

High sensitivity surface plasmon resonance bio-chip detect female cancer Indicator protein

Chia-Tzu Kuo, Nan-Fu Chiu*
Institute of Electron-optical Science and Technology
National Taiwan Normal University
Taipei, Taiwan
nfchiu@ntnu.edu.tw

Abstract

Graphene oxide-based materials got a huge interest in bio-sensing, pharmaceutical exploitation, water purification since their unusual features, such as large surface area, low-cost fabrication and they can disperse in water greatly [1]. Moreover, the irreplaceable bio-compatibility due to carboxyl groups is the main reason. Since the carboxyl groups can make a covalent binding with amino-group that be exposed by proteins [2]. That makes the binding of sensing layer and probe protein become stronger, and makes the sensitivity become higher. Since that reason, we utilized carboxyl group modified Graphene-oxide (GO-COOH) to enhance the quantity of fixing anti-body and increase the signal that we detect by catching more analyte.

Surface plasmon resonance (SPR) provides a high sensitivity, stability and instantaneity formula of Immune response. Our previous work is about GO enhance the SPR. In that work we confirmed that after changing the thickness and dielectric constant of sensing layer by modifying GO on the chip would increase sensitivity and SPR [3]. Then, we confirmed the immunity reaction would change the SPR angle shift, immune response protein was employed [4]. So, the reaction between the antigen and antibody or other combination in proteins would change the thickness and reflect index of the dielectric layer. By this reason, it is beneficial to establish a useful bio sensing system. We propose a novel procedure by combining these two techniques to achieve high accuracy, simplicity and promptness bio-sensor [5]. And Kretschmann prism configuration is employed.

Beta - human chorionic gonadotropin (β - HCG) that produced by developing placenta would increase rapidly when females are pregnant, then become the most concentrated at about ten weeks after zygote implantation. And there is very low concentration in males or non-pregnant females. It is an indicators protein about ovarian cancer, premature birth, testicular cancer, ectopic pregnancy [6]. By detecting this protein, we can further understand lots of problem and take more countermeasures.

Our work is about using carboxyl modified Graphene oxide applied in SPR bio-chip. We fixed GO-COOH on a gold chip, to be a sensing layer, then, inject peptide to capture β - HCG, figure. 1 shows the process. First, we dropped 5mM Cystamine (Cys) on gold film for 24 hours. Self-assembled monolayer (SAM) principle was employed. Then, we dropped 1mg/ml GO-COOH on Cys layer for 5 hours. By this structure, the response after we fixed 100uM peptide to detect 10nM β - HCG can be enhanced to about three times larger than pure 8-mercaptopoctanoic acid (MOA) chip, shows in figure 2. And the detection limit would turn into 10 pM or lower. And, we arranged the response in different concentration, shows in figure 3. Next, we are going to detect whole blood and urine, to build a national data base, and differentiate the concentration about different races.

References

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Figure 1

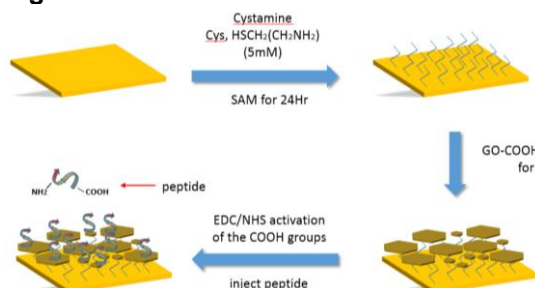


Figure 2

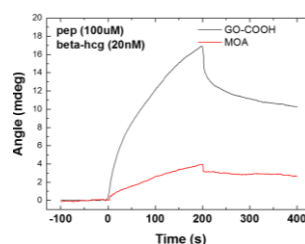


Figure 3

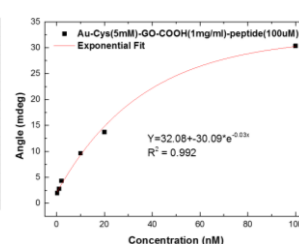


Figure 1 shows the process of modification of high sensitivity bio-chip.

Figure 2 shows the GO-COOH and MOA chip's signal about fixed 100uM peptide and detect 10nM β - HCG.

Figure 3 shows the responsibility between the concentration and SPR angle shift.