Title: A HYPOXIA-MAINTAINING PERFUSION CHIP FOR PROLONGED CELL STUDIES

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Keywords:
Hypoxia, body-on-chip, PDMS, 3D-printing, FEM

Abstract
Oxygen is essential for many processes in the human body. For instance, different oxygen levels induce different cellular responses and regulate tissue behaviour. Despite its importance, oxygen is often overlooked in cell studies. Body-on-chip applications involving oxygen control could bring tissue models closer to *in vivo* conditions to better replicate the physiological environment of cells.
The aim of this study is to develop and characterize a microfluidic chip capable of setting and maintaining specific oxygen levels outside of incubator conditions. Additionally, the chip offers the possibility of 2D-oxygen measurements over prolonged periods.
The chip channels consist of a single polydimethylsiloxane (PDMS) piece cast from a 3D-printed mould. It features a medium channel surrounded by a gas channel, separated by a gas-permeable PDMS wall which allows for oxygen exchange between the two channels.
The chip behaviour is studied by applying different oxygen levels and flow rates. Oxygen levels are measured optically under a microscope using a ratiometric oxygen-sensitive sensor.
The chip is able to set hypoxic conditions in 52 minutes when perfused with a flow rate of 4µL/min and is able to maintain set levels with flow rates up to 10 µL/min. These results are mirrored by a finite element method simulation model that achieves similar results and offers more insight into the behaviour of the chip outside the measurement area.
This study combines both medium perfusion and oxygen control in one chip. Its properties are especially useful for, for example, conducting prolonged measurements outside of incubator conditions without disrupting hypoxia.