Department of Biomedical Engineering
The Chinese University of Hong Kong

The physics and chemistry of directional freezing: implications in biofabrication and cryobiology



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Paris, France

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Time : 2:30 pm
Venue : Room 1122, William M W Mong Engineering Building, CUHK

Abstract

Freezing is ubiquitous in nature. In oceans, rivers, soils, and in the atmosphere, ice is formed under radically different environmental conditions that depend on hydration, temperature and pressure. In most of these conditions freezing threatens the integrity and the viability of biological entities. Paradoxically, cryopreservation (i.e. freezing biological entities under strictly controlled conditions) is the only solution to extend the lifespan of living cells, and to preserve biomolecules. In this lecture I will focus on the interaction between biological matter (from biopolymers up to living mammalian cells) with a controlled freezing front. During freezing, ice growth induces a phase separation between pure ice crystals, and the remaining solutes and suspended particles. This strategy can serve as a driving force to design biomimetic systems such as vascular tissue grafts, muscle tendon junctions as well as 3D cell culture systems. Our recent results in designing biomaterials from the main components of the Extracellular Matrix such as type I collagen using ice will be addressed in the first part of the talk. The second part will be devoted to the role of directional freezing as an alternative approach to cryopreservation of cells, from model organisms like yeast and bacteria to cells relevant in human cell therapy in absence of toxic components such as DMSO. Overall, we demonstrate the potential of controlled freezing processes to outperform current cryopreservation methods and tackle tissue engineering challenges.

Biography

Francisco M. Fernandes is a Full Professor at Sorbonne Université, where he leads the Materials & Biology team at the Laboratory of Condensed Matter Chemistry of Paris (LCMCP). He holds a degree in Chemistry and an MSc in Environmental Sciences from the University of Minho (Braga, Portugal). He completed his PhD under the supervision of Prof. Ruiz-Hitzky at the Materials Science Institute of Madrid, Spain, where he investigated bionanocomposite materials. In 2011, he joined the LCMCP in Paris as a postdoctoral researcher, working on collagen-based materials for biomedical applications. Following his initial appointment at Sorbonne he has developed an original research program focused on processing biomimetic materials. His work adapts materials science processing techniques to the constraints and requirements of living matter. His main tool is ice.

***** ALL ARE WELCOME *****

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