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Enhancing the response of a hybridization SPR biosensor using modified gold nanoparticles

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Aim. The research was aimed to determine the optimal working conditions of SPR biosensor system for the detection of DNA sequences of the hybrid gene BCR-ABL under which it is possible to enhance its sensor signal using gold nanoparticles modified with probe oligonucleotides and surface blocking molecules. **Methods.** To investigate the processes of immobilization and hybridization of the BCR-ABL oligonucleotides, the two-channel SPR spectrometer "Plasmon SPR6" developed at the V.Ye. Lashkaryov Institute of Semiconductor Physics of the NAS of Ukraine was used. In accordance with the aim of the study, an 80-base oligonucleotide from the site of e13a2 junction of BCR-ABL fusion gene was employed as the target for detection; here it is referred to as 80-mer BCR-ABL. The developed biosensor system consisted of two parts, first of which being the SPR sensor surface modified with thiolated probe oligonucleotides (mod-Ph) which were complementary to a 24-base region of 80-mer BCR-ABL. The second part of the system consisted of colloid gold nanoparticles (AuNPs) which were modified with another DNA probe (SH-DP) complementary to a different 18-base region of the 80-mer BCR-ABL target. The hybridization of 80-mer BCR-ABL oligonucleotides with mod-Ph probes was achieved by injection of the solution of the target sequence in the 2×SSC buffer into the measuring flow cell followed by a 10-minute incubation, after which the flow cell was washed with 2×SSC and treated with modified AuNPs. Since the SH-DP oligonucleotides on AuNP surface were noncomplementary to mod-Ph, the value of the sensor signal obtained by skipping the 80-mer BCR-ABL injection step was taken as the nonspecific response of the biosensor system. **Results.** Comparison of the results obtained using different AuNPs for signal enhancement of the proposed hybridization biosensor system allowed to determine the optimal method for their modification that allows to significantly reduce the detection limit of 80-mer BCR-ABL in studied solutions. The specific response of the biosensor system linearly increased with the increase of 80-mer BCR-ABL concentration up to 80 nM, at which its was greater than the nonspecific response by a factor of 5. The detection limit for measuring the concentration of 80-mer BCR-ABL with the proposed biosensor system was 100 pM, which is 500 times lower than that of the known biosensor [1]. **Conclusions.** The use of the developed AuNPs led to the shift of linear operating range of the proposed biosensor system to low concentrations by two orders of magnitude, which makes it more perspective for analyzing biological samples prior to their PCR treatment.

Keywords: Surface plasmon resonance, DNA hybridization biosensors, gold nanoparticles.

REFERENCES

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