X-Cite®
Fluorescence Illumination • In Control

Emerging use of LEDs in Optogenetics

Problem

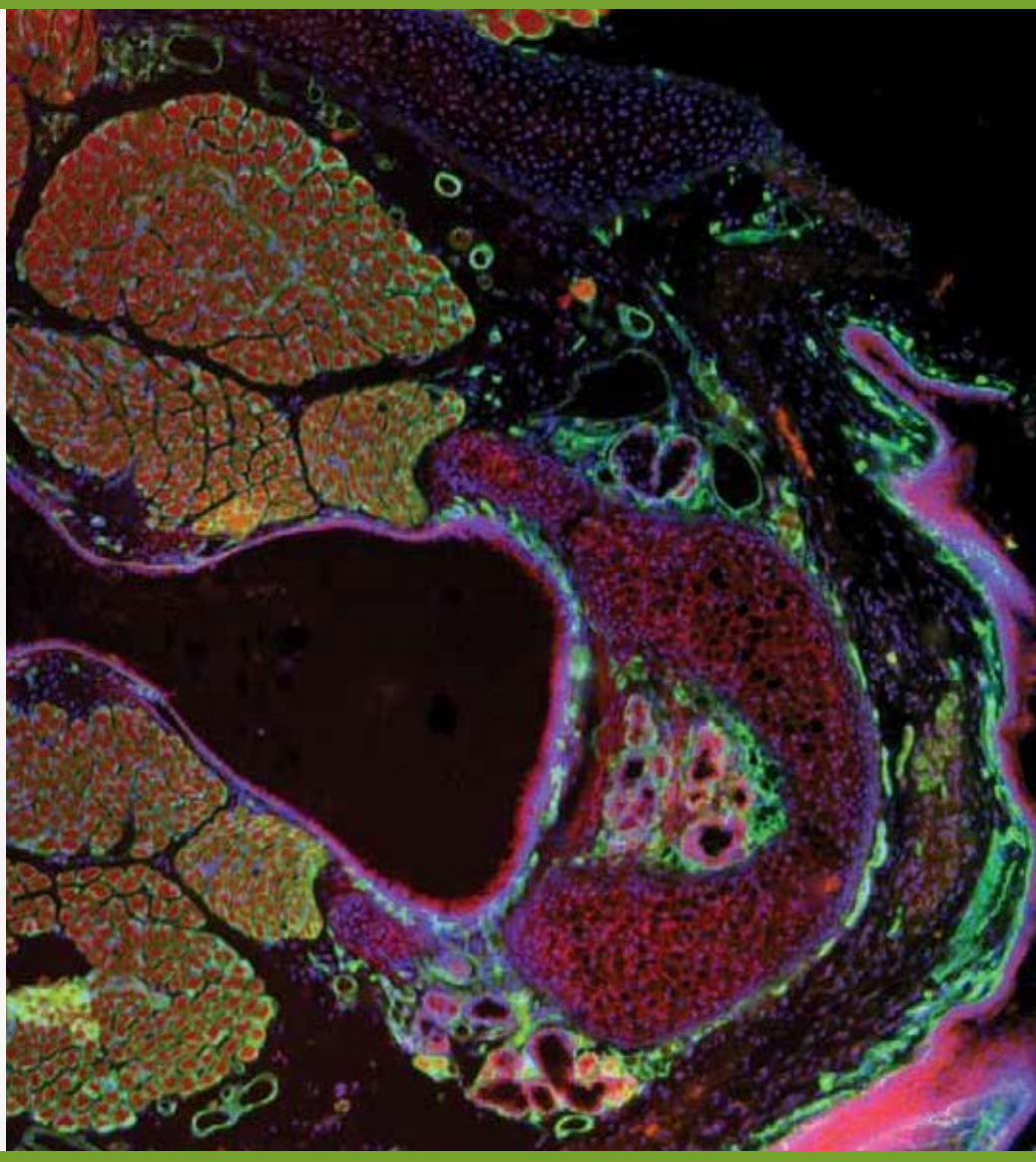
Reliability of using LEDs in Optogenetics

Solution

X-Cite® XLED1 to photoactivate molecular pumps

Benefit

High power LEDs enabling photoactivation or inhibition of optogenetic molecules



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Case Study: X-Cite® October 2011

Introduction

Optogenetic techniques use the power of light in order to inhibit or activate genetically defined populations of cells without affecting the surrounding cells. This technique is widely used to activate or inactivate ion channels and pumps within cells in order to replicate changes that may occur if the channel function is disrupted due to a genetic or environmental change.

Traditionally, optogenetics is conducted using a laser or lamp system as these are known for their high powers. In this recent study, we tested if an LED light source would be able to reliably activate the chloride pump halorhodopsin in embryonic zebrafish.

Methods

Zebrafish at the 19-21 hours post fertilization stage were kept in embryonic fish water in a glass bottom petridish in a dissection microscope. The LED light source used was the X-Cite® XLED1 (Lumen Dynamics, Canada). The XLED1 light guide was pointed toward the fish while fish behaviour was imaged using a high-speed camera. 20s pulses of yellow light (525nm LED) were followed by 20s pulses of green light (460nm LED). Fish were imaged for a few minutes at a time during the illumination period using a Fastec camera (Fastec Imaging, USA) and beating was counted manually.

Results:

Illumination with yellow light (525nm) inhibited spontaneous beating of the zebrafish tail in halorhodopsin expressing fish. Green light (460nm) did not inhibit tail movements. Control fish maintained spontaneous tail movements when illuminated with either yellow or green light.

Discussion

Halorhodopsin expression was controlled by a motor neuron enhancer. In these experiments, we were able to demonstrate that yellow light from an LED source was able to activate halorhodopsin and inhibit motor neuron activity. Inhibition of halorphodopsin was induced in the period of spontaneous activity during zebrafish development.

X-Cite® XLED1

We conclude that yellow light was able to inhibit spontaneous tail movements in fish expressing halorhodopsin but not in control fish.

It is widely perceived that LEDs emit low power which has been the case when they first entered the imaging market. Newer technologies, as well as LED technology, has evolved to where these systems are usable in applications where they may not have been previously considered.

Summary:

This study demonstrates the feasibility of using X-Cite® XLED1 LED sources to activate the optogenetic chloride pump halorhodopsin. The system power was high enough to be able to activate this pump which requires much more energy than other molecular pumps such as channelrhodopsin.

It also indicates that LED sources might be used in other optogenetic studies.

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