Engineering DNA Assembly in vivo and Knock Down of Gene Expression Using the Reverse Transcriptase Activity

Technology #16593

Applications

This invention produces oligonucleotides for the self-assembly of DNA nanostructures for a variety of uses.

Problem Addressed

Functional DNA nanostructures have a number of applications, including, but not limited to, scaffolds for the organization of materials, synthesis of organic elements, control of biomineralization, drug delivery, and intracellular sensors. *In vivo* implementation has been largely limited as it is costly to generate such elements and current method's DNA assembly information remains outside of the genetic record of the cell causing it to lose structural information upon division. Further, it remains difficult to build structures using long single stranded DNA (ssDNA). This invention is a method to develop genetic circuits for the self-assembly of nanostructures *in vivo* using reverse transcription to produce ssDNA. This technology has already been demonstrated through engineering E. coli to reverse transcribe ssDNA for the successful knockdown of genes.

Technology

A synthetic pathway was developed in E. coli to perform reverse transcription. Reverse transcriptase and a functional template, a conjugate of a eukaryotic t-RNALys with a noncoding targeted RNA, are expressed in the cell. The functional template serves as a reconstituted replacement for a fundamental missing element in the activation of a reverse transcriptase, such as the HIV reverse transcriptase, process in bacteria. This strategy produces oligonucleotides, which optionally may be further manipulated to cause nucleic acid single strand crossover assembly for the formation of various DNA nanostructures. Additional internal and/or external stimuli can fine tune the *in vivo* synthesis of ssDNAs resulting in the dynamic control of the nanostructure shape and/or size and/or constitution. Once the ssDNA oligonucleotide is produced in the cell it may be used in the cell or isolated from the cell for therapeutic applications.

Advantages

- Self-assembly of different DNA nanostructures *in vivo*
- Control of shape/size/constitution

Categories For This Invention:

Life Sciences
Biotechnology
Health

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Other (Biotechnology)
Research Tools
Oligonucleotide Synthesis
Synthetic Biology
Therapeutic (Synthetic Biology)
Therapeutics
Drug Delivery
Gene Silencing
Other (Therapeutics)

Intellectual Property:

Engineering DNA assembly in vivo and methods of making and using the reverse transcriptase technology
Issued US Patent
9,970,040

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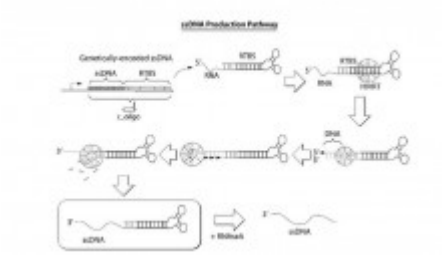
Publications:

Genetic Encoding of DNA Nanostructures and Their Self-assembly in Living Bacteria
Nature Communications
April 19, 2016

External Links:

The Voigt Lab
http://mit.edu/voigtlab/

Image Gallery:



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