INSTITUTIONEN FÖR KEMI OCH MOLEKYLÄRBIOLOGI

Development of Electrochemical Biosensors for Neurochemical Applications

Jenny Bergman

Institutionen för kemi och molekylärbiologi
Naturvetenskapliga fakulteten

Akademisk avhandling för filosofie doktorsexamen i Naturvetenskap som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras fredagen den 26 januari, 2018 kl. 10 i föreläsningssal KB, institutionen för kemi och molekylärbiologi, Kemigården 4, Göteborg.

ISBN: 978-91-629-0398-5 (tryck)
ISBN: 978-91-629-0399-2 (pdf)
Tillgänglig via http://handle.net /2077/54578

Development of Electrochemical Biosensors for Neurochemical Applications

Jenny Bergman
Institutionen för kemi och molekylärbiologi, Naturvetenskapliga fakulteten, Göteborgs Universitet

ABSTRACT

The brain consists of billions of cells, including nerve cells, which have the ability of transforming an incoming electrical signal in to a chemical output by the release of neurotransmitters through a process called exocytosis. Malfunction in neuronal communication has been linked to several conditions including Parkinson's disease, schizophrenia, ADHD and autism why a better understanding of neuronal communication is of great importance contributing to increased knowledge about these conditions. For studying neuronal activity with single exocytosis events that occur on sub-millisecond to milliseconds time scale, analytical methods with high temporal resolution is the key. In my research, I have focused on developing miniaturized enzyme-based electrochemical biosensors for the detection of glucose and the neurotransmitters acetylcholine and glutamate. A biosensor is a sensor combining a biological component, here an enzyme, with a transducer part, here an electrode. In this thesis, biosensors based on a carbon fiber microelectrode modified with gold nanoparticles and enzyme have been developed with the aim to improve the temporal resolution of these probes compared to existing technology. By limiting the biosensor surface enzyme coverage close to a monolayer, millisecond time resolution was obtained. With this approach of biosensor design, we were able to detect vesicular release of acetylcholine from an artificial cell mimicking exocytosis as described in paper I, and glutamate release from mouse brain slice which is shown in paper IV. Also, a glucose biosensor able of co-detecting glucose and dopamine with millisecond time resolution has been fabricated as described in paper III. In paper II an analytical method for characterizing the interaction of the enzyme-gold nanoparticle interface was developed.

Keywords: biosensors, electrochemistry, neurochemistry

ISBN 978-91-629-0398-5 (PRINT)
ISBN 978-91-629-0399-2 (PDF)
Tillgänglig via http://handle.net /2077/54578