PhD position

Understanding osteoarthrisis at the nanoscale using atomic force microscopy

Osteoarthritis (OA) is the most common age-related musculoskeletal disease and is the leading cause of disability in the elderly. OA affects about 40 million people in Europe. This leads to important functional and economic burdens. The global burden of OA, evaluated with total DALYs (Disability-Adjusted Life-Years) has risen by 35% between 1990 and 2015. In addition, OA patients have a higher risk of mortality, especially due to a higher risk of sedentarity-induced cardiovascular events. An exponential number of OA patients is expected in the very next years due to ageing and to the epidemic of obesity, the main modifiable risk factor for OA. Today, no curative treatments are available.

OA is mainly characterized by cartilage degradation and subchondral bone remodeling. Both events are linked; the remodeling process at the interface is thus pivotal in OA (Figure 1A-C). In this project, we intend to probe the bone-cartilage interface at the nanoscale with the aim to investigate structural changes induced by OA, and identify biological and physicochemical processes involved in this disease. For this purpose, we will use atomic force microscopy (AFM) and take advantages of this technique to probing biological samples with the minimum of disturbance (controlled *in vitro* conditions, preservation of biological tissue, etc). At the nanoscale, the structure of bone and cartilage are different but both include highly ordered organization of mineral (calcium phosphate compounds) and organic phases, particularly collagen. The characterization of these tissues with AFM will provide relevant information regarding the processes of biomineralization, bio-resorption, supramolecular organization of collagen, growth and organization of mineral nanostructures, etc (e.g. Figure 1D). The use of complementary spectroscopic techniques, available in LRS lab, will be envisaged (IR, XPS, etc). Samples will be provided by the UMR_S938 lab (INSERM/UPMC) from a biobank (BioJOINT) of human OA tissues obtained after total knee arthroplasty.

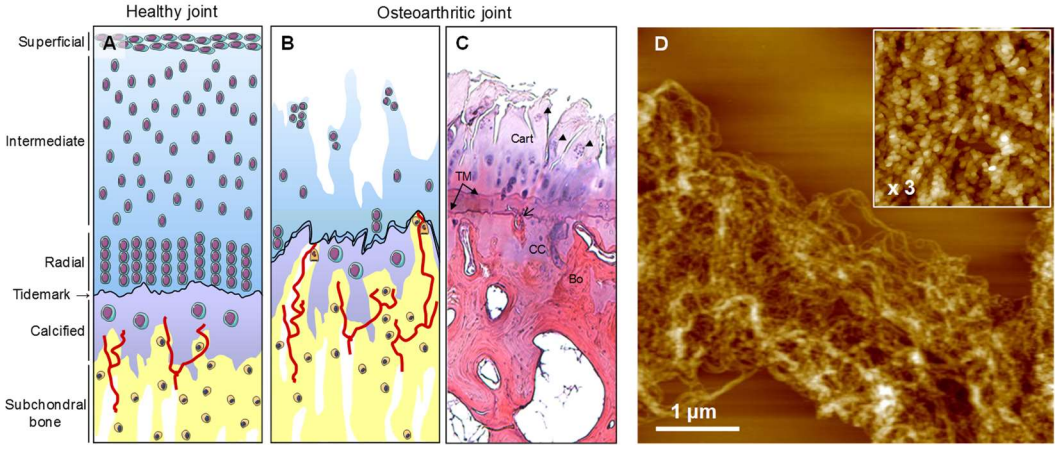

Figure. Schematic representation (A, B) and micrograph (C) of the interface bone-cartilage. (D) AFM height image of mineralized collagen fibrils (zoom: hydroxyapatite nanoparticles attached to collagen fibrils).

The PhD student will be in charge of preparing biological samples and performing AFM experiments. Skills in (bio)chemistry or physical chemistry are required. An interest in multidisciplinary subjects will be appreciated.
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Contacts

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