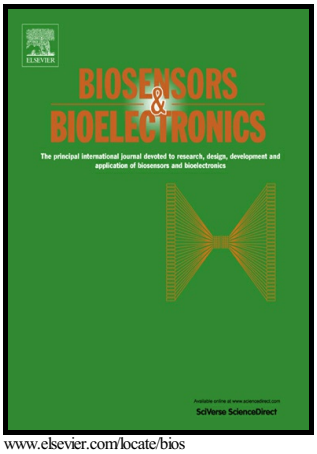

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Abstract

Synthetic enzyme-free DNA nanomachine performs quasi-mechanical movements in response to external intervention, suggesting the promise of constructing sensitive and specific biosensors. Herein, a smart DNA nanomachine biosensor for biomolecule (such as nucleic acid, thrombin and adenosine) detection is developed by target-assisted enzyme-free hairpin DNA cascade amplifier. The whole DNA nanomachine system is constructed on gold nanoparticle which decorated with hundreds of locked hairpin substrate strands serving as DNA tracks, and the DNA nanomachine could be activated by target molecule toehold-mediated exchange on gold nanoparticle surface, resulted in the fluorescence recovery of fluorophore. The process is repeated so that each copy of the target can open multiplex fluorophore-labeled hairpin substrate strands, resulted in amplification of the fluorescence signal. Compared with the conventional biosensors of catalytic hairpin assembly (CHA) without substrate in solution, the DNA nanomachine could generate 2 to 3 orders of magnitude higher fluorescence signal. Furthermore, the DNA nanomachine could be used for nucleic acid, thrombin and adenosine highly sensitive specific detection based on isothermal, and homogeneous hairpin DNA cascade signal amplification in both buffer and a complicated biomatrix, and this kind of DNA nanomachine could be efficiently applied in the field of biomedical analysis.

Keywords: biomolecule detection, DNA nanomachine, fluorescence, gold nanoparticles, hairpin DNA cascade amplification.