

Quadruplexes in DNA nanotechnology for non-enzymatic nucleic acid diagnostics

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Quadruplexes are highly structured forms of DNA consisting of stacked guanine tetrads linked by hydrogen bonds, which require the presence of cations, positively charged ions, such as potassium. Their high stability has made quadruplexes a good candidate for the development of new and effective diagnostic methods. Using quadruplexes, an isothermal diagnostic method for the detection of nucleic acids has been developed, called quadruplex primer amplification (QPA). It is an exponential reaction similar to the polymerase chain reaction (PCR) using DNA polymerases, where the advantage of QPA lies in its isothermal nature. Our current research is focused on the development of an isothermal and non-enzymatic diagnostic method, which would be quite practical for the point-of-care (POC) diagnostics that involves conducting diagnostic research at the patient's site. This method is based on structural transformations between a hairpin (a duplex with the ability to form a loop) and a quadruplex. Hairpin, which contains a quadruplex forming sequence and the fluorescent nucleotide - 2-aminopurine (2AP) in the loop, opens in the presence of a pathogen and then instantly folds into a quadruplex, after which 2AP produces the appropriate fluorescent signal. This method will make it possible to isothermally and non-enzymatically diagnose any DNA/RNA of interest.