Increasing Microdialysis Recovery using COMSOL and Microfluidics

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Modeling and Simulation

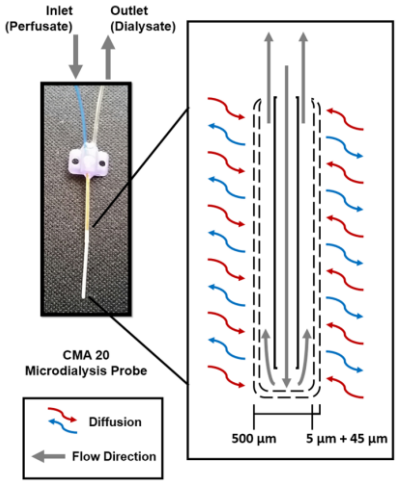
Biological Sensors

Background/Relevance

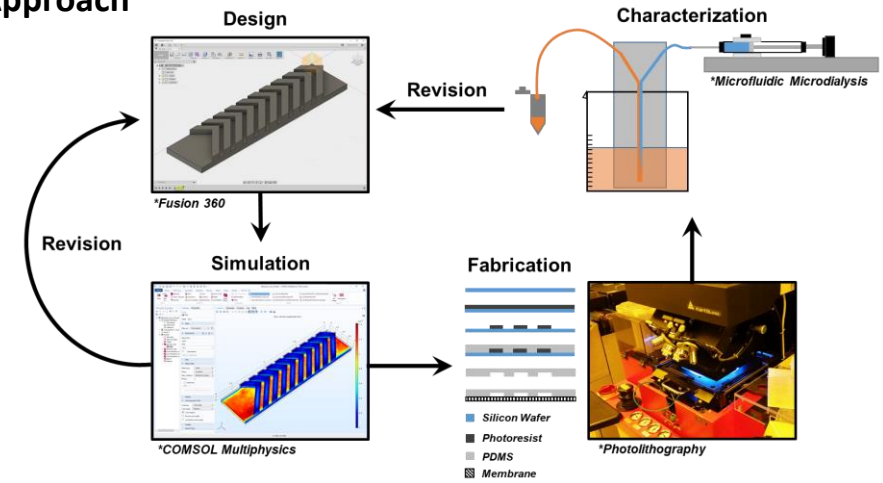
- Microdialysis (µD) – diffusion based sampling technique for in vivo collection.
- Requires extensive in vivo calibration.

Innovation

- Predict µD relative recovery (RR)
- Simulate new µD device with improved relative recovery.

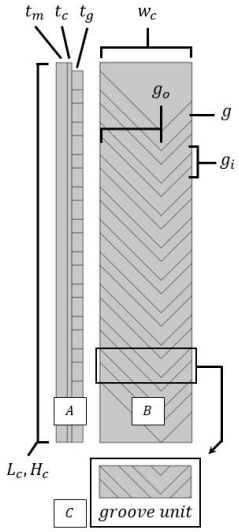


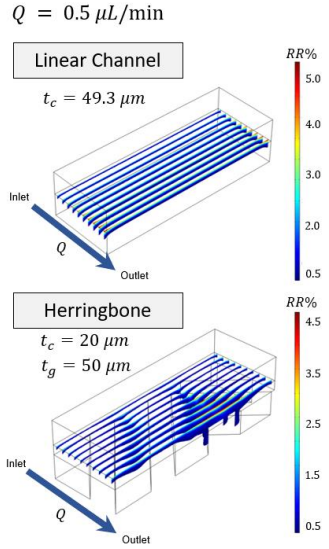
Approach



Key Results

- µD herringbone linear channel simulated with COMSOL
- Concentration boundary layer collapsed without increasing the fluid linear velocity.
- 16.9% increase in RR above simple linear channel.





Conclusions

- COMSOL template µD model developed for *custom* geometries.
- Characteristic length scales for diffusion and advection were optimized for a linear-looped µD probe yielding a 16.1% relative increase in RR at a 1.0 µL/min flow rate.
- Concentration boundary layers were shifted using a herringbone mixer µD probe design with a 16.9 ± 0.7% relative increase in RR over seven different flow rates.
- Linear-looped µD probes can be fabricated in PDMS with in-house fabricated polyethersulfone membranes.

Future Work

- Optimize herringbone geometry for further increases in RR.

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