Ultrasensitive electrical detection of protein using nanogap electrodes and nanoparticle-based DNA amplification

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Abstract: The present study describes an ultrasensitive protein biochip that employs nanogap electrodes and self-assembled nanoparticles to electrically detect protein. A bio-barcode DNA technique amplifies the concentration of target antigen at least 100-fold. This technique requires the establishment of conjugate magnetic nanoparticles (MNPs) and gold nanoparticles (AuNPs) through binding between monoclonal antibodies (2B2), the target antigen, and polyclonal antibodies (GP). Both GP and capture ssDNA (single-strand DNA) bonds to bio-barcode ssDNA are immobilized on the surface of AuNPs. A denature process releases the bio-barcode ssDNAs into the solution, and a hybridization process establishes multilayer AuNPs over the gap surface between electrodes. Electric current through double-layer self-assembled AuNPs is much greater than that through self-assembled monolayer AuNPs. This significant increase in electric current provides evidence that the solution contains the target antigen. Results show that the protein biochip attains a sensitivity of up to 1 pg/μL.

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