SELF-PROPELLED CHEMOTACTIC DROPLETS

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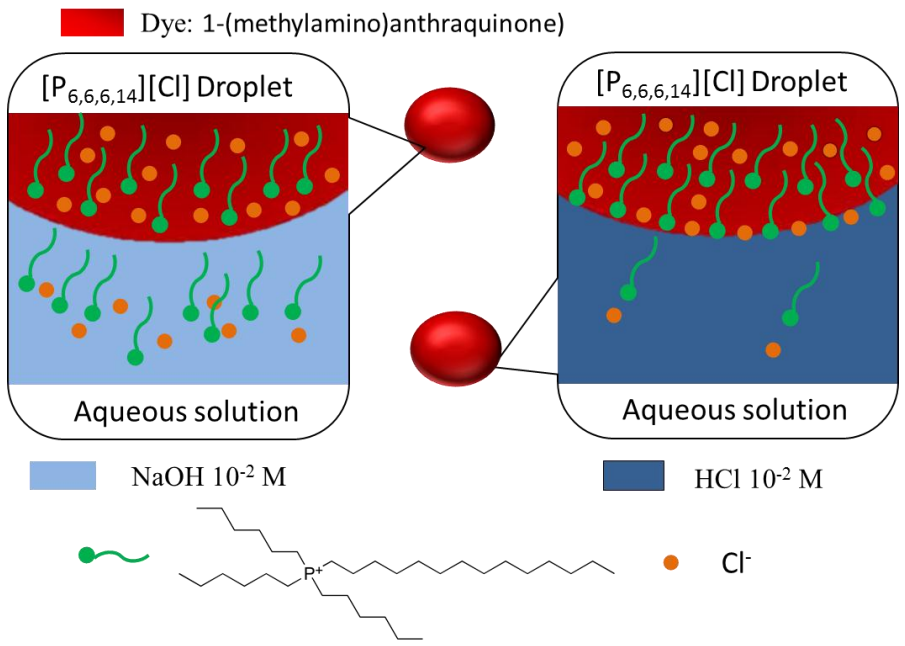
Introduction

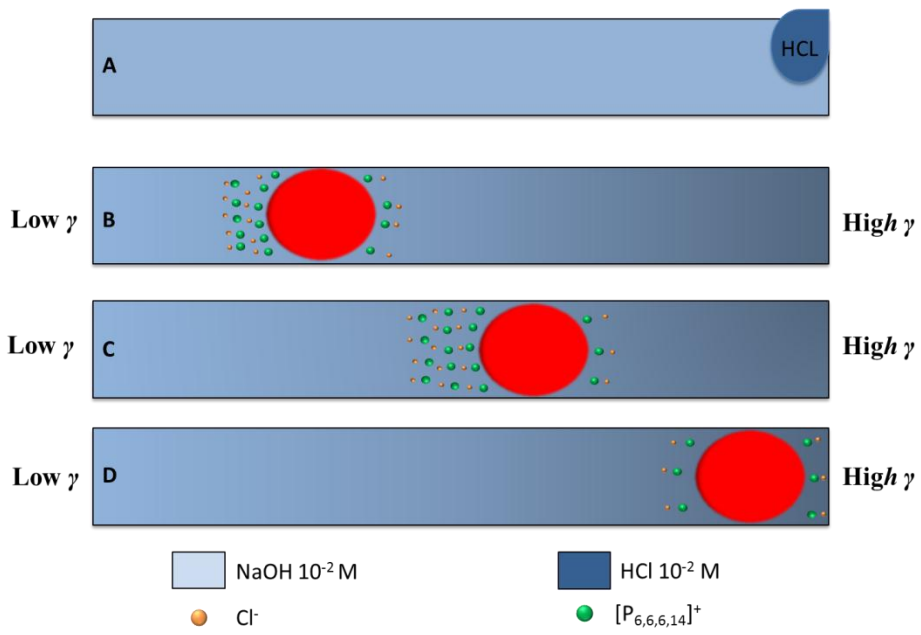
The ability to move in response to an external stimulus is essential for many lifeforms. Certain cells such as bacteria, somatic cells, and other single cell or multicellular organisms move in response to chemical stimuli present in their environment. This phenomenon, known as chemotaxis, is crucial for many biological processes. Notably there are only few equivalents of similar chemotactic-driven “micro-vehicles” in the synthetic world.

Droplet Movement and Composition

The self-propelled chemotactic droplets used in this project were designed to move in an open fluidic channel and were composed of the ionic liquid (IL) trihexyl(tetradecyl)phosphonium chloride ($[P_{6,6,6,14}][Cl]$).

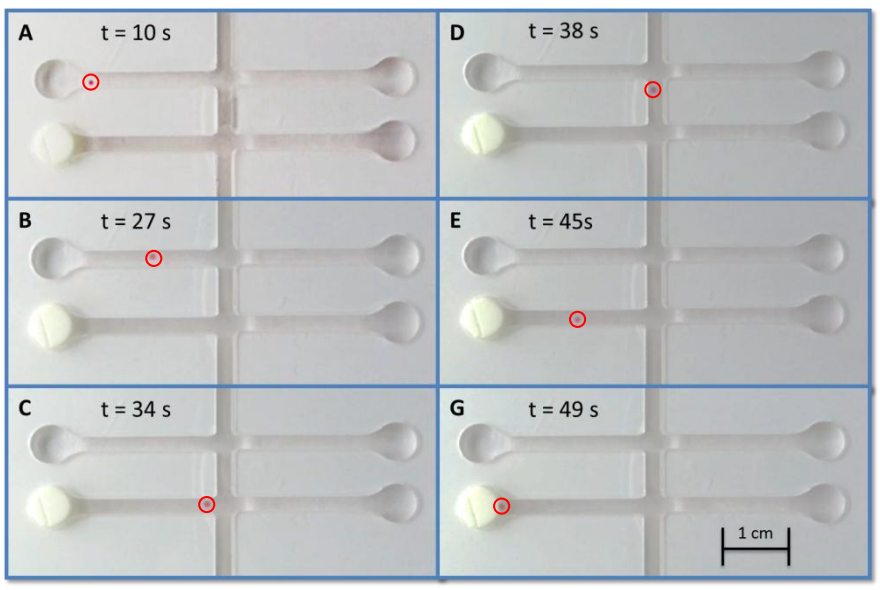


Once released, the $[P_{6,6,6,14}]^+$ surfactant lowers the surface tension of the aqueous solution, thus creating an asymmetric surface tension gradient. This leads to Marangoni like flows which drive the droplet from areas of low surface tension toward areas of high surface tension.



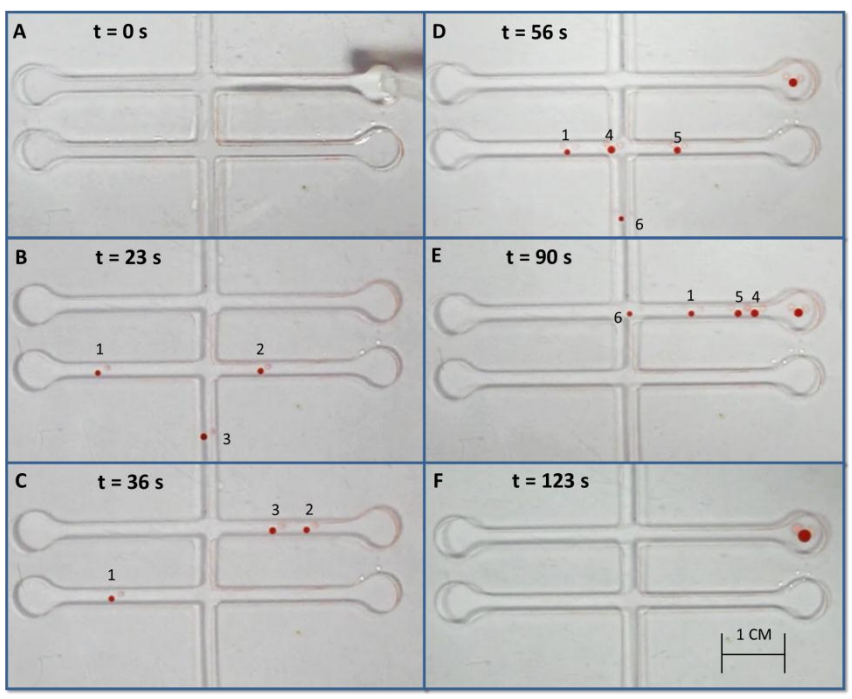
Single Droplet Movement

Controlled movement of a single droplet was achieved by initially filling the channels with a solution of 10^{-2} M NaOH and placing the chemoattractant (a polyacrylamide gel which had been previously soaked in a solution of 10^{-2} M HCl) at the desired destination.



Multiple Droplet Movement

Controlled movement of multiple droplets was achieved by filling the channels with a solution of 10^{-2} M NaOH and placing the chemoattractant (two - three drops of a solution of 10^{-2} M HCl) at the desired destination.



Conclusion

We have shown the chemotactic behaviour of self-propelling single component IL Droplets. These droplets move without any external energy source and can find their way to pre-determined locations by following an appropriate chemical gradient. It is envisioned that these droplets could be used for dynamic sensing, spontaneous directed micro-cargo transport, and as micro-vessels for creating chemical reactions at specific locations.

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