Miniature Electronic Dynamic Ion Channel Sensor (MEDICS)

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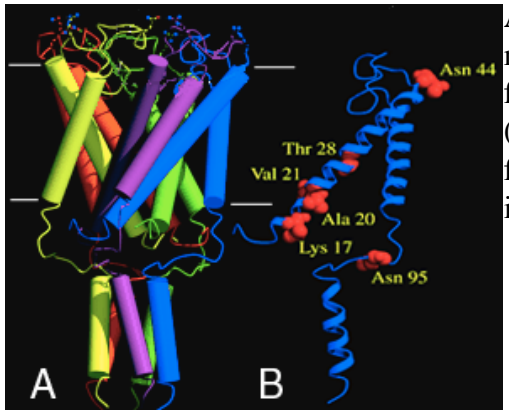
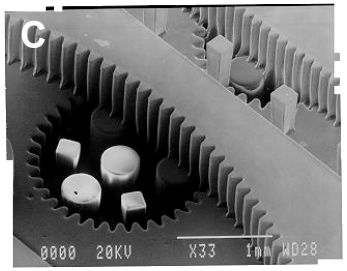


A. 3-D schematic of a bacterial mechanosensitive channel as it fits across the cell membrane (white lines). **B.** Important sites for targeted mutations have been identified.



C. Microstructures built from photosensitive epoxy will provide stable packaging for the channels.

Description

- This proposal will develop bacterial transmembrane ion channels into biosensors by stabilizing them in a physically supported lipid bilayer across a micromachined aperture.
- Ion channels will be mutated to yield desired specificities.
- The device will be tested for stability, specificity, reproducibility, and signal-to-noise.
- The eventual goal is an array of channels with heterogeneous sensitivity to amino acids, sugars, and other compouds. This will be useful for *in vivo* monitoring of diabetes, neurological conditions, and some cancers, as well as in *in vitro* models of disease.

Innovative Claims/NASA Significance

- Use of an embedded agarose gel to prevent drying out and to provide mechanical strength is a significant contribution.
- Mutation of bacterial channels makes use of new breakthroughs in high-throughput screening.
- Developing a useful biosensor based on ion channel proteins found the cell membranes is likely to eventually lead to an extremely sensitive and specific device: single channel molecules responds to single agonist molecules with a signal of 10-100 picoamps, with background noise of <0.5 pA.
- Small, stable biosensors may prove useful for monitoring astronaut health and/or spacecraft environments and for *in situ* life detection.

Plans

Biology

> Develop a technique for high-throughput screening of mutant channels

>Create a self-assembling bacterial ion channel with engineered sensitivity to a biologically relevant ligand, such as a metal ion, intracellular messenger, peptide, or amino acid

>Refine techniques for purification of milligram amounts of engineered channel

Engineering

•Establish expression of ion channels in agarose-embedded structure

•Miniaturize the gel wells and create an array of 8-16 wells on a single chip

•Couple the array to electronics; take and analyze electrophysiological data