Introductory Remarks to Symposium 22

Illuminating the brain – current applications and future developments of next-generation biosensors

Olivia Masseck and Lutz Wallhorn, Bremen

Inferring correlations between the activity of neurons within a neuronal ensemble and the behavioral state of the animal is one of the key goals of systems neuroscience. Optical approaches have the necessary spatial resolution to record activity from hundreds of neurons simultaneously. With the development of genetically encoded calcium indicators (GECIs), it was possible to record Ca^{2+} influx (as a proxy for neuronal activity) with high spatial and temporal resolution. This advancement in neuroscience paved the way for a new line of research: Development of new genetically encoded biosensors.
In the last years, genetically encoded fluorescent sensors have emerged as versatile tools for imaging neurochemical release with high specificity and sensitivity. Most of the genetically encoded sensors use a specific G-Protein coupled receptor as sensing moiety fused to a circularly permuted fluorescent protein. Other biosensors are based on periplasmic binding proteins (PBP) from bacteria that have been modified to measure neurotransmitters.
Additionally, genetically encoded voltage indicators (GEVIs) can directly detect voltage changes across the membrane during spiking activity as well as during synaptic transmission. So far voltage imaging has remained demanding because of the fast nature of action potentials (i.e. typical length of 1 ms). However, protein engineering together with high-throughput screening as led to compelling improvements of currently available GEVIs.
As a complement to optical sensors for neural activity, molecules that permit optical control of selected aspects of neuronal signaling permit causal investigations in neuroscience. Photo-switchable tethered ligands have been established in this context as powerful tools to control various receptors with high precision or to obtain information on their activation state. Furthermore, modifying existing optogenetic tools, like ChRmine has potential for clinical use, for example in hearing restoration.

This symposium will cover different aspects of biosensor neurotechnology: from ultrafast neuromodulator and neurotransmitter imaging to all-optical assays and state-of-the-art voltage imaging.

Symposium 22

Friday, March 24, 2023
08:30 - 10:30, Lecture Hall 10

Chairs: Olivia Masseck and Lutz Wallhorn, Bremen

08:30 **Opening Remarks**

08:35 Tommaso Patriarchi, Zurich, Switzerland
NEW OPTICAL TOOLS FOR MONITORING AND CONTROLLING NEUROMODULATOR SIGNALING (S22-1)

09:00 Victoria Hunniford, Goettingen
IN VITRO AND *IN VIVO* CHARACTERIZATION OF IMPROVED CHANNELRHODOPSIN ChRmine VARIANTS FOR OPTOGENETIC ACTIVATION OF THE AUDITORY PATHWAY (S22-2)

09:15 Olivia Masseck, Bremen
NEXT GENERATION GENETICALLY ENCODED FLUORESCENT SENSORS FOR SEROTONIN AND BEYOND (S22-3)

09:40 Andreas Reiner, Bochum
OPTOCHEMICAL APPROACHES TO CONTROL AND SENSE GLUTAMATE RECEPTOR SIGNALING (S22-4)

10:05 Daan Brinks, Delft, The Netherlands
VOLTAGE IMAGING WITH GENETICALLY ENCODED VOLTAGE INDICATORS: DEVELOPMENT AND APPLICATIONS (S22-5)