CHEMOTACTIC DROPLETS FOR MULTIFUNCTIONAL FLUIDIC SYSTEMS

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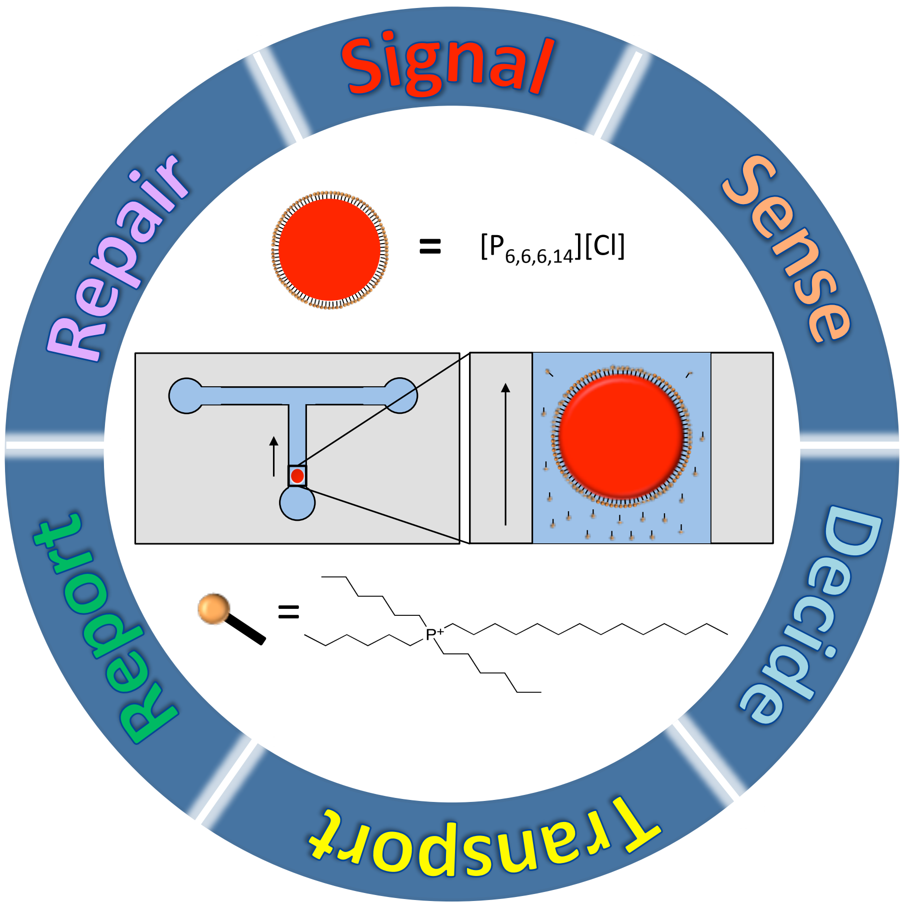
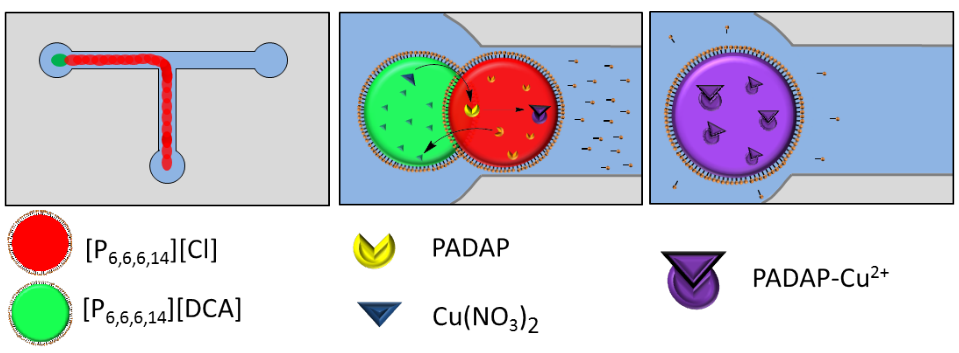
Introduction

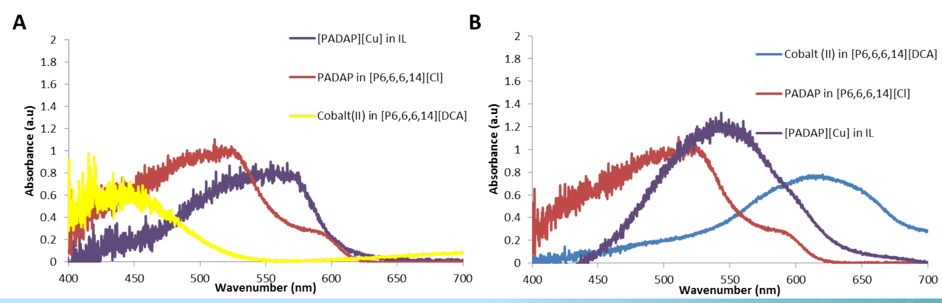
The ability to move in response to an external stimulus is essential for many life forms; this phenomenon is known as chemotaxis and generally cells use this ability to seek out sources of food or flee from toxic substances. Herein we present synthetic analogues based on ionic liquid droplets. Not only do these droplets show biomimetic locomotion, but through the inclusion of functional molecules they can also be used to perform a variety of tasks.



Signal and Seek

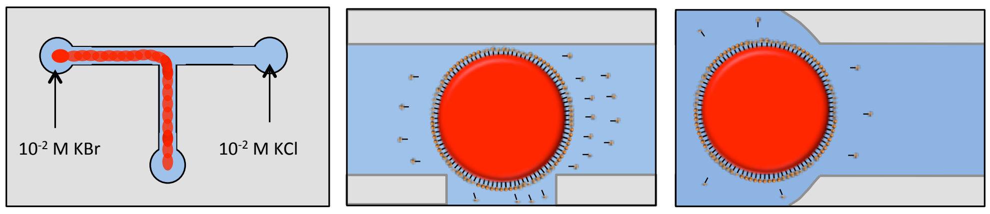
The signaller droplet made of $[P_{6,6,6,14}][DCA]$ ionic liquid releases an ionic chemoattractant ($Co(NO_3)_2$) and remains stationary. When the chemoattractant diffuses towards the seeker droplet $[P_{6,6,6,14}][Cl]$, this spontaneously moves along the concentration gradient and chemo-tactically finds the signaller droplet. Both droplets then merge, enabling specific reactions to occur only at the location of the signaller droplet.





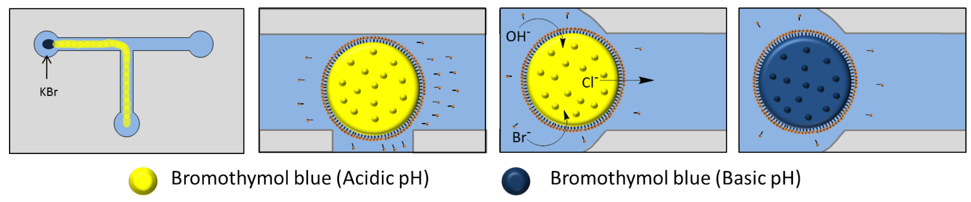
Decide

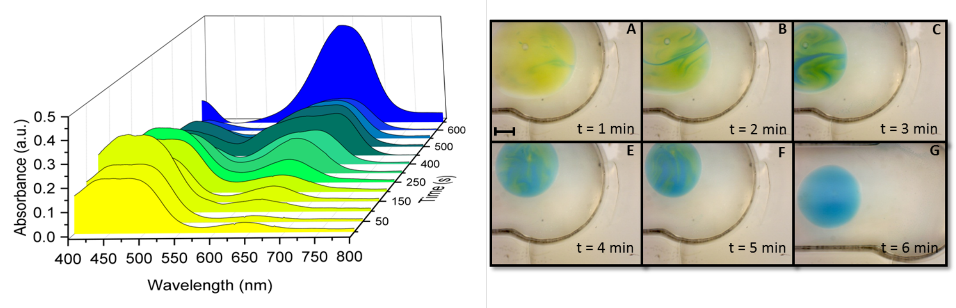
The chemotactic droplets were investigated for their capability to choose between different halides as chemoattractants. The droplets were seen to migrate, with increasing preference, to the source of halide lower down Group 7. This selectivity can be explained by the relative solubility of the $[P_{6,6,6,14}]^+$ in halide salt solutions.



Sense and Report

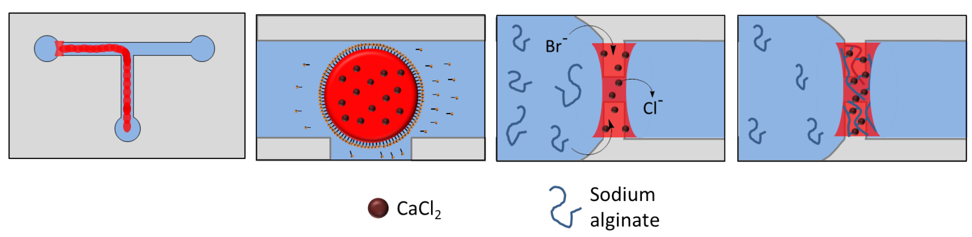
The chemotactic droplets could be made to sense and report information on the solution they were traversing during chemotactic movement. This is due to ion exchange between the IL component and the aqueous solution, resulting in a more permeable droplet/water interface. These droplets are capable of mimicking the ability of living cells to sense and exchange cargo with their external environment.





Transport and Repair

$[P_{6,6,6,14}][Cl]$ IL droplets containing $CaCl_2$ were able to chemotactically find and seal a leak in a fluidic system by crosslinking alginate chains present in the system. This resulted in the generation of a crosslinked hydrogel which sealed the damage.



Conclusion

This work aims to explore new concepts which are inspired by biomimetic models, as a route to deliver fundamental breakthroughs in microfluidic device performance. We envision using these systems to create a new generation of sustainable, low-cost, externally controlled and self-reporting fluidic systems.

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