ES1

Electrochemical Sensors for DNA Hybridization by Electron Transfer

전자전달을 이용한 DNA 검출의 전기화학적 센서

김진홍
창원대학교 공과대학 화공시스템공화학과

Identifying infectious organisms, quantitating gene expression, and sequencing genomic DNA on chips all rely on the detection of nucleic acid hybridization. Described here is a novel assay for detection of the hybrization of products of the polymerase chain reaction using electron transfer from guanine to a transition-metal complex. The hybridization assay was modeled in solution by monitoring the cyclic voltammetry of $Ru(bpy)_3^{2+}$(bpy=2,2′-bipyridine)in the presence of a probe strand containing only A, T, and C prior to and after hybridization to a complement that contained seven guanines, which led to high catalytic current due to the oxidation of guanine by $Ru(bpy)_3^{3+}$. To allow recognition of all four bases in the target sequence, it was shown that inosine 5′-monophosphate was 3 orders of magnitude less reactive than guanosine 5′-monophosphate, suggesting that effective hybridization sensors could be realized by immobilization of probe strands in which inosine was substituted for guanosine; hybridization to guanosine-containing target strands would then provide high catalytic currents. A sensor design was tested in a model system for the detection of a synthetic 21-mer oligonucleotide patterned on the sequence of the ras oncogene, which gave an increase in charge collected of 35 ± 5 μC after hybridization and of only 8 ± 5 μC after exposure to noncomplementary DNA. Independent quantitation of probe and target by radiolabeling showed that the hybridized electrode contained 3.0 ± 0.3 ng of target. New sensor electrodes were then prepared for the detection of PCR-amplified genomic DNA from herpes simplex virus type Ⅱ, genomic DNA from *Clostridium perfringens*, and genomic RNA from human immunodeficiency virus and gave an additional charge of 35-65 μC for hybridization to complementary amplicon and only 2-10 μC after exposure to noncomplementary DNA.