Single nucleotide polymorphism and short tandem repeat detection using carbon nanotubes

DNA sequences among individuals are unique in part due to mutations and variations such as single nucleotide polymorphisms (SNPs) and short tandem repeats (STRs). These minor changes lead to severe genetic disorders, trait expression, and differences in drug reactions. Techniques that determine an individual’s SNP and STR pattern can provide crucial information to healthcare providers, allowing for personalized medical regimens to optimize care. However, current techniques are time consuming and expensive. This technology describes a method to detect such SNPs and STRs by measuring the electrical signals of an individual’s DNA via carbon nanotubes. Changes in conductivity allow researchers to determine variations in DNA. Potentially, the technology can be used as a diagnostic tool to determine genetic differences that can lead to more accurate diagnoses and individualized treatment plans.

Measuring electrical conductivity of DNA enables sensitive and efficient mutation detection

Using single-walled carbon nanotube electrodes, this technology measures the current through a DNA duplex. The nanotubes are cut to form polar caps that can bind to modified DNA. The DNA strand is hybridized with a test strand in question. Mismatches during hybridization increase resistance and can be easily detected via the nanotube. As a result, SNPs and STRs can be identified based on the conductivity of the DNA strand. This technique is affordable, efficient, and rapid. Consequently, it is well suited for personal medical applications such as determining patients’ unique drug responses and dosages. Moreover, its versatile design may be used for research regarding the properties of DNA kinetics or the effects of SNPs and STRs on diseases and traits. A prototype of the technology has been tested and reported.

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Applications:

- Microarrays
- DNA hybridization and binding research
- Genotyping
- Personalized pharmacological recommendations based on SNP analysis
- Short tandem repeat analysis

Advantages:

- More efficient, real-time nucleotide analysis
- Lower development costs compared to other nucleotide detection methods
- Sensitive and reliable

Patent Information:

Patent Pending (US 20110275062 A1)

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Related Publications:


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