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Analytical Chemistry 2019: Direct electrochemical stripping detection of cystic-fibrosis-related DNA linked through cadmium sulfide - Arben Merkoci - YKA University

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Electrochemical detection of a cadmium sulfide quantum dots (CdS QDs)–DNA complex connected to paramagnetic microbeads (MB) was performed without the need for chemical dissolving. The method is based on dropping 20 µl of CdS QD–DNA–MB suspension on the surface of a screen-printed electrode. It is followed by magnetic collection on the surface of the working electrode and electrochemical detection using square-wave voltammetry (SWV), giving a well-shaped and sensitive analytical signal.We herein report an electrochemical biosensor for the sequence-specific detection of DNA with high discrimination ability for single-nucleotide polymorphisms (SNPs). This DNA sensor was constructed by a pair of flanking probes that "sandwiched" the target. A 16-electrode electrochemical sensor array was employed, each having one individual DNA capture probe immobilized at gold electrodes via gold-thiol chemistry. By coupling with a biotin-tagged detection probe, we were able to detect multiple DNA targets with a single array. In order to realize SNP detection, a ligase-based approach was employed. In this method, both the capture probe and the detection probe were in tandem upon being hybridized with the target. Importantly, we employed a ligase that specifically could ligate tandem sequences only in the absence of mismatches. As a result, when both probes were complementary to the target, they were ligated in the presence of the ligase, thus being retained at the surface during the subsequent stringent washing steps. In contrast, if there existed 1-base mismatch, which could be efficiently recognized by the ligase, the detection probe was not ligated and subsequently washed away. A conjugate of avidin-horseradish peroxidase was then attached to the biotin label at the end of the detection probe via the biotin-avidin bridge. We then electrochemically interrogated the electrical current for the peroxidase-catalyzed reduction of hydrogen peroxide. We demonstrated that the electrochemical signal for the wild-type DNA was significantly larger than that for the sequence harboring the SNP.Electrochemical detection of a cadmium sulfide quantum dots (CdS QDs)-DNA complex connected to paramagnetic microbeads (MB) was performed without the need for chemical dissolving. The method is based on dropping 20 microl of CdS QD-DNA-MB suspension on the surface of a screen-printed electrode. It is followed by magnetic collection on the surface of the working electrode and electrochemical detection using square-wave voltammetry (SWV), giving a well-shaped and sensitive analytical signal. A cystic-fibrosis-related DNA sequence was sandwiched between the two DNA probes. One DNA probe is linked via biotin-streptavidin bonding with MB and the other one via thiol groups with the CdS QD used as tags. Nonspecific signals of DNA were minimized using a blocking agent and the results obtained were successfully employed in a model DNA sensor with an interest in future applications in the clinical field. The developed nanoparticle biosensing system may offer numerous opportunities in other fields where fast, low cost and efficient detection of small volume samples is required. A cystic-fibrosis-related DNA sequence was sandwiched between the two DNA probes. One DNA probe is linked via biotin–streptavidin bonding with MB and the other one via thiol groups with the CdS QD used as tags. Nonspecific signals of DNA were minimized using a blocking agent and the results obtained were successfully employed in a model DNA sensor with an interest in future applications in the clinical field. The developed nanoparticle biosensing system may offer numerous opportunities in other fields where fast, low cost and efficient detection of small volume samples is required.

Biography:

ICREA Research Professor and leader of the ICN2 Nanobioelectronics and Biosensors Group, Arben Merkoçi obtained his PhD at the University of Tirana (Albania) in ion selective electrodes. Since 2005 he has carried out research as postdoctoral fellow and research professor at the Polytechnic University of Budapest (Hungary), University of Ioannina (Greece), *Università degli Studi di Padova* (Italy), *Universitat Politècnica de Catalunya*, *Universitat Autònoma de Barcelona* and New Mexico State University (USA).

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