the possibility of adjusting their structural, mechanical and electrical properties ad hoc and with minimally invasive interventions, in a reversible manner, through the application of external magnetic fields.

The main idea of this project is the creation of a conceptually new type of bioactive materials sensitive to magnetic fields capable of being directly manipulated in situ in real time. This is a multidisciplinary and interdisciplinary topic of great importance at the intersection of applied physics and biology of potential interest in several aspects within System Biology including biofabrication, 3D bioprinting and organs-on-a-chip technology.

Magnetic hydrogels will be fabricated using an unprecedented homemade device that is capable to generate high frequency fields (up to 4 kHz) to promote the formation of time-averaged magnetic driven scaffolds for directed cell growth and differentiation. For the first time the resulting structures will be frozen within a living hydrogel under a confocal magneto-rheomicroscope. An exhaustive physicochemical and mechanical characterization (rheology) will be carried out. Next, biological assays will follow in the design of advanced medical tools and therapies. We anticipate synergy within Archifun consortium in Mechanical characterization of biomaterials and viscometry (with ESRF, IP & BIFI-UZ) and microfluidics (with NTT & FIDABIO).

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Proposed collaboration within ArchiFun network (not mandatory at this stage):

TBD Newtonian

Proposed list of secondments (not mandatory, but recommended if known already):

TBD

Main ArchiFun theme involved:

- [ ] Host-pathogen interactions;
- [ ] Mechanisms of bacterial resistance and cancer onsets;
- [ ] Neurodegenerative and autoimmune diseases;
- [x] **Translational research in prevalent diseases**;
- [ ] Physiology and ecology;
- [ ] Neurosciences and cognition.