In Vivo Electroanalysis in Brain

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Development of new strategies and methodologies to directly, selectively, and sensitively record chemical signals of neurons during brain functions has drawn increasing attention because information on the dynamics of chemical signals is very essential to understanding the chemical essence involved in brain functions, for example, neurotransmission and diagnosis and therapy of brain diseases. However, the chemical and physiological complexity of the central nervous system (CNS) unfortunately make this pursuit very challenging to the conventional analytical protocols. Aiming at this challenge, we have been working on in vivo electroanalysis in live brain ranging from mechanistic development (mainly with rationally modulating electrode/brain interface) to in vivo understanding brain chemistry (mainly on brain ascorbate). This topic will focus on our recent attempts on electroanalysis in live brain based on rational design and regulation of electrode/brain interface and its application for in vivo understanding brain chemistry with ascorbate as an example.

Typical References

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Bioelectrochemistry and biofuel cells

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Bioelectrochemistry is one of subjects that uses electrochemical approaches to understanding physiochemical properties (typically electron-transfer properties) of biomacromolecules such as proteins and enzymes and applies bioelectrocatalytic concepts to develop bioelectronic devices for sensing and energy conversion. Enzymatic biofuel cells (BFCs) that utilize enzymes as biocatalysts for the conversion of chemical energy into electrical energy represent a new kind of energy conversion technology distinct from conventional fuel cells such as H_2/O_2 and methanol/O_2 fuel cells. Compared with the conventional fuel cells, BFCs can operate under moderate conditions and possess prospective applications as in vivo power sources for implantable electronic devices such as biosensors and pacemakers in human body. In this topic, I would like to present our recent studies on bioelectrochemistry and its application in biofuel cells and in vivo biosensing with several enzymes such as oxidase, dehydrogenases and laccase.

Typical References

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Graphdiyne - Based Electrochemistry

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Graphdiyne (GDY), as a new member in 2D carbon allotropes formed by sp- and sp^2-hybridized carbon atoms, was predicted by Baughman in 1997 and first successfully synthesized on a large area of copper surface by Li *et al.* in 2010. As a novel kind of 2D carbon allotropes, GDY bears the unique butadiyne linkages (−C≡C−C≡C−) in its aromatic matrix. Such a uniqueness has been suggested by theoretical and experimental studies to not only endow GDY with the completely different chemical property, energy band and porous structure but also bring in unprecedented features for various applications, such as photoelectrochemical hydrogen production, lithium storage, dye-sensitized solar cells, oil/water separation. Moreover, GDY is forecasted to be well competitive with ‘‘conventional’’ sp^2-hybridized carbon systems (e.g., carbon nanotubes and graphene) in meeting increasing demand for carbon-based nanomaterials. This topic will focus on our recent attempts on the graphdiyne-based electrochemistry, particularly on how to conduct electrochemical studies and electrochemical biosensing with GDY.

Typical References

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