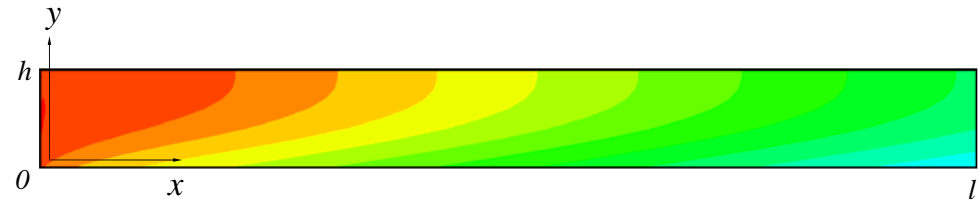


Fluid Flow and Mass Transport in a Microchannel Bioreactor

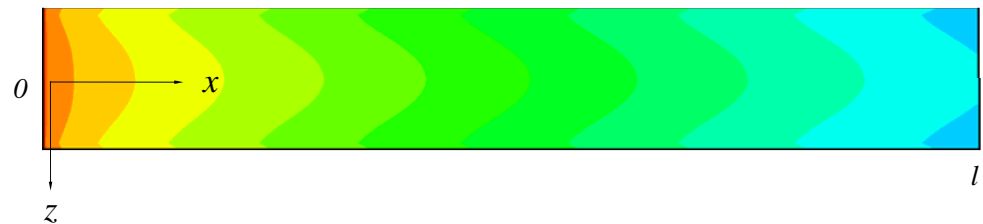
Microchannel bioreactors have been used in many studies to manipulate and investigate the fluid microenvironment around cells. The present study develop a numerical model of the fluid flow and mass transport in a microchannel bioreactor for single culture, randomly mixed co-culture and micropatterned co-culture.

The numerical results of substrate concentration in the single culture bioreactor are well correlated by the combined parameters. The mass transport and shear stress are related in a generalized result. Based on the generalized results and the condition of dynamic similarity, various means to isolate their respective effects on cells were considered.

The study on co-culture considers two different types of cells distributed randomly as a co-culture at the base of a microchannel bioreactor: absorption cells which only consume species based on the Michaelis-Menten process, and release cells which secrete species, assuming zeroth order reaction, to support the absorption cells. The species concentrations at the co-culture cell-base. The numerical results of species concentration at the co-culture cell-base are approximately correlated by the combined parameters. Based on the correlated results, the critical value of the inlet concentration is determined which depends on the effective microchannel length.



Substrate concentration profile in the microchannel bioreactor



Micropatterning of two different cell types based on surface modification allows spatial control over two distinct cell sub-populations. The micropatterned co-culture system has release and absorption parts arranged alternately at the base, and each part has a single cell type. The cells in the absorption parts consume species which are secreted by the cells in the release parts. Different combined parameters were developed for the release and absorption parts to make the data collapse in each part. Combination of the collapse data in the release and absorption parts can be used to predict the concentration distribution through the whole channel. Based on the correlated results, the critical length ratio of the release and absorption parts can be determined to avoid species insufficiency.

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