Minimizing Fouling of Microelectrode For in vivo Measurement

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Resisting biomolecule adsorption onto the surface of brain-implanted microelectrodes is a key issue for in vivo monitoring of neurochemicals. Furthermore, biofouling often triggers foreign-body responses, leading to the formation of a foreign-body capsule surrounding the implanted electrode and thus isolating it from the tissue. This hinders or completely prevents analyte from reaching the electrode and hence inactivates the implanted microsensor, leading to decreased sensitivity and prolonged response time for in vivo measurements. Coating antibiofouling films has proven to be one of the most effective strategies. The antibiofouling film should be bio- compatible and easily coated onto the surface of the micro- electrode.

Towards the goal of minimizing the protein adsorption on the brain-implanted microelectrodes, we found that pre-treatment of carbon fiber microelectrode (CFEs) with bovine serum albumin (BSA) can minimize further adsorption of proteins when the electrodes are implanted into the rat brain. We demonstrate that electrode precalibration in aCSF containing BSA is valid and effective for in vivo measurements. In this case, the electrode/electrolyte interface formed in the medium employed here for electrode precalibration (i.e., in aCSF containing BSA) may be considered to be similar to that formed in real brain environment in short-term in vivo analysis, from the electrochemical point of view. However, this also causes significant sensitivity drop of CFEs to neurochemicals, including DA.

To in vivo tracking of neurochemical dynamics without decrease of electrode performance, we report an ultrathin cell-membrane-mimic film of ethylenedioxythiophene tailored with zwitterionic phosphorylcholine (EDOT-PC) electropolymerized onto the surface of a carbon fiber microelectrode (CFE), which not only resists protein adsorption but also maintains the sensitivity and time response for in vivo monitoring of dopamine (DA). On the other hand, we construct porous structure on the surface of microelectrode through electropolymerizing polyaniline and polytannic acid. As a consequence, the as- prepared PEDOT-PC/CFEs and porous CFES could be used as a new reliable platform for tracking DA in vivo and would help understand the physiological and pathological functions of DA.

References

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