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# light engines for a BRIGHTER. GREENER. PLANET.

## LIGHT **BYTES:** October 2016

# Light for Life Sciences and More

Many applications in life sciences and beyond benefit from the integration of spectral, temporal and spatial control of light output provided by Lumencor light engines®. A glance at some recent research publications provides insight into the diversity of these applications.

### Optogenetics: Not Just For Neurons

Although optogenetic stimulation and inhibition are most often used to modulate neuronal function, there are emerging applications in other areas of biomedical research as well. Here are three examples.

#### 1. Protein–protein Interactions

Researchers from Stanford University described the use of *Arabidopsis thaliana* cryptochrome 2 (CRY2) photodimerization with its partner protein CIB1 to control the kinesin-mediated intracellular distribution of mitochondria, peroxisomes and lysosomes. CRY2–CIB1 dimerization was initiated using 200-ms light pulses from a **SOLA SE light engine**.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/25963241

#### 2. Developmental Biology

Mutations in genes encoding potassium channels expressed during embryonic development result in anomalous craniofacial morphogenesis. Adams and co-workers used optogenetic stimulation and inhibition of transmembrane potassium flux driven by a **SPECTRA light engine** to demonstrate that the spatial distribution of membrane potentials ultimately controls the development of craniofacial anomalies in *Xenopus* embryos.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/26864374

#### 3. Calcium Signaling

Researchers at the University of Pennsylvania describe optogenetic control of calcium oscillations in HeLa cells via expression of the photosensitive G protein-coupled receptor melanopsin. They used a **SPECTRA X light engine** for photostimulation of melanopsin at 470 nm and also for excitation of the intracellular $Ca^{2+}$ indicator X-rhod-1 at 570 nm.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/27135540

### Expansion Microscopy

Expansion microscopy (ExM) is a new technique that enables super-resolution microscopy with conventional widefield microscopes by physically expanding the specimen, bringing sub-resolution structures into the diffraction limited resolution range. Boyden and co-workers used a **SPECTRA X light engine** for validation of ExM on cells and tissues with multicolor immunofluorescence and fluorescent protein labeling.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/27376584

### Intravital Imaging

Intraoperative 5-aminolevulinic acid (ALA)-induced protoporphyrin IX fluorescence imaging provides margin definition to guide the surgical removal of tumors. However, the measured fluorescence signal is distorted by light scattering and tissue autofluorescence, potentially compromising complete tumor excision. Sibai and co-workers describe implementation of spatial frequency domain imaging (SFDI) using structured illumination from a **SPECTRA X light engine** coupled to a digital micromirror device (DMD) to generate spectral maps of tissue optical properties, which are then applied on a pixel-by-pixel basis to correct the measured fluorescence image.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/26713206

### Solar Energy

Artificial photosynthesis is the process of converting sunlight into fuels by photochemical splitting of water into oxygen and hydrogen or reduction of $CO_2$ to carbon-based fuels. In pursuit of this objective, dye-sensitized photoelectrosynthesis cells (DSPEC), in which a wide band-gap, nanoparticle oxide film, typically $TiO_2$, is derivatized with surface-bound molecular assemblies for light absorption and catalysis are currently under active development. Researchers from the University of North Carolina at Chapel Hill recently described a second-generation DSPEC that achieves greatly enhanced visible-light–driven water splitting efficiencies. Performance evaluation was carried out using 445 nm light output from a **SPECTRA light engine**.

Reference: http://www.ncbi.nlm.nih.gov/pubmed/25918426

For more recent research publications illustrating the many applications of Lumencor light engines, visit our online **Applications Bibliography**.