Invited talk

Agarose-based microsystems to control the mechanical and chemical environment of cells

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There is a number of evidence indicating that both tumor micro-environment and mechanics are playing an important role in the malignant transformation of cells and resistance to treatment [1]. We try to take into account these important issues (micro-environment and mechanics) by developing original techniques enabling precise control of the cell micro-environment, including the applied mechanical stress.
In particular, we have developed agarose-based microsystems that enable precise control of the cell micro-environment in terms of mechanics (stiffness, stress) and transport of molecules (through a porous matrix) (**Figure 1**, [2-5]). Combined with multi-positions time-lapse microscopy and image analysis, we can decipher cell response *in-situ* in such situations, at the single-cell level, and over space and time.
In this seminar, I will first present our agarose-based microsystems, before describing results obtained for 2D confinement or 3D models as well as how these systems can be used to assess transport and therapeutic efficacy of novel nano-therapeutics in a more physiological environment than the classical 2D *in-vitro* assay used. As such, it could be a valuable tool to assess the interplay between mechanics and biochemical signaling in the progression of cancer.

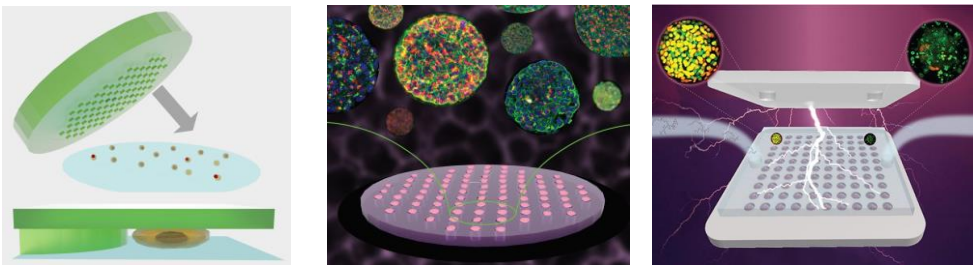

Figure 1. Illustration of the soft confiner (left, adapted from [1]) and of the agarose-based microsystem developped for *in-toto* imaging of hundreds of spheroids (middle, from [2]) and electroporation (right, from [3])

References

[1] Stylianopoulos, T. et al. Reengineering the Physical Microenvironment of Tumors (..). *Trends in Cancer* **2018**, 4 (4), 292–319
[2] Rivière C et al., Plaque de Micropuits En Hydrogel Biocompatible. **2018** *Patent*:FR3079524A1
[3] A. Prunet et al., A new agarose-based microsystem to investigate cell response to prolonged confinement, *Lab on a Chip* **2020** 20:4016–4030
[4] S. Goodarzi et al., Quantifying nanotherapeutic penetration using a hydrogel-based microsystem as a new 3D in vitro platform, *Lab on a Chip* **2021** 21:2495–2510
[5] P. Bregigeon et al., Integrated platform for culture, observation and parallelized electroporation of spheroids, *Lab on a Chip* **2022**, 22, 2489-2501.