NEW AMPLIFICATION STRATEGY FOR ELECTROCHEMICAL DETECTION OF DNA USING CATIONIC POLYMERS AGGREGATES

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The detection of DNA hybridization is of central importance to the diagnosis and treatment of genetic diseases, for the detection of infectious agents, and for reliable forensic analyses. Such DNA sensing applications require approaches that allow sensitive and specific transduction of a recognition event. Moreover, facile approaches can lead to the conception of miniaturized, portable and affordable devices. Electrical detection of DNA has shown great promise for this purpose and has been the subject of intense research activities. Strategies based on conjugated polymers for the transduction of hybridization events into an electrical signal have been reported [1-3], but they present a low signal-to-noise ratio caused by the steadily presence of the polymer, and they usually rely on a decrease of the electrical signal.

We previously reports a new promising solid-state electrostatic approach based on neutral peptide nucleic acid (PNA) capture probes and an electroactive, cationic, water-soluble polythiophene transducer bearing one ferrocene (Fc) moiety per monomer unit [4]. This simple and rapid methodology allows room temperature detection of 3×10^{9} unmarked DNA targets in a volume of 10μL, or 5×10^{-10}M.

In order to understand the electronic transfer between remote Fc moieties and the gold electrode, different Fc-functionalized cationic polymers were synthesised. Cyclic voltammetry studies with those molecules discard a molecular wire-like mediation by the conjugated polymer backbone. Each ferrocenyl groups undergoes reversible oxidation but the global current measured per hybridisation event is limited by the distance of the markers to the surface.

To take advantage of the large number of Fc moieties indebted to the polymeric nature of our transducer, we propose a double surface amplification strategy using aggregates composed of polymer and single strand of DNA target (duplex). Hybridization is performed at one surface addressing specific PNA capture probe and electrochemical detection is done at an electrode nearby. Owing to the unique DNA recognition capabilities of cationic polythiophenes in the duplex form [5, 6], this strategy leads to signal amplification, coupled to an effective discrimination against non-complementary nucleic acids.

References:

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