Accepted Manuscript

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PII: S1001-8417(17)30454-0
DOI: https://doi.org/10.1016/j.cclet.2017.10.037
Reference: CCLET 4310

To appear in: *Chinese Chemical Letters*

Received date: 13-4-2017
Revised date: 26-10-2017
Accepted date: 27-10-2017

Please cite this article as: Jun Ruan, Wenbo Zhang, Hang Zhang, Yun Chen, Fawad Ur Rehman, Hui Jiang, Steffen Strehle, Alberto Pasquarelli, Xuemei Wang, Highly sensitive electrochemical detection of living cells based on diamond microelectrode arrays, Chinese Chemical Letters https://doi.org/10.1016/j.cclet.2017.10.037

Communication

Highly sensitive electrochemical detection of living cells based on diamond microelectrode arrays

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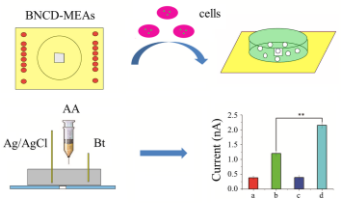
ARTICLE INFOArticle history:*ReceivedReceived in revised formAccepted Available online*

Graphical Abstract



The new boron-doped nanocrystalline diamond microelectrode arrays (BNCD-MEAs) with 16 channels were designed to detect biological signals from some activated cancer cells. Upon recordings of the released H_2O_2 from cancer cells stimulated by ascorbic acid (AA), it can readily detect the reactive oxygen species (ROS) released from target cells, which will be helpful for the cancer cell recognition and also beneficial for further studying the cause of relevant disease.

ABSTRACT
We designed boron-doped nanocrystalline diamond microelectrode arrays (BNCD-MEAs) with 16 channels for the bioanalysis of multicellular samples, which could be readily adapted for a highly sensitive detection of H_2O_2 release from stimulated cells by ascorbic acid (AA). Our observations demonstrated that the as-prepared diamond microelectrode arrays could be utilized to distinguish cancer cells from normal cells, and the amperometric study showed the considerable differences in the currents, indicating that the related HepG2 cancer cells could release more H_2O_2 than that of L02 normal cells. This supports the possibility to use diamond-based MEAs for rapid cancer cell detection in future clinic applications.

Keywords:BNCD-MEAs16 ChannelsBioanalysisStimulated cellsH_2O_2 detection

Boron-doped nanocrystalline diamond (BNCD) shows unique and superior performance in many ways such as biocompatibility, transparency and high chemical as well as electrochemical stability, giving a wide potential window ranging from –2.0 V to +2.0 V, with small background current and corrosion resistance [1-4]. Because of these properties, the BNCD is an attractive material for a wide range of applications. It plays especially an important role in the electrochemical analysis and electrochemical treatment of wastewater [5-7], where the relevant electrochemical analysis includes organic and inorganic detection, biological analysis, trace metal composition detection, and others.

Diamond-based microelectrode arrays (MEAs) [8-9] have been used as a tool in the field of excitatory cell research for many years because of their small sizes and high sensitivity. Meanwhile, reactive oxygen species (ROS), which comprise oxygen anions (O_2^-), molecular hydrogen peroxide (H_2O_2), hydroxyl radicals (OH·), etc. [10], play a crucial role in the generation and development of