DNA-Based Biosensor

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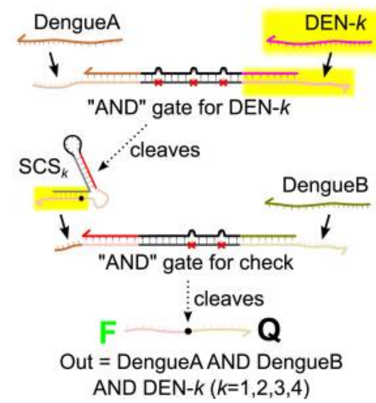
Background

DNA computation shows great promise for developing autonomous nanoscale devices for use in biomedical fields. DNA has high biocompatibility, is easy and relatively cheap to produce, and modeling software (to enable structural and sequence-based predictions) already exists. As DNA computing applications evolve and become more sophisticated, integrating different components will allow for greater flexibility in design and function than is currently possible for molecular logic circuits produced from a single type of component. In order for this technology to become possible, the various DNA computing components must be able to communicate with one another. In typical electronic circuits, wires allow for this type of communication between transistors, capacitors, and other such components. Until this point, no suitable biomolecular equivalent has existed, making communication between DNA computing components unrealistic and impossible to achieve.

Technology Breakthrough

Researchers at the University of New Mexico have developed a DNA-RNA hybrid which acts as a molecular interface enabling DNA computing components to interact and communicate with one another. This DNA-RNA hybrid molecule is the bimolecular equivalent of an electrical circuit. This molecule links existing DNA computation architectures and is capable of transmitting between different kinds of DNA computing circuit components. The DNA-RNA hybrid molecule employs a dual stem-loop design and contains five domains. Each domain plays a distinct role in signal propagation. The unique structure of the DNA-RNA hybrid molecule allows for multiple types molecular logic circuits to be interfaced with each other; expanding the utility of these systems.



Example application of the structured chimeric substrate (SCS) in a multi-layer diagnostic logic circuit. Design of multi-layer diagnostic logic circuits for detection of sequences from the genomes of all four dengue serotypes.

Key Advantages

- *The system is completely isothermal; operating at room temperature and a variety of temperatures.*
- *Only requires synthetic nucleic acids to create a complete assay; no costly and unstable protein based enzymes or antibodies are required.*
- *The input can be almost anything that is typically of interest to biomedical/environmental detection.*
- *Directly detects specific nucleic acid sequences or biomolecules of interest by either a nucleic acid trigger or an aptamer based trigger.*
- *Allows for large signal amplification with a detection limit on the order of the tens of pM to fM LODs.*
- *Inherently compatible with PCR or other nucleic acid amplification technologies and could dramatically enhance other isothermal detection approaches and allow single molecule detection of nucleic acids.*
- *Allows for direct programming of logic into the assay resulting in a multilayer cascade allowing for a single assay to detect multiple targets.*
- *Can be coupled with a variety of technologies for readout, ranging from fluorescence to electrochemical readouts.*
- *Demonstrates interoperability between different architectures and allows for interfacing between a variety of different existing DNA circuit components.*
- *Applications in clinical and biomedical fields; specifically, the DNA-RNA hybrid molecule can be used in practical bioassays.*

Intellectual Property

Issued U.S. Patent 9,476,090
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