Hindawi
Journal of Nanomaterials
Volume 2017, Article ID 3615707, 7 pages
https://doi.org/10.1155/2017/3615707

Research Article

Carbon Nanoparticles Based Electrochemical Biosensor Strip for Detection of Japanese Encephalitis Virus

Huat Choi Lai,[1] Suk Fun Chin,[1] Suh Cem Pang,[1] Magdline Sia Henry Sum,[2] and David Perera[2]

[1] *Department of Chemistry, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*
[2] *Institute of Health and Community Medicine, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*

Correspondence should be addressed to Suk Fun Chin; sukfunchin@gmail.com

Received 28 July 2017; Revised 27 October 2017; Accepted 13 November 2017; Published 18 December 2017

Academic Editor: Rajesh R. Naik

We reported a disposable and sensitive electrochemical biosensor strip based on carbon nanoparticles modified screen-printed carbon electrode (SPCE) for rapid and sensitive detection of Japanese Encephalitis Virus (JEV). Amino group functionalized carbon nanoparticles were prepared from preformed chitosan nanoparticles. Japanese Encephalitis Virus (JEV) antibody was immobilized onto the surfaces of carbon nanoparticles through amide bonds formation between amino groups of carbon nanoparticles and carboxylic groups of JEV antibody. The analytical performance of SPCE electrochemical biosensor strip was characterized using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). SPCE electrochemical biosensor strip exhibited a linear detection range of 1–20 ngmL^{-1} with a low detection limit of 0.36 ngmL^{-1} (at S/N = 3) for JEV, detection sensitivity was 0.024 ngmL^{-1} for JEV, and analysis results were obtainable within 10 minutes. The potential clinical application of this SPCE electrochemical biosensor strip was demonstrated by the detection of JEV in human serum.

1. Introduction

Japanese Encephalitis (JE) is an infectious disease caused by flavivirus viruses that affect human's brain membrane, and it is an endemic in China, India, and Southeast Asia [1, 2]. Currently, the treatment options for Japanese Encephalitis Virus (JEV) are limited and not often successful. Early diagnosis is therefore critical in controlling JE outbreak and preventing the development of long-term serious symptoms in patients [3, 4]. The conventional diagnostic methods for JEV include Enzyme-Linked Immunosorbent Assays (ELISA), Plaque Reduction Neutralisation Test, Reverse Transcription Polymerase Chain Reaction (RT-PCR), and virus isolation [1, 2, 5]. However, these methods require costly and bulky laboratory facilities, tedious diagnostic procedures, specially trained personnel, and long assay time.

Most JE cases happen at rural settings in Southern and Eastern Asian countries, where diagnostic laboratory facilities are very limited [6]. A portable diagnostic system that can provide point-of-care, rapid, sensitive detection of JEV is highly desirable in such settings [7]. Electrochemical biosensors have received much attention as a reliable diagnostic tool for infectious diseases as their sensing performances are not affected by turbidity or absorbance of the sample [8]. Besides, electrochemical biosensors offer the advantages of being highly sensitive, rapid in signal generation and readout, highly amenable for miniaturization, and inexpensive for virus detection, and it requires relatively simple operational instrumentation [9].

To date, very few studies on electrochemical biosensors for JE diagnosis have been reported. Recently, an electrochemical biosensor was fabricated for rapid detection of JE antigen by immobilized serum antibody on a silanized surface of an interdigitated sensor with a detection limit of 0.75 μgmL^{-1} within 20 minutes [10]. In another study, gold-coated magnetite beads were used for the immobilization of JEV antibody and multiwall carbon nanotubes (MW-CNT) were used to improve the signal as well as the conductivity of electrochemical biosensors. However, this method suffers