Poster

INTEGRATION OF BIOLOGICAL MOLECULES AND SYNTHETIC MEMBRANES TO CREATE EXCITABLE VESICLES

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The neuron can be considered the brain's fundamental processing unit. There have been numerous attempts to take advantage of the properties of neural networks, including software, replication of similar networks in silicon, and the *in vitro* growth of neurons.[1,2] The recent identification of a number of voltage-gated prokaryotic ion channels has created an opportunity for a new approach to the creation of artificial neural networks.[3,4]

Our group has recently begun a project to utilize ion channel proteins with engineered biomimetic copolymers to replicate some of the functionality of a neuron. This interdisciplinary project integrates contributions from molecular biology, synthetic chemistry, and mathematical modeling. The goal is the creation of an excitable vesicle (EV) capable of generating an action potential using trans-membrane ion flow, similar to a biological neuron.

Sodium and potassium ion channels can be overexpressed and purified from *E. coli*. They can then be reconstituted into sub-micron polymer vesicles which mimic the natural cell membrane. Ultimately, EVs may be used to analyze ionic current behavior in very small volumes and may eventually be used to create networks which enable the study of emergent properties in complex systems. We will present the current progress on the biological and integration aspects of the project.

References:

[1] Hopfield JJ, Brody CD. What is a moment? Transient synchrony as a collective mechanism for spatiotemporal integration. Proc Natl Acad Sci USA 98(3), 1282-1287 (2001).

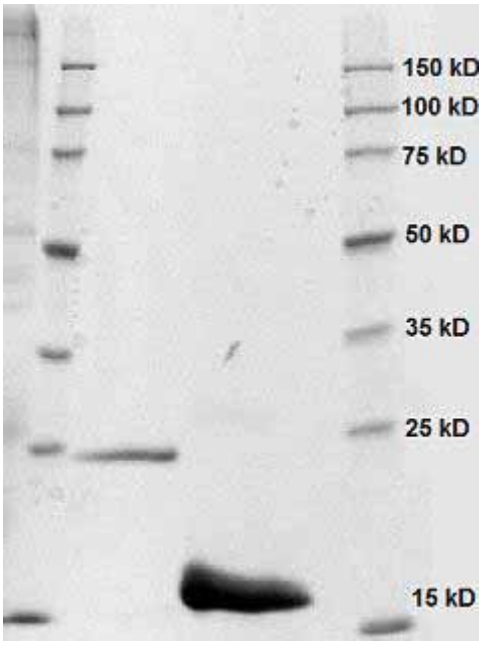
[2] Mead C. Analog VLSI and Neural Systems. New York: Addison-Wesley Publishing Company, 1981.

[3] Ren, D, Navarro B, Xu H, Yue L, Shi Q, Clapham DE. A prokaryotic voltage-gated sodium channel. Science 294(5550), 2372-2375 (2001).

[4] Ruta V, Jiang Y, Lee A, Chen J, MacKinnon R. Functional analysis of an archaebacterial voltage-dependent K+ channel. Nature 422, 180-185 (2003).

Figures:

Figure 1:



SDS-PAGE gel showing purification of NaChBac Na^+ channel (left lane) and KcsA K^+ channel (right lane).