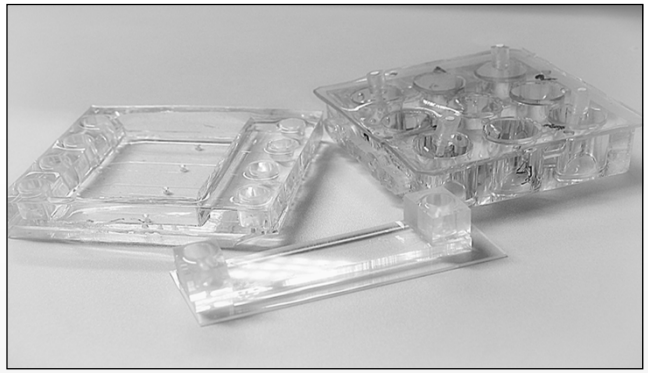
Bio-microreactors for cell cultures



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Practical advantages of perfusion microfluidic culture systems systems over traditional static cultures:

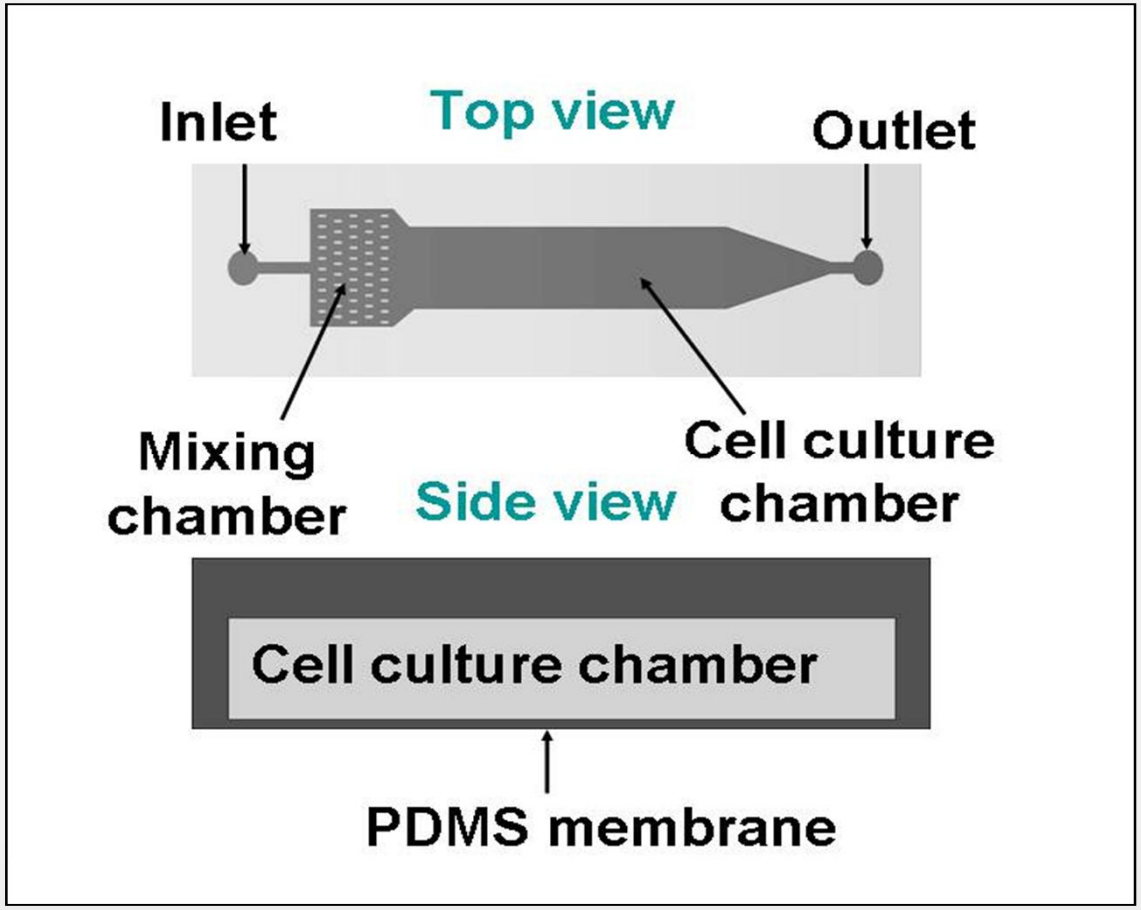
- Provide the cells with favorable physico-chemical conditions by continuous delivery of nutrients and removal of waste metabolites away from cells.

- Perfusion enhances mass transfer and provide the cells with specific biochemical and/or physical stimuli.

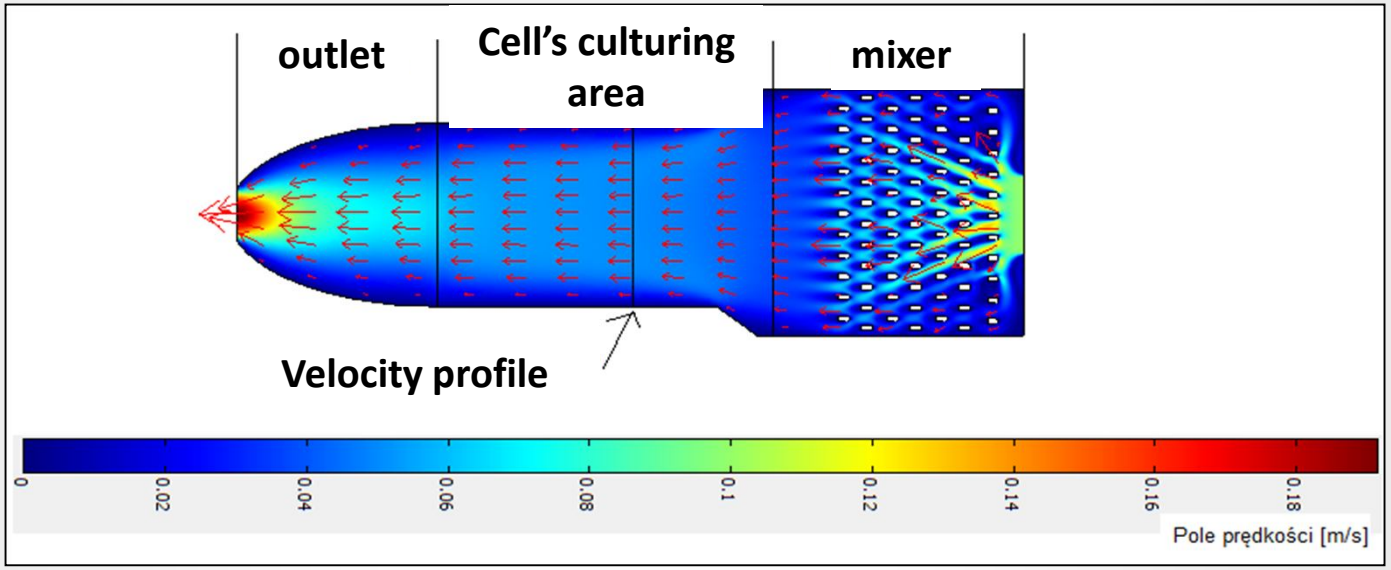
- Automatic perfusion eliminates the need for periodic media exchange.

- Miniaturization allows to diminish amount of reagents used and in consequence reduce total costs of experiments.

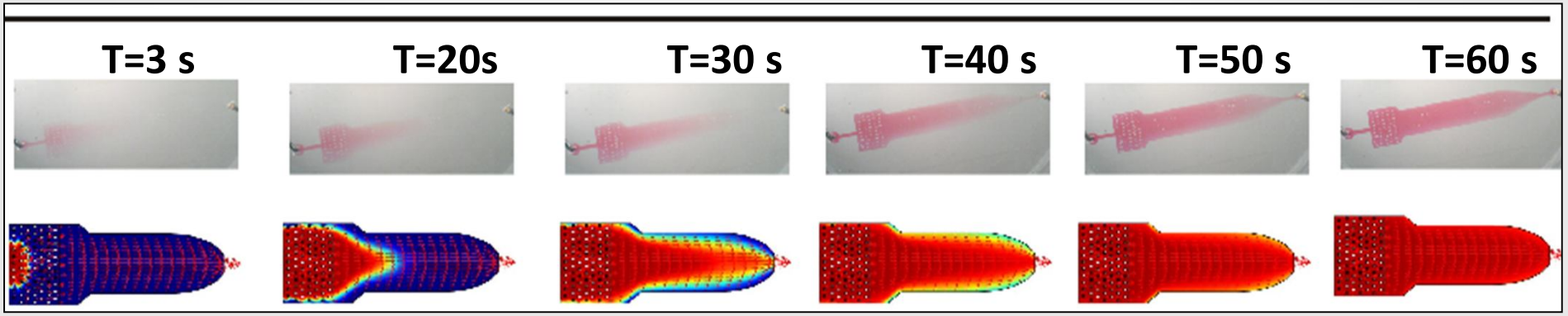
Novel planar microreactor for hepatocytes



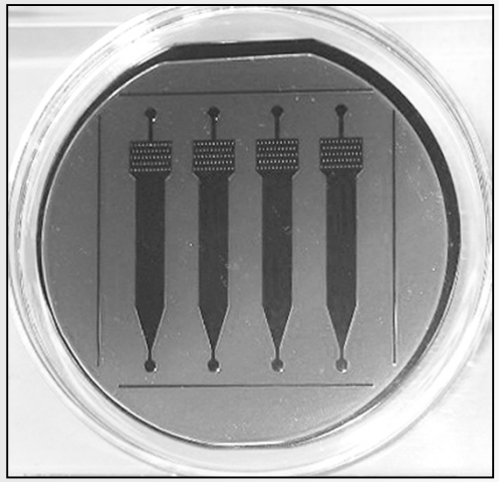
Computational modeling of fluid dynamics

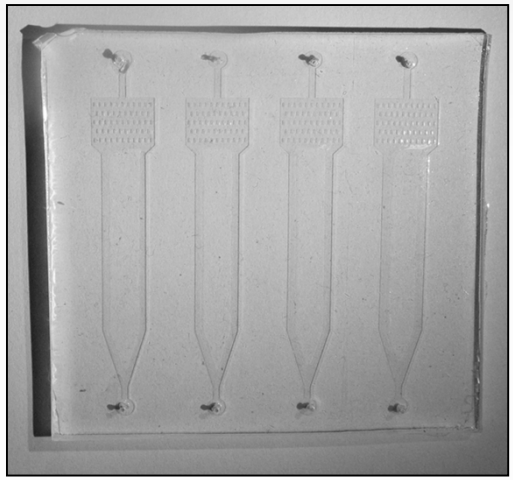


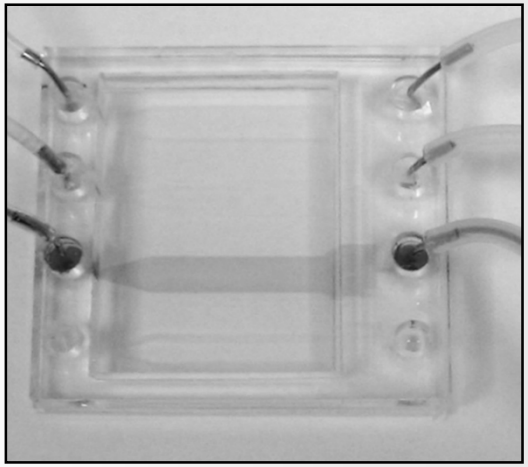
Flow rate = 5 µl/min

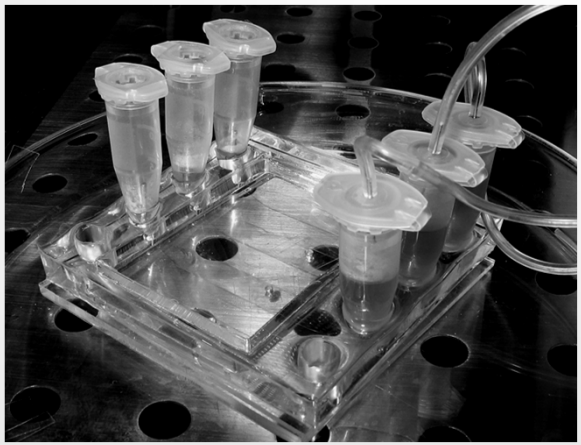


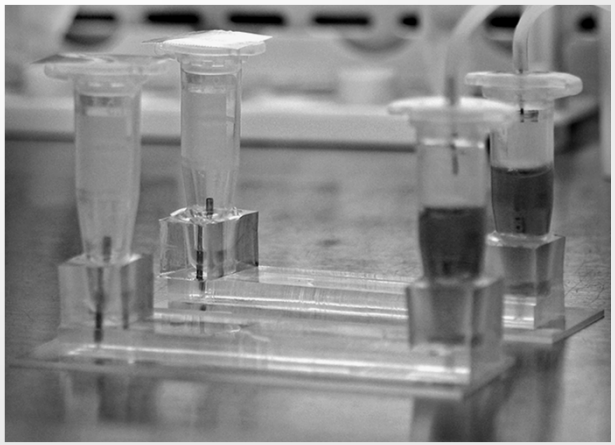
Fabrication of microreactor





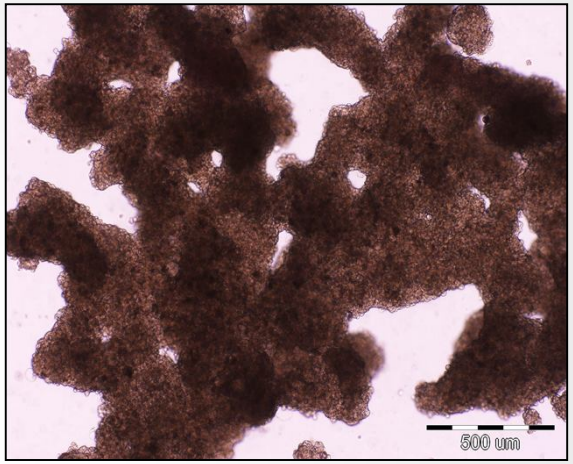




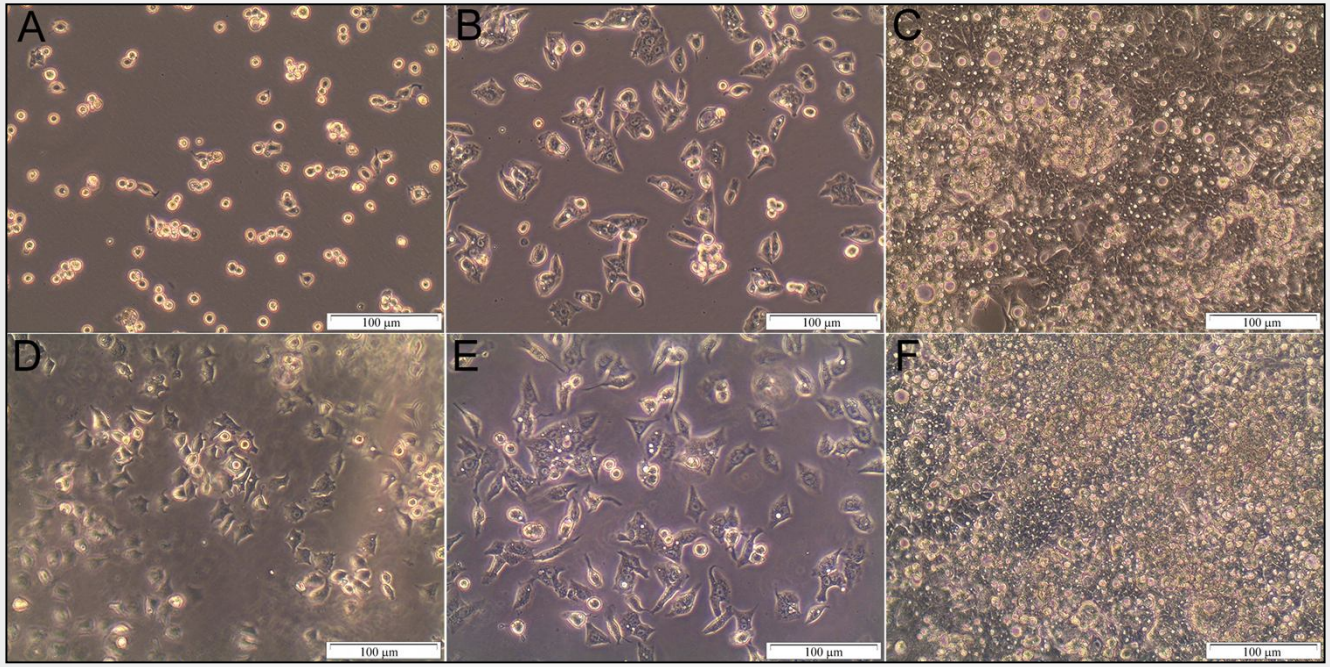


Modification of PDMS surface

- Covalent modification
- Plasma exposure
- Coating with polyelectrolyte multilayer
- Coating with extracellular matrix (ECM) proteins (collagen, fibronectin)
- Chemical vapour deposition



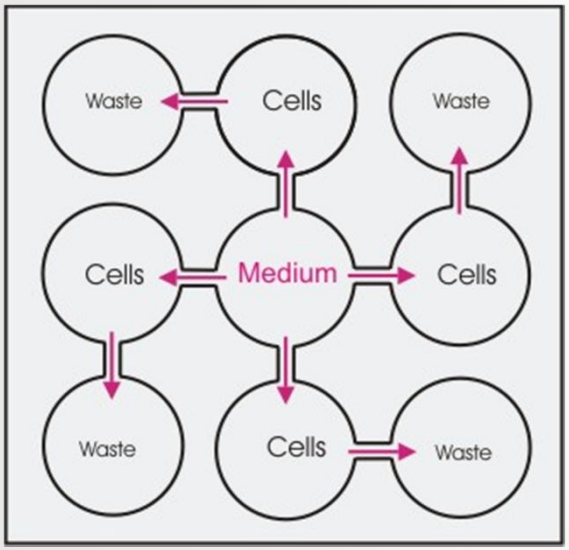
Culture of hepatoma derived C3A cell line in collagen coated microreactor

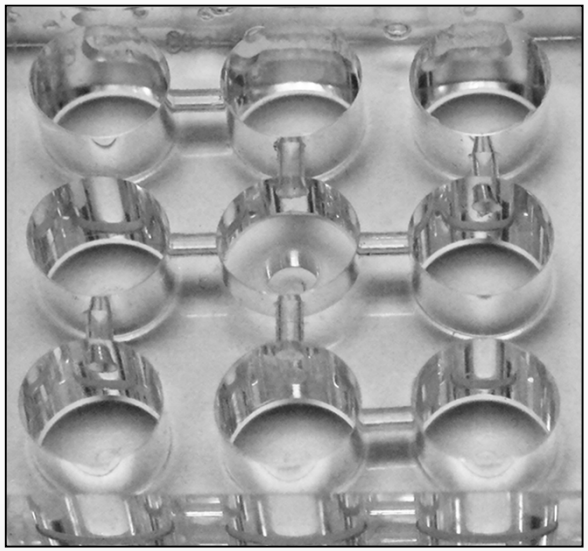


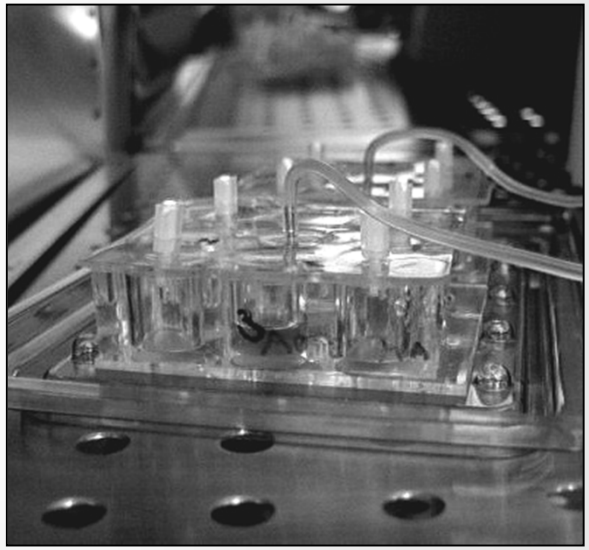
N/No = 7.94 ± 1.51 x (7 days)

Conclusion: Successful growth of C3A cells in our membrane-based biorector provides evidence that the device meets the requirements of hepatic cultures and positively validates its design.

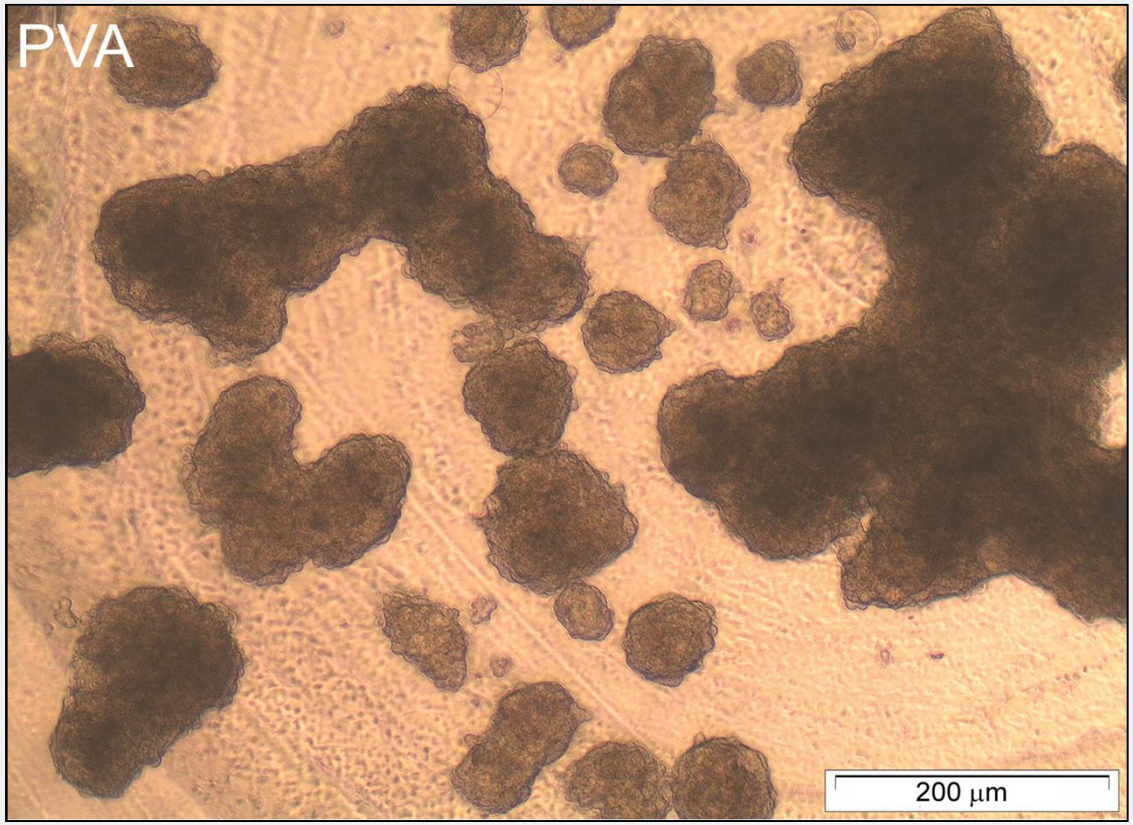
Perfusion bioreactor for culturing adherent and suspension cells







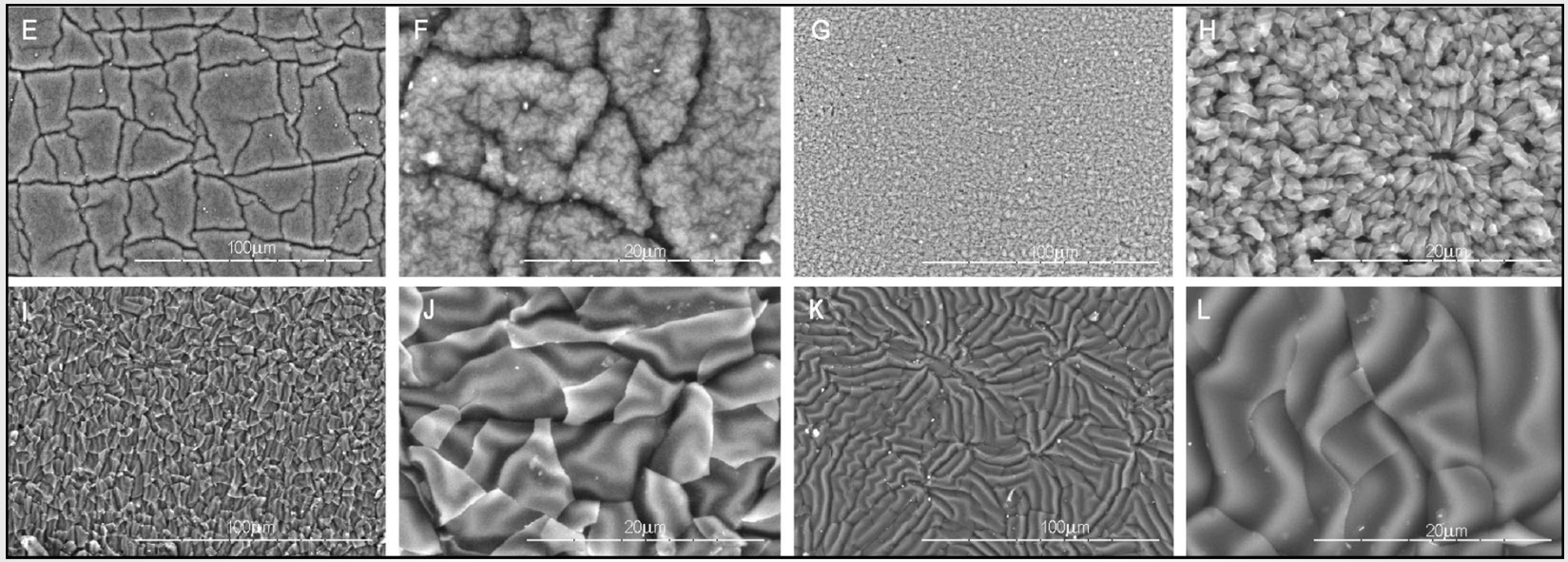
Suspension culture of C3A cells



Static condition: N/No = 12 ± 0.94 x (7 days)

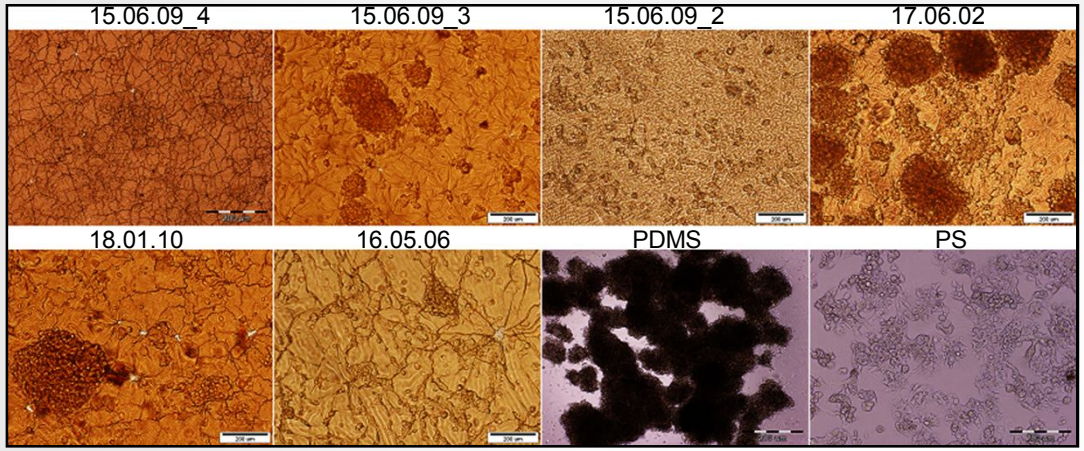
Perfusion: N/No = 21.3 ± 2.03 x (7 days)

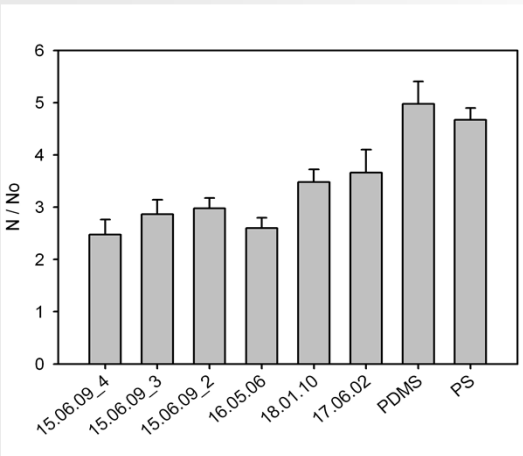
Culturing cells on diamond-like carbon coated PDMS

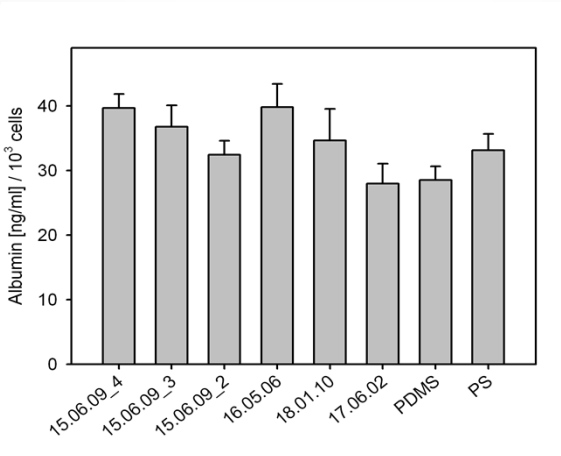


Aim: to test various DLC films deposited on PDMS to influence morphology and proliferation of three selected cell lines: human hepatocyte cell line (C3A), human osteoblast cell line (HOS) and human embryonic kidney cell line (HEK293).

Culturing C3A cells on DLC layers





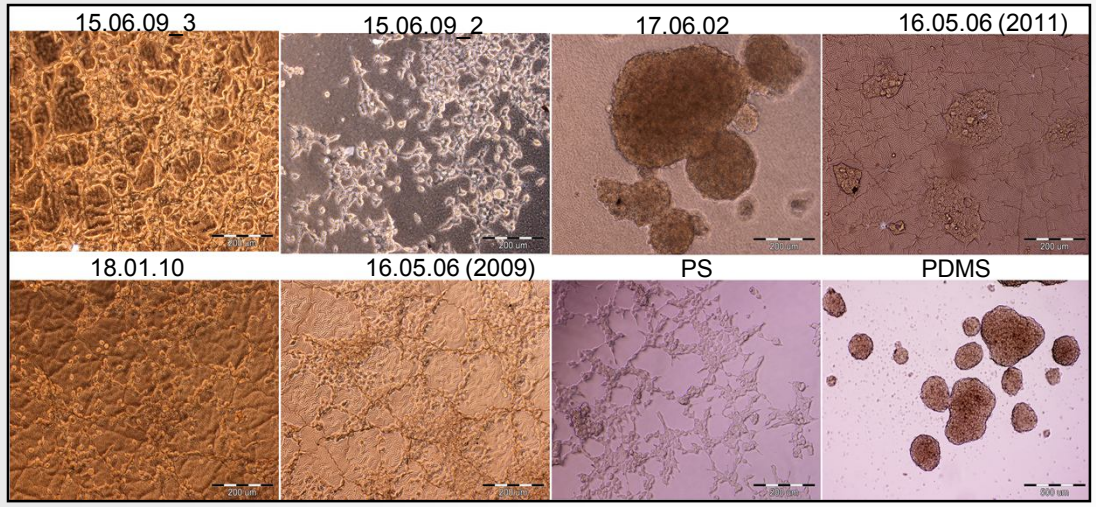


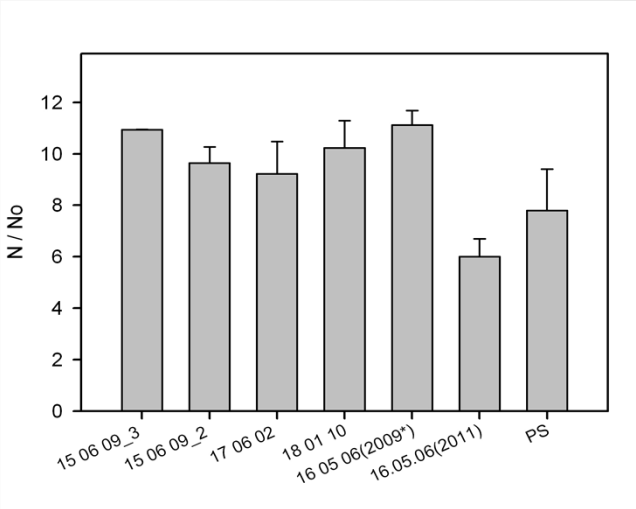
- On various DLC layers, cells displayed, specific morphology that was manifested by either, preferential aggregation into surface-attached 3D structures, or by spreading over the substrates.

- Proliferation of C3A cells on DLC coatings was inhibited by 20-50% in comparison to the control culture on the standard polystyrene plate.

- Hepatocytes cultured on DLC layers exerted higher functional activity as far as albumin production is concerned.

Culturing HEK cells on DLC layers

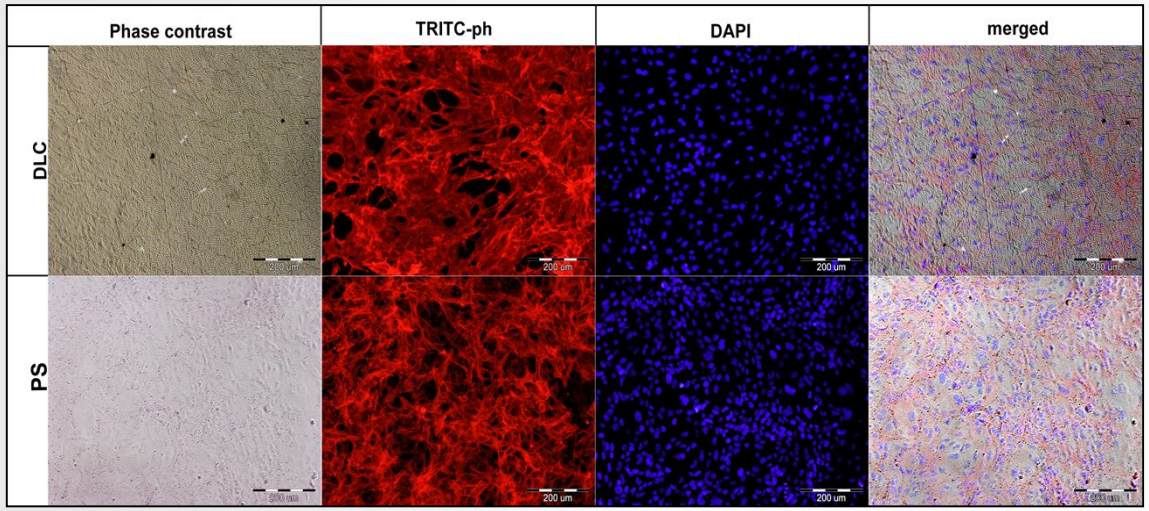




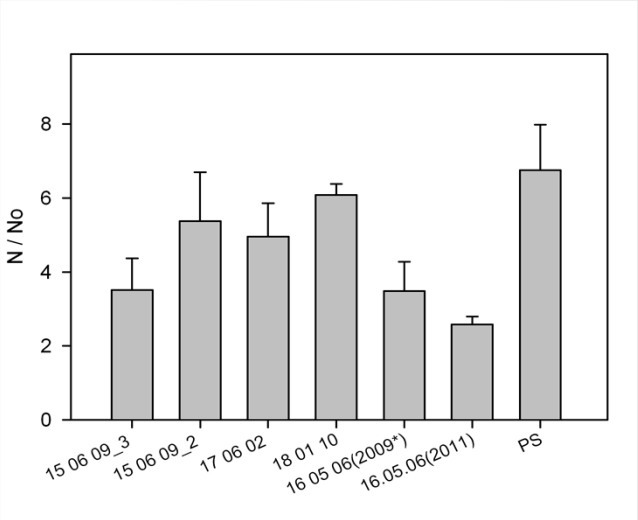
HEK cells spread well on most tested DLC films (Fig. 3A). The one exception was the sample 17.06.02 that, similarly to PDMS, induced formation of large cellular aggregates.

Proliferation of HEK cells was better on DLC than on polystyrene plate.

Culturing HOS cells on DLC layers



Osteoblastic HOS cells easily attached and spread out on all diamond like carbon coatings, and no morphological differences were observed between the cells cultured on DLC samples and polystyrene.



Comparing to polystyrene, most of the tested DLC films had antiproliferative effect on HOS cells.

Conclusions

- Cellular responses to diamond-like carbon coated PDMS are cell type specific.
- In view of the fact that there was no significant differences in the wettability of majority tested DLC samples, most likely their topographical features are responsible for the diverse effects on cellular behavior within the cell type.
- DLC films can alter morphology and proliferative activity of cells.

Thank you for your attention.