Ternary Interfaces for Direct and Sensitive Electronic Detection of Nucleic Acids in Complex Samples

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BACKGROUND

Electrochemical DNA biosensors are simple, inexpensive, and portable, making them attractive for decentralized genetic testing. Surface chemistry plays a major role in the overall performance of such biosensors. In particular, surface chemistry and coverage control is essential for assuring high reactivity, orientation/accessibility, and stability, while avoiding nonspecific adsorption and related background contributions. Several schemes for attaching nucleic acid probes to electrode surfaces and controlling the surface chemistry have thus been developed. Alkanethiol self-assembled monolayer (SAM) methods have been particularly useful for preparing reproducible probe-modified surfaces with high hybridization efficiency. Most often, two-component SAM monolayers of thiol-derivatized single-stranded oligonucleotide probe (thiolated capture probe, SHCP) and a short-chain 6-mercapto-1-hexanol (MCH) are used. Yet, such binary monolayers still suffer from background contributions and irreproducibility problems resulting from incomplete backfilling and surface defects.

TECHNOLOGY DESCRIPTION

UC San Diego researchers have developed ternary SAMs as genosensor interfaces with greatly improved signal-to-noise ratio (S/N) characteristics compared to those of conventional binary capture-probe/MCH assemblies. Such dramatic improvement in detection limits is attributed primarily to the remarkably higher resistance to nonspecific adsorption. One example ternary layer is formed by co-immobilizing dithiothreitol (DTT) with the SHCP at gold surfaces, followed by sequential addition of MCH, and has been shown to facilitate measurements in diluted human serum and ultrasensitive detection. Even better S/N characteristics and enhanced performance in clinical samples have been demonstrated using various other third interfacial components. Relationships between the structure of the third component and the analytical performance of the ternary monolayers have been systematically evaluated. The sensitivity and high specificity of the invention's simple methodology indicate great promise for a wide range of nucleic acid testing, including clinical diagnostics, biothreat detection, food safety, and forensic analysis.

RELATED MATERIALS

Ternary Surface Monolayers for Ultrasensitive (Zeptomole) Amperometric Detection of Nucleic Acid Hybridization without Signal Amplification, Anal Chem. 82(2010)8830.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,746,468	08/29/2017	2011-159

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OTHER INFORMATION

KEYWORDS

DNA biosensor, genosensor, nucleic acid testing, self-assembled monolayers, alkanethiol SAM

CATEGORIZED AS

- **Medical**
  - Diagnostics
  - Research Tools
  - Screening
- **Security and Defense**
  - Screening/Imaging

RELATED CASES

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