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Passive and Active Detection of Conducting Nanoparticles by Nanogaps

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Immobilization of conducting nanoparticles on a nanogap comprising two electrodes spaced at a distance comparable to the particle size can be used as a simple and sensitive method of detecting the particles. In this work, we have examined the performance of the nanogap devices in the measurement of metallic nanoparticles, particularly gold nanoparticles (Au NPs). Detection of pM-level Au NPs in an aqueous suspension was quite straightforward irrespective of the existence of non-conducting materials. Speed of detection or the time necessary for the completion of the measurement, however, was strongly dependent upon the immobilization process. Active trapping process was found to be much more efficient and also effective in the detection of nanoparticles than its passive counterpart.

Keywords: conducting nanoparticle, nanogap device, active trapping

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Detection of PspA by Interdigitated Nanogap Devices

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Nanogap interdigitated electrodes (NIDEs) can serve as an alternative platform for the biomolecular detection [1]. In this work, the NIDEs were adopted in a simple and sensitive detection of Pneumococcal surface protein A (PspA). The NIDEs were fabricated by the combination of photo and chemical lithography. Photolithographically-defined initial gap of about 200 nm was narrowed down to a few tens of nanometers by surface-initiated growth of the initial electrodes (chemical lithography) [2]. Bare silicon oxide surface between the electrodes was chemically modified to immobilize capturing antibodies and, after exposure to the samples, the device was immersed in a solution containing the probe-antibody-conjugated Au nanoparticles (Au NPs). The conductance change accompanied with the Au NP immobilization was interpreted as the existence of PspA. Detection limit of the measurements and further improvement of the detection efficiency were discussed with the results from I-V analysis, scanning electron microscopy, and atomic force microscopy.

References

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Keywords: Nanogap interdigitated electrodes, Pneumococcal surface protein A (PspA), Chemical lithography, Antibody-conjugated Au nanoparticles