CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
S0419

Project Title
The Electrical Transport of DNA across Periodic Cross-Pattern Surfaces

Abstract

Objectives/Goals
We have propsed a new method of electrophoresis and the seperation of biomolecules such as DNA and proteins. This proposed method is dubbed "surface electrophoresis". In this method, we have vastly increased the efficiency of the conventional method of gel electrophoresis and increased its applicability to extremely wide range. We propose a cheap, fast, and efficient way for biomolecule (or in this case DNA) seperation and analysis.

Methods/Materials
We used silicon surfaces that were printed through soft lithography with alternating Au strips. After doing so, we would dilute the concentration of our DNA with a concentration of 1-250ìg/ml in a solution of 0.1M Tris-EDTA. A 1ìl drop of the DNA solution was deposited onto the surface and allowed to air dry, thus "loading" the DNA. We then set a laser approximately 2mm away from the load point and turn on the electric field. Mobility was then measure by the excitation of photons in the laser as the DNA gets closer to it/hits it. The photons are measured using a photomultiplier tube which is connected to a computer.

Results
We found that this method is far superior from past electrophoretic methods. First, we saw that there was a dependence of mobility on pattern spacing. With different pattern spacings, there was different mobility and this allowed for the segregation of different DNA sizes. We also discovered that the intrisic rigidity, or persistence length, affects the time it spends in the "traps" (interfaces between gold and silicon). Time spent at the traps directly correlates to persistence length which correlates with the intrisic structure of the DNA as well (linear, supercoiled, etc.)

Conclusions/Discussion
Through our new proposed method, we have created a new method for DNA seperation and analysis as originally discussed. It uses far less voltage than current methods (5V instead of 1500V), small run times (5 minutes instead of hours), and extreme portability. Our further investigation proved that mobility is completely dependent on pattern spacing, providing for a huge range of DNA seperation, unlike gels. It can also differentiate between DNA of different structures (which gels cannot do). Overall, the proposed method far improves the current method for biomolecule (DNA) analysis.

Summary Statement
A novel, more efficient and more portable way to conduct DNA electrophoresis and analysis

Help Received
SUNY Stony Brook; GARCIA MRSEC