Characteristics of MOSFET Protein Chip Using Gold Black Gate

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Abstract

Nowadays, a device for detecting protein and gene has been growing importance in medical diagnosis. Thus, research in the field of biosensors has enormously increased over the recent years. Typical methods are optical measurements, mass spectrometry and surface plasmon resonance. At present, the use of optical measurements is predominant, but this method has the problems of using fluorescent material, multi-stage processes and a costly scanner equipment. [1]

To overcome these disadvantages, the metal-oxide semiconductor field effect transistor (MOSFET) type protein chip as a new device have been proposed, which is fabricated by the semiconductor integrated circuit technology and operates as molecular recognitions.[1,2] This device offers a lot of potential advantages such as small size and weight, fast response, high reliability, low output impedance, the possibility of automatic packaging at wafer level, on-chip integration of biosensors arrays, and the label-free molecular detection. However, the application of the FET type protein sensor is restricted because of the relatively low voltage response caused by limited protein number on the gate surface. [1]

Therefore, in this study, we will try to improve the response of a MOSFET protein chip using the gold black gate (porous gold gate). It is that if the surface area of the porous gold is wider than that of the planar gold, it is possible that the wider gold gate will be able to capture more proteins, L41 Ribosomal. That is to say, the porous gold allows a large number of ligands per surface area in comparison with planar gold. [3] Especially, porous gold has the advantage over porous silicon dioxide surfaces of being more stable in buffer solutions. [3]

In addition, to effectively capture proteins, a thiol group in the porous gold surface of the MOSFET gate is chemically bonded by immobilized molecular receptors, so called self-assembly monolayer (SAM). Since the SAM and the protein have a charge, negative, and positive, respectively, their specifically combine each other. Fig. 1 shows porous gold of the gate area, which is sensing membrane of the MOSFET protein chip and fig. 2 is device photograph of completed.

In this result, we will consider that the charge difference of the gate was induced by attached SAM and protein on the porous gold. Then, we will be noticed that the device using the porous gold gate is higher the rate of change of charge than that of the device with the planar gold. According to, its gate potential variation will be able to be used as the improved response of MOSFET protein chip for analyzing.

References

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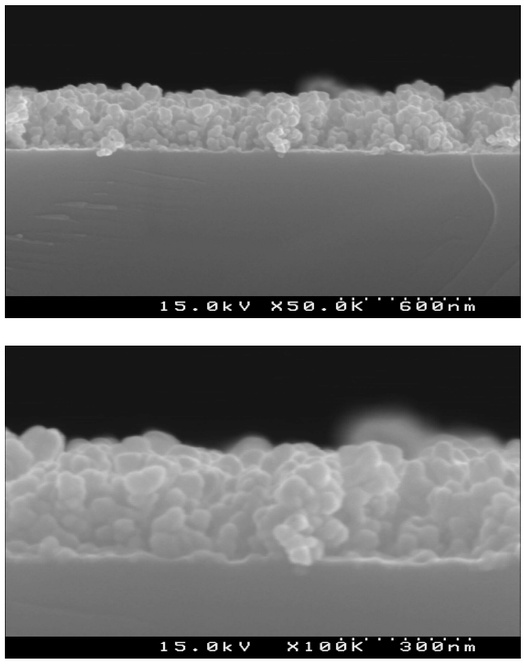

Fig. 1 SEM photographs of the porous gold on gate area.

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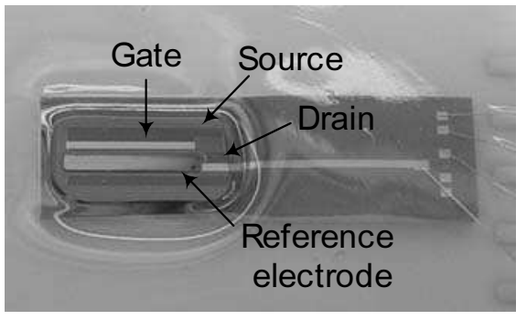

Fig. 2 Photograph of MOSFET protein chip.