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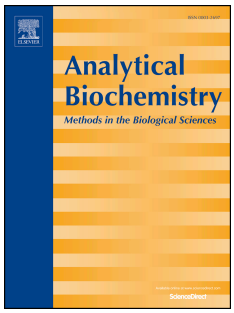

Single-wall carbon nanotube based electrochemical immunoassay for leukemia detection

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Single-wall carbon nanotube based electrochemical immunoassay for leukemia detection

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Abstract

A label- free electrochemical immunosensor is fabricated using high quality single-walled carbon nanotube for early detection of leukemia cells. It is based on P-glycoprotein (P-gp) expression level detection; by effective surface immune-complex formation with the monoclonal anti-P-glycoprotein antibodies bound to an epoxy modified nanotube surface. The expression level of P-gp on the leukemia cell surface detected by cyclic voltammetry is in good agreement with immunofluorescence microscopy studies. The proposed biosensor could be used for the detection of P-gp expressing cells within a linear range of $1.5x10^3$ cells/ mL – $1.5x10^7$ cells/mL where lowest detection limit is found to be 19 cells/mL. A calibration plot of peak current v/s the logarithm of concentration of leukemia K562 cells is found linear with a regression coefficient of 0.935. This strategy promises high sensitivity, low- cost, fast, and repeatable recognition of cancer cells. The immunosensor was stable for three weeks and showed good precision with the relative standard deviation (RSD) of 3.57% and 2.12% assayed at the cell concentrations of $1.5x10^3$ and $1.5x10^5$ cells mL^{-1} respectively. The proposed single-wall carbon nanotube based immunosensor showed better analytical performance in comparison to similar leukemia electrochemical sensors reported.

Keywords: P-glycoprotein (P-gp); Fluorescence Microscopy; Electrochemical Sensor; Chronic Myeloid Leukemia; Single-wall Carbon Nanotube.

Introduction

Cancer is the second major cause of global mortality and also a leading cause for 8.8 million deaths in 2015 **[1]**. Leukemia, a malignancy of the early blood cells, mostly starts in the bone marrow and infiltrates in the blood. It is the most common cancer in children and teens, where it is acute or fast-growing in nature. In adults, leukemia is mostly chronic and slow growing. According to the American cancer society, leukemia is ranked 7^{th} in the estimated death rate in 2018 (24,370 people) and 10^{th} in the estimated new cases in 2018 (60,300 cases) **[2]**. Early