Ultrasensitive, Ion Channel-Based Sensors

Tech ID: 19190 / UC Case 2008-006-0

BACKGROUND
Detection and quantification at the level of single molecules is the ultimate goal of analytical assays. This sensitive, platform technology could transform diverse fields, from environmental monitoring and medical diagnostics to the fundamental studies of chemical and biochemical processes. The early potential of synthetic, ion channel-forming peptides was not realized; one factor of many has been the inability to translate the technology to low cost, large scale production of stable and portable devices. The absence of generalized modalities for sensing a broad range of analytes left few incentives to clear the hurdles.

TECHNOLOGY DESCRIPTION
UC San Diego researchers developed proprietary compositions of matter and methods for synthesizing exquisitely sensitive, ion channel-based nanosensors. Two different synthetic building blocks give ready access to a wide range of ion channel-based sensors that respond to specific and tailored external stimuli. These novel ion channels are extremely stable and the approach has been validated by the detection of selected chemical transformations, protein-ligand interactions, and enzymatic reactions. The nanoscale characteristics of these probes enable the development of highly sensitive assays in a low cost, portable format and the ability to design miniaturized devices may also enable the development of parallel assays in a high density platform.

ADVANTAGES
Ion channel-forming peptides are particularly attractive as a practical, molecular platform for development of nanoprobe technologies. Advantages include their:

- Ability to sense a wide variety of external factors, including the presence of ligand-binding proteins, chemically and biochemically reactive agents, light, pH or electrolytes.
- Availability from commercial inexpensive sources and their amenability to large scale production.
- Spontaneous, self-incorporation into membranes, i.e., direct dissolution in aqueous solution vs. reconstitution into bilayers by proteoliposome fusion.
- Compatibility with user-friendly chemistry, such as “click” chemistry.
- Quantized conductance properties that simplify interpretation of the signal.
- Potential to customize derivatives with distinct conductance properties for specific sensing applications.
- High sensitivity based on amplification of ion flux through a single pore plus low background signal from non-ionic or colored molecules, which make their detection orthogonal and complimentary to existing optical detection platforms.

STATE OF DEVELOPMENT
A robust and well-characterized, proprietary, synthetic method has been used to generate ultra-sensitive sensors. Two of these ion channel-based building blocks (carrying reactive amine and azide functionalities) have been modified by versatile “click” reactions to yield sensors that:

- Respond to specific, programmed wavelengths of light.
- Detect chemically reactive analytes and potential biowarfare agents in solution.
- Probe the activity of membrane active enzymes.
- Quantify the binding and activity of specific proteins in solution at pH concentrations.

INTELLECTUAL PROPERTY INFO
See issued patent, below, for “Novel Ion Channel-Forming Peptides.”

RELATED MATERIALS
http://yangserver.ucsd.edu

PATENT STATUS

<table>
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<tr>
<th>Country</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,586,369</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- pH-"Tunable" Nano-Particle Drug Delivery System
Lead Compounds for Diagnosis and Therapy of Alzheimer's Disease

Fluorescent Amyloid Binding Agents for Diagnosis of Alzheimer's Disease