HORIZON 2020

Organic Light-Emitting Diodes for Optogenetic Control of Neurons

Berichterstattung

Projektinformationen

NeurOLED

ID Finanzhilfevereinbarung: 703387

Projektwebsite

DOI
10.3030/703387

Projekt abgeschlossen

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EXCELLENT SCIENCE - Marie Skłodowska-Curie Actions

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EU-Beitrag
€ 195 454,80

Koordiniert durch
THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS
United Kingdom

Dieses Projekt findet Erwähnung in ...

Periodic Reporting for period 1 - NeurOLED (Organic Light-Emitting Diodes for Optogenetic Control of Neurons)

Berichtszeitraum: 2016-03-01 bis 2018-02-28

Zusammenfassung vom Kontext und den Gesamtzielen des Projekts

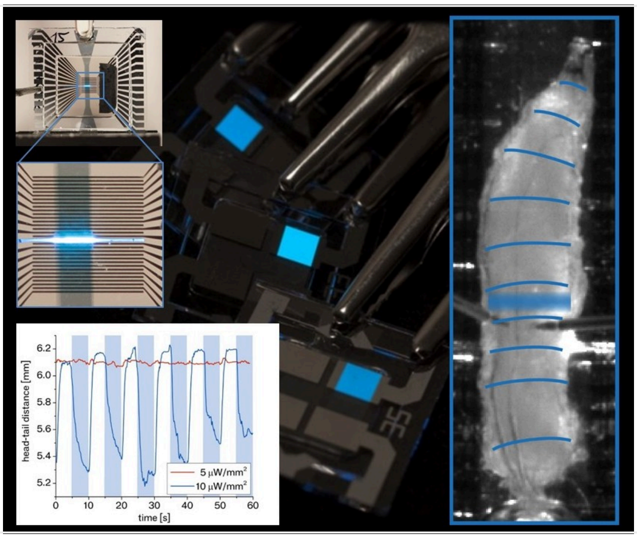
Optogenetics is an emerging technique in neuroscience that allows controlling cells with light. One of the main limitations so far is the low spatial resolution of the available light sources which prevents specific optical targeting of individual cells or groups of cells. Furthermore, the rigidity of the traditional light sources is hardly compatible with soft biological tissue.
The NeurOLED project aimed at developing a new light source for optogenetics based on organic light-emitting diodes (OLEDs). OLEDs are based on extremely thin layers of organic compounds, can be structured to high-density arrays and may be fabricated on flexible plastic foils. Thus, they can overcome limitations of existing light sources and enable high-resolution optogenetic stimulation of cells over both small and large areas.
Due to the high brightness requirements for optogenetics, the harsh aqueous environment, and the need for small pixel arrays – all of which are not standard for OLEDs –, a large part of the project looked at adapting OLED technology for this new application. To demonstrate the usability of OLEDs in optogenetics, neurons were stimulated both in vitro and in vivo.
This project has been highly interdisciplinary, located at the interface of physics, materials science, biophotonics and neuroscience, and successfully established OLEDs as new light source in different environments for optogenetics. This gives neuroscientists a new tool to better understand the brain and allows a more in depth research of neurological diseases.

Arbeit, die ab Beginn des Projekts bis zum Ende des durch den Bericht erfassten Berichtszeitraums geleistet wurde, und die wichtigsten bis dahin erzielten Ergebnisse

A large part of the project was aimed at the development of patterned, high-brightness blue OLEDs. Importantly, brightness levels exceeding 1 mW/mm2 were reached, which is a benchmark for light sources applied in optogenetics. In order to allow future flexible devices and to achieve a good spatial resolution, further research was pursued on improving thin-film encapsulation using atomic layer deposited oxides to protect the organic layers from the aqueous environment of cells.
The developed OLEDs were used to stimulate cultured neurons, and the electrical activity of the cells was monitored optically with fluorescent indicators. A quick response of the neurons to OLED light was observed, demonstrating that OLEDs can achieve the required brightness levels for optogenetics.
Furthermore, structured OLEDs were also applied in vivo to stimulate neuronal networks in Drosophila (fruit fly) larvae. Using light-sensitive proteins, sensory neurons in individual segments of the larvae were both activated and silenced.

Fortschritte, die über den aktuellen Stand der Technik hinausgehen und voraussichtliche potenzielle Auswirkungen (einschließlich der bis dato erzielten sozioökonomischen Auswirkungen und weiter gefassten gesellschaftlichen Auswirkungen des Projekts)

The NeurOLED project demonstrated for the first time that OLEDs can be used to stimulate neurons both in culture and in vivo. For the latter, a structured light source was developed that allowed targeting individual segments of fruit fly larvae and to quickly switch between targeted areas. Through behavioural observations of the larvae, new insight was gained into the neuronal networks underlying Drosophila locomotion (movement). The project is a major milestone on the way towards flexible high-density OLED arrays for precisely controlling large neuronal networks, which ultimately may enable new therapeutic techniques to alleviate neurological diseases such as epilepsy or Parkinson's disease, or to restore vision in blind people.



Structured high-brightness OLEDs used for optogenetic stimulation of fruit fly larvae.

Letzte Aktualisierung: 30 November 2018

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