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Abstract: 98O

Investigating biological noise: building a tuneable model system with DNA nanotechnology and droplet hydrogel bilayers

Alexander F. Mason,[1] James P. Gaston,[1] Matthew A.B. Baker[1]

[1] *School of Biotechnology and Biomolecular Science, UNSW, Australia*

At the molecular level, the impact of random thermal fluctuations on biological processes is ubiquitous. Nature has evolved an impressive array of mechanisms to control these stochastic events towards useful biological output. These range from the dampening of cellular noise to stabilize stochastic decisions in the development of neuronal cells to the autonomous motion of DNA walkers. However, reproducing this elegant mode of control in synthetic systems represents a significant challenge.

Random fluctuations will always be present at the molecular level, and instead of ignoring stochasticity or averaging it out, we should view it as an opportunity to engineer more sophisticated biomimetic systems.[1] Here, we present a new platform for the investigation of stochasticity in a biomimetic platform. Vesicle fusion is one of the key processes in the transmission of information across a chemical synapse, and this process can be reconstituted in droplet hydrogel bilayers (DHBs), a water-in-oil droplet system that provides a planar lipid bilayer which is able to be characterized by TIRF microscopy. First, it was shown with readily fusing (oppositely charged) vesicles that vesicle fusion could be characterized in this system. Second, DNA nanotechnology was employed to facilitate vesicle fusion,[2,3] mimicking the way this happens in nature (SNARE proteins). Finally, by tuning the sequence of the DNA strands (and hence the binding strength), we have a simple method to start investigating the effect of random thermal fluctuations (DNA hybridization at an interface) on a larger macromolecular process (vesicle fusion).

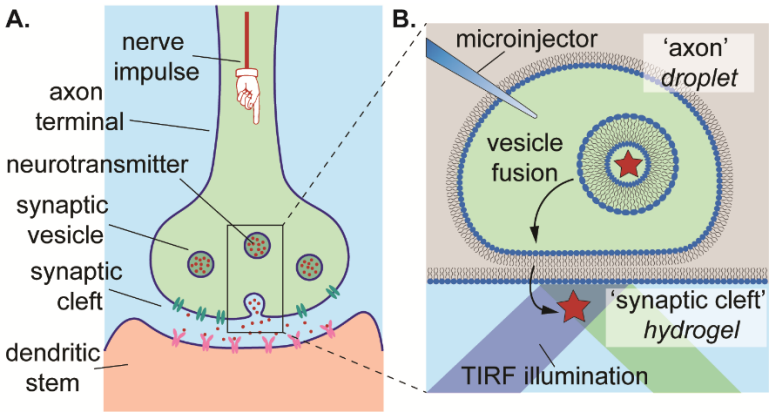

Figure 1: **A**. Cartoon of a chemical synapse, with the focus of this work expanded. **B**. Vesicle fusion is integral to synaptic signal transfer. This can be modelled in a droplet hydrogel bilayer and characterised by TIRF microscopy.

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3. Stengel, G.; Simonsson, L.; Campbell, R. A.; Höök, F. *J. Phys. Chem. B* **2008**