

Metallic Nanoparticles-Based Biochip with Multi-Channel for Immunoassay

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Recently, biochemistry nanosensor is an active research topic in both life sciences and engineering [1]. It involves the interdisciplinary areas of life sciences and information sciences such as bioinformatics, biochemistry chip, bio cybernetics, bionics, and bio-computer etc. Their common characteristics are exploring and opening out the basic rules of the production, storage, transmission, process, transition, and control of the information in the biological systems, and discussing the basic methods which are employed for the human economy activity. The biosensor related research focuses on combination of the sensors and the diversified biological active materials as well as their relevant applications.

The Localized Surface Plasmon Resonance (LSPR)-based nanosensor becomes the hotspot problem because they have benign development situation and important position in the life sciences research [2-8]. LSPR nanosensor can be implemented using extremely simple, small, light, robust, and low cost equipments. It has many advantages such as convenience, high sensitivity, wide application and real-time detection etc. Thus it is deemed to be a kind of furthest potential biosensor. The metallic nanoparticles' optical properties mainly depend on their size, shape, metal composition and the refractive index of the surrounding mediums. Previous research has shown that the LSPR-based nanosensor is a refractive index-based sensing device which strongly relies on the extraordinary optical properties of noble (e.g. Ag, Au, Cu, and their alloy) metal nanoparticles [9-12]. The Ag nanoparticles have endowed the device with excellent optical characteristics. Especially, the peak wavelength of the transmittance spectrum λ_{max} is unexpectedly sensitive to the nanoparticle's size, shape, and local external dielectric environment, as shown in Figure 1. Its sensitivity to the nanoenvironment has given us the foundation to develop a new serial of nanoscale affinity biosensors. In this paper, we used multi-channel optical biochip with different shapes and periods of metallic nanostructure array as the biosensors' substrates to

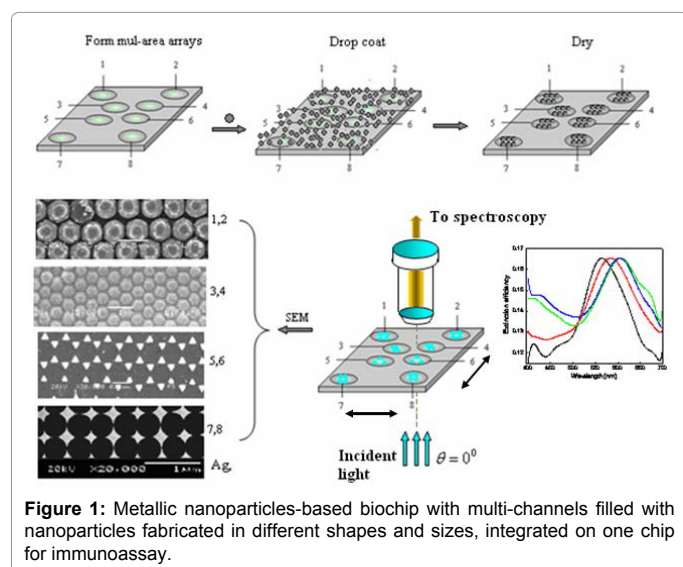


Figure 1: Metallic nanoparticles-based biochip with multi-channels filled with nanoparticles fabricated in different shapes and sizes, integrated on one chip for immunoassay.

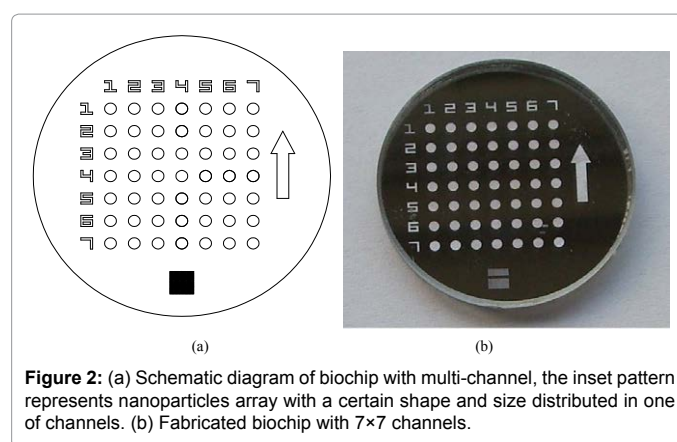


Figure 2: (a) Schematic diagram of biochip with multi-channel, the inset pattern represents nanoparticles array with a certain shape and size distributed in one of channels. (b) Fabricated biochip with 7×7 channels.

measure the transmission and extinction spectrum of these nanoscale biosensors, as shown in Figure 2. Through the experimental results, we found that these LSPR nanobiosensors with different shapes and periods nanoparticles array can be used as the nanobiosensor. Moreover, multi-channel optical biochip can realize detecting the target molecule using different shapes and periods simultaneously. The biochip can be used for two purposes: 1) detecting one bio-sample on the chip in different channels for different analyzing sensitivity; and 2) analyzing multi-samples on the chip at one time: high efficient immunoassay.

Fabrication of the multi-channel optical biochip with different shapes and periods of metallic nanostructure array is a challenging issue. Normally, self-organized assembly technique is employed for the particles distributed in large area with pure one shape and size. However, it is too difficult to adopt the technique for the multi-channel chip here unless the particles are fabricated one channel by one channel separately. Of course, it is a tedious fabrication process. The other option is a physical methodology-based fabrication process, such as Focused Ion Beam Direct Milling (FIBM) and e-beam lithography. FIBM is a one-step processing technology, and quite suitable for manufacturing a prototype for research. Considering advantages of writing any shapes of the particles by FIBM and e-beam writing, they provide more freedom for the chip design in comparison to that of the chemical method.

Apparently, the metallic nanoparticles-based biochip with multi-

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channel has the advantages of high throughput, high efficiency, and cost effective bioassay. Hopefully, it will appear in hospitals and pharmacy corporations in the near future.

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