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On-Demand Ligand-Base DNA Sensor with Electrochemical Impedance Spectroscopy

Abstract

We have developed a DNA sensor that can be finalized to detect a specific target on demand. The electrode surface was modified with 2,7-diamino-1,8-naphthyridine (DANP), a small molecule with nanomolar affinity for the cytosine bulge structure. The electrode was immersed in a solution of synthetic probe-DNA that had a cytosine bulge structure at one end and a complementary sequence to the target DNA at the other end. The strong binding between the cytosine bulge and DANP anchored the probe DNAs to the electrode surface, and the electrode became ready for target DNA sensing. The complementary sequence portion of the probe DNA can be changed as requested, allowing for the detection of a wide variety of targets. Electrochemical impedance spectroscopy (EIS) with the modified electrode detected target DNAs with a high sensitivity. The charge transfer resistance (Rct) extracted from EIS showed a logarithmic relationship with the concentration of target DNA. The limit of detection (LoD) was less than 0.01 μM. By this method, highly sensitive DNA sensors for various target sequences could be easily produced.