國 立 交 通 大 學

奈 米 科 技 研 究 所

碩 士 論 文

矽化金奈米線生化感測器於蛋白質之檢測應用

Fabrication of Gold-Silicide Nanowires for Protein Sensing

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摘 要

近年來蛋白質的偵測被視為重點研究項目,快速且有效的偵測特定蛋白質愈來愈急迫。半導體元件如奈米線和奈米溝槽都可用於檢測生物分子的效用。我們使用一維結構的矽化金奈米線來偵測streptavidin,此元件利用標準的半導體製程技術，製造出經濟又大量的矽化金奈米線感測元件。

首先，我們利用電子束微影技術(Electron-Beam Lithography)以及濕式蝕刻的方法，製作出80nm的多晶矽奈米線。在多晶矽奈米線表面沉積金屬金之後，進行400℃、、500℃、600℃和650℃ 快速退火，利用王水在75℃的溫度下將未參與反應的鉑蝕刻掉，能夠得到80nm的鉑矽化物奈米線。

矽化金奈米線浸潤在1,2-ethanedithiol ,sulfoSMCC , biotin及 streptavidin溶液中, 利用四點探針把矽化金奈米線電性量測結果與蛋白質修飾的鉑矽化物奈米線相比較,其表面電荷的不同會影響奈米線本身導電性的結果,來偵測特定的蛋白質。

The fabrication of Gold-Silicide Nanowires for Protein Sensing

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Abstract

Recently, there has been an increasing demand to find simple and rapid methods for the detection of specific protein, which can also be used easily in non-specialized laboratories. The detection of specific protein is critical importance because protein mutation can induce a couple of diseases. The traditional techniques for protein identification are enzyme-linked immunosorbent assay, fluorescence immunoassays, and western blot. The drawback of above methods is time-consuming, tedious labeling process and poor sensitivity. Semiconductor processing devices such as nanowires and nanogaps possess the advantages of low cost and high sensitivity. In this study, we propose a self-aligned one-dimensional gold-silicide nanowire to detect the streptavidin molecule.

The fabrication process for the one-dimensional gold-silicide nanowire . The pattern of nanowire was defined by electron beam direct writing. The 80 nm gold-silicide nanowire is successfully achieved. We use the HP-4156 analyzer to characterize the electrical signal.

The nanowire is immersed in the 1,2-ethanedithiol ,sulfoSMCC , biotin and streptavidin solution. Due to the extremely high affinity of biotin- interaction, The streptavidin molecule has assembled onto the nanowire.

The sheet resistance of nanowires decreases after the binding of streptavidin onto the sensor. We also use boiling DI water to remove the protein, and the sheet resistance can be restored. These observations indicate the successful detection of protein and can be extended to tumor makers, antibodies, or virus shell proteins for early detection of diseases.

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