Design and Implementation of DX-DNA Nanotube Tracks for Autonomous DNA Walking Machines

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One goal of bionanotechnology research involves designing nanowalkers which mimic biomolecular motors. Previously, light-powered DNA nanomotors have been studied to walk on tracks made of double stranded DNA (dsDNA). However, the limited stiffness of dsDNA constrains such tracks to present no more than three binding sites for the nanomotor's legs. Alternatively, DNA nanotubes, made of double crossover (DX) tiles, are over 100 times stiffer than dsDNA, which allows for the presentation of more binding sites via longer tracks. Furthermore, DNA nanotubes can be ligated for increased thermal stability, mechanical strength, and buffer compatibility. I design and construct six-tile DX-DNA nanotubes to present three binding sites for use in preliminary fluorescence motility experiments. I confirm the creation of the nanotubes using gel electrophoresis and atomic force microscopy (AFM). Using the Bootstrap method, I also measure the persistence length of the nanotubes to be 27.3 ± 0.9 um. If successful, this design can be modified to create DX-DNA nanotubes of unconstrained length. Such long nanomotor tracks can enable a gliding assay to study the speed and efficiency of the light-powered nanomotor.