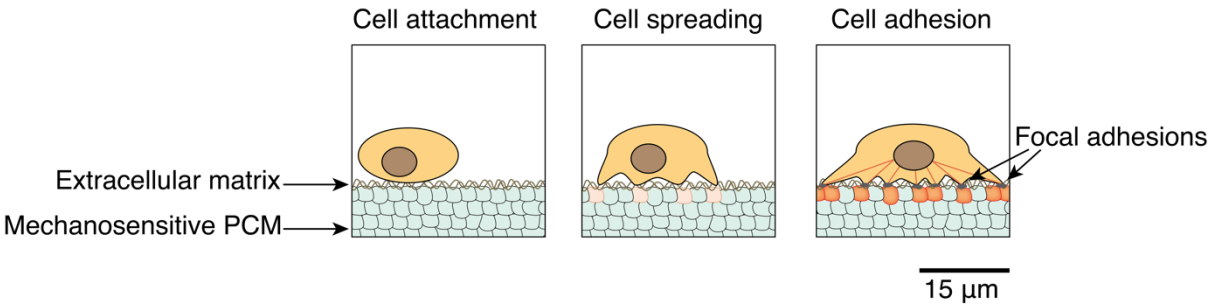
Development of mechanosensitive protocellular materials as next-gen substrates for mechanobiology

Background: Bridging the gap between synthetic chemistry and biology remains an important challenge of modern biodesign. In recent years, researchers have begun to bring these two fields together by developing different models of materials-based cell-like entities called *protocells*. The Gobbo Group works at the cutting edge of bottom-up synthetic biology and developed the first methodology to organise protocells into interconnected networks, termed *protocellular materials* (*PCMs*).[1-3] The Gobbo Group has demonstrated that by employing bio-orthogonal chemistry it is possible to fabricate tissue-like materials with complex and reproducible 3D architectures. Most importantly, these PCMs can be built with any shape and size (up to a few cm^2), are mechanically robust, stable in water, and capable of advanced communication properties, biological complementarity, and higher-order functions (collective contractility, out-of-equilibrium sensing, enhanced catalysis).[1, 3]

Project Aims: The Gobbo Group now intends to move PCMs towards important applications in tissue engineering and regenerative medicine. To achieve this ambitious goal, it is necessary to develop the first mechanoresponsive PCMs capable of:

(i) interfacing with living cells and tissues

(ii) Converting mechanical deformations exerted by the cells on the individual protocells that constitute the PCM into an optical output.



The achievement of this ambitious goal will not only provide the first example of effective integration between synthetic cells and living cells, but it will equally provide major developments in the emergent field of mechanobiology. In fact, such PCM would allow for the detailed study of how living cells physically interact with a multicompartmentalised substrate, providing a new paradigm of mechanobiology.[4-5]

Researcher Activity: The main activity of the postdoctoral fellow will be the development of novel mechanoresponsive polymers and polymer networks to build mechanosensitive protocells. These protocells will be used as building blocks to create PCMs which respond to mechanical stimuli with an optical output, such as a change of colour or a fluorescence turn-on. The PCMs will then be used to study the mechanical behaviour of living cells using fluorescence microscopy. The Post-doctoral Fellow will join a highly dynamic and interdisciplinary research group with important connections with several groups in Europe and Canada.

Required Skills: The Post-doctoral Fellow should have a well-documented expertise in polymer chemistry, and specifically either in small molecule and polymer synthesis and characterisation (*i.e.*, Schlenk line operation, polymerisations, NMR spectroscopy, gel permeation chromatography, light scattering), or in the mechanical characterisation of polymeric materials (Young's modulus, viscoelasticity, dynamic mechanical analysis, etc.). The researcher must have an excellent track record of publications in their research field, with at least 5 publications in peer reviewed journals.

References:

[1] P. Gobbo, A. J. Patil, M. Li, R. Harniman, W. H. Briscoe, S. Mann, *Nat. Mater.* **2018**, *17*, 1145-1153.

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[3] A. Galanti, R. O. Moreno-Tortolero, R. Azad, S. Cross, S. Davis, P. Gobbo, *Adv. Mater.* **2021**, *33*, e2100340.

[4] D. Mohammed, M. Versaevel, C. Bruyere, L. Alaimo, M. Luciano, E. Vercruysse, A. Proces, S. Gabriele, *Front. Bioeng. Biotechnol.* **2019**, *7*, 162.

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