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Real-time monitoring of oxygen levels within thermoplastic Organ-on-Chip devices

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Abstract:

Organ-on-chip (OOC) systems involve culturing of biological tissues within dynamic and controlled microenvironments, in order to mimic as closely as possible, *in vivo* conditions. PDMS has allowed the majority of the pioneering work in the field of OOC, due to its ease of fabrication. While the high oxygen permeability of PDMS is generally regarded as an advantage, there is growing evidence that this could be a major drawback for OOC systems. The aim of OOC system is to replicate as closely as possible physiological conditions with the human body, such as the oxygen levels, which varies between 0 % and 14 %. PDMS organ-on-chip systems placed within standard cell culture incubators are exposed to hyperoxic conditions, which do not reflect the conditions within the body. In this research paper, we demonstrate the ease of integration of optical oxygen sensors and efficient control of oxygen levels within thermoplastic organ-on-chip systems, compared to their PDMS counterparts. We also demonstrate that culturing spheroids in a thermoplastic microfluidic chip for 4 days does not decrease their viability, despite a decrease in oxygen level, due to oxygen consumption by the spheroids, with time.

Keywords: Organ-on-chip, microenvironment, PDMS, control of oxygen levels, spheroids, thermoplastic microfluidic chip