
# Soft thermoplastic elastomer compartmentalized chip for neurofluidic: applications to neural organotypic culture

**S. Moreau[1*], R. Flores-Berdines[1], T. El Jalkh[2], C. Becker[1], S. Bernard[1], H. Salmon[1,3]**

[1]T3S, UMR-S INSERM 1124, Université Paris Cité, Paris, France
[2]IMRB, INSERM U955, Université Paris-Est, Créteil, France
[3]MSC, UMR CNRS 7057, Université Paris Cité, Paris, France
*solene.moreau1@etu.u-paris.fr

Compartmentalized microfluidic chips have changed our way to study the nervous system and screen drugs. They now play an important role in the understanding of the cellular mechanisms involved in peripheral nervous system disorders and demyelination.. [1] Most of the microfluidic chips for cell culture are made of polydimethylsiloxane (PDMS), yet they present limitation in terms of fabrication, assembling and biological modeling. Easy to prototype and to translate, soft thermoplastic elastomers (sTPE) have emerged as an alternative material for on chip biology with a potential for cell biology to explore. sTPE are less expensive than PDMS and present an easy scale up for commercial or industrial purposes. [2]

Here, we develop the first sTPE compartmentalized device and compare it to a standard PDMS one, and grow embryonic Dorsal Root Ganglia (DRG) explants in standard well plates compatible with high content screening microscopy (HCS) (Fig.1A). We emboss a FDA approved copolymer of polystyrene and ethylene/butylene. This material has a Young modulus of 1.15 MPa, close to PDMS, is transparent, flexible and stable to treatments such as oxygen plasma and coating. We exploit its bulk properties for fast prototyping (less than 10 min/chip) and reversible adhesive bonding allowing easy and accurate manual assembly of two-level architectures. This sTPE is resistant to small particles adsorption and have a low reduced gas permeability, making it an ideal material for biological applications. We demonstrate its capacities on DRG cultures from mouse embryos in a well suited axisymmetrical design, with no impact on the axonal growth or the cell viability (Fig.1B). After more than 1 month of culture, we are able to open the chip without damaging the cells to realize direct analysis using atomic force or scanning electron microscopy (Fig.1C). After a simple washing and sterilization procedure, the chips can be re-used up to five time without impacting its bonding or the viability of the cells. The sTPE microfluidic chip paves the way to an alternative way of prototyping compartmentalized devices, widening their field of applications and making their manufacturing more accessible and sustainable.

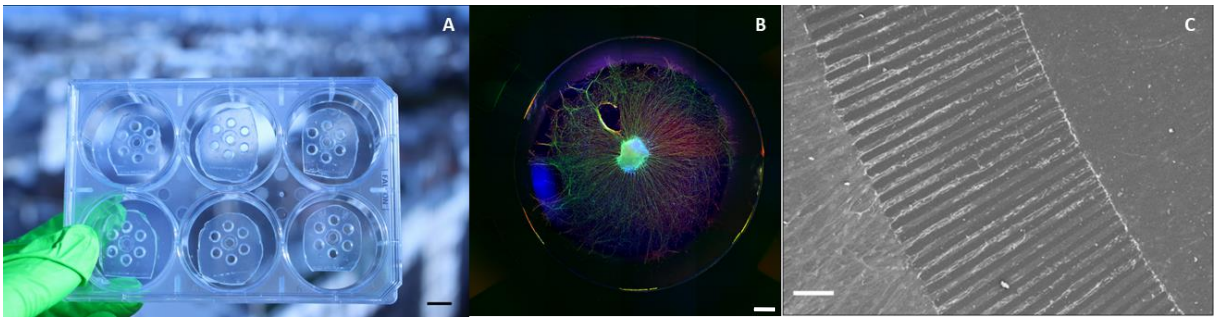


Figure 1: (A) sTPE compartmentalized chips in a standard well plate for HCS, scale=1cm (B) DRG explant at DIV3 inside a sTPE microfluidic chip, nuclei (blue), neurofilaments H (green), neurofilaments M and H (red), scale=500µm (C) SEM picture of aligned axons after opening of the microfluidic chip, scale=100µm

[1] S. Hyung, S.R. Lee, J. Kim, N.L. Jeon., *A 3D disease and regeneration model of peripheral nervous system–on–a–chip*, Science Advances, 7, n°5 (2021)
[2] H. Salmon, M. R. Rasouli, N. Distasio, M. Tabrizian, *Facile engineering and interfacing of styrenic block copolymers devices for low-cost, multipurpose microfluidic applications*, Engineering Report, **3**, n°7 (2020)