Fast Near Infrared Probes for Optical Electrophysiology

SUNY Upstate Medical University is actively seeking a partner to commercialize improved infrared probes for electrophysiological probing of tissue, especially thick tissue.

Current problem
Optical imaging of myocardial tissue is traditionally done by using either branch electrodes, or high voltage sensitive dye. Both of these mapping procedures have significant drawbacks. Using branch electrodes to map the myocardial tissue is problematic because several needles have to be inserted into the heart, causing damage to heart muscle. Furthermore this method yields inconsistent measurements due to the size and displacement of the needles from one another. Current high voltage sensitive dye is problematic because it cannot penetrate thick tissue at depth. Furthermore the excitation wavelength of the current dyes is in the same range wavelength that blood and tissue typically absorb (450-550 nanometers). This results in low image quality even with a very high light intensity.

Upstate’s solution
Upstate’s new probe is in the styryl class of dyes, developed with researchers at the University of Connecticut, but can be used to image thick tissue at a greater depth than current styryl-class dyes. The new dye fluoresces at a wavelength range of 700 to 900 nanometers, which significantly reduces interference from biological tissue so a clearer image can be obtained, is able to penetrate deeper into thick tissue than currently used dyes (up to 20 mm), can remain in tissue for 2-4 hours even if it is blood perfused, and have fast response times (responds to membrane potential changes in less than 1 millisecond).

Benefits
• Fluoresces at a near infrared wavelength, thus limiting biological interference
• Probes can penetrate tissue as thick as 20 mm and remain present for 2-4 hours
• Probes have fast (<1ms) response to membrane potential changes
• Probes are non-toxic and can be loaded without any agent or with FDA approved agents.

Publications:
Matiukas et al. “Near Infra-red Voltage-sensitive fluorescent dyes optimized for optical mapping in blood perfused myocardium

Image of a single cell recorded at a 490 nm wavelength.