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Label-free Detection of Cordyceps Sinensis Using Dual-Gate Nanoribbon-based Ion-Sensitive Field-Effect Transistor Biosensor

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Abstract

We report a dual-gate nanoribbon-based Ion-Sensitive Field-Effect Transistor (NR-ISFET) biosensor system for direct label-free detection of Cordyceps sinensis's DNA (CorDNA) by conductance measurements of the NR-ISFET biosensors, where sample delivery can be conducted by a cavity or microchannel. Compared with conventional methods, the NR-ISFET biosensors demonstrate smaller sample amount and shorter detection time. Especially the measurements in a microchannel at dual-gate (DG) mode exhibit a better sensitivity of 0.5054 mS/dec in a wide dynamic range spanning four orders of magnitude, a lower limit of detection (LOD) of 50 pM, and significantly improved specificity as compared to these with single solution-gate (SG). Moreover, the performance of the NR-ISFET biosensor system can be improved in a microchannel in comparison with a cavity, which may be attributed to better surface modification in a microchannel with larger DNA probe density on the sensing surface.

Keywords

Dual-gate ISFET, conductance measurements, DNA detection, Cordyceps sinensis

1. Introduction

Cordyceps sinensis (CorS), also known as “DongChongXiaCao” or golden worm, is one of the most precious Traditional Chinese Medicines (TCM) due to its rareness and multiple medical effects [1,2]. CorS first gained worldwide attention in 1993 when several Chinese runners breaking world records had included this fungus in their training programs [3]. Since then, it has attracted tremendous attention worldwide especially in Asia. CorS is only found in the soil of prairies at elevation of 3,500–5,000 meters, mainly in the provinces of Tibet, Qinghai, Sichuan, Gansu and Yunnan of China. Its growth cycle is 2 to 3 years, and no artificial cultivation has been achieved with good quality until recently [2,4]. A wide range of biological functions, such

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