

## INTRODUCTION

Several methods have been employed to comb/stretch single DNA molecules such as magnetic [1] and laser tweezers [2], movement of an air-water interface [3] and air jet guided fluid flow [4]. However, the scientific community still lacks a feasible technique to directly deposit and comb large DNA molecules on surfaces. A novel method to comb large DNA molecules at the micron and ultramicro scale has been demonstrated in this application note.

## DATA SUMMARY

A molecular printing system has been designed and developed. This system, termed the Nano eNabler™ system, incorporates a microfluidic MEMS device to transfer and print bio/nano materials at the nano and ultramicro scale. The instrument itself features 50 mm of XY travel with 20 nm resolution for high precision patterning over large distances, an integrated optical microscope to observe the process, and an environmental chamber, all of which can be controlled and monitored through a convenient software interface. The Nano eNabler™ system has an ensemble of MEMS devices, termed SPT™ print cartridges, with various geometries and numbers of cantilevers for printing. Depositing and combing large DNA molecules was carried out using a single cantilever SPT™ print cartridge. Lambda DNA (~15 μm long) at 500 μg/ml was mixed 1:1 with DMSO and approximately 300 nL of the mixture was back loaded onto the single lever SPT™ print cartridge and brought into slight contact with an APTES (3-aminopropyltriethoxysilane) treated mica surface. Movement of the surface relative to the SPT™ print cartridge resulted in the formation of lines of oriented DNA. The DNA was incubated on the mica surface for 30 minutes to facilitate binding, washed with distilled water and blown dry before imaging by atomic force microscopy (AFM). A Dimension 3100 AFM (Veeco, Woodbury, NY) was used in tapping mode due to the delicate nature of the surface-bound DNA molecules.

The width of DNA lines varied from a few hundred nanometers to a few microns. The length of each line of large DNA molecules was at least 300 μm long. A 5 μm scan (Figure 1, inset) shows a

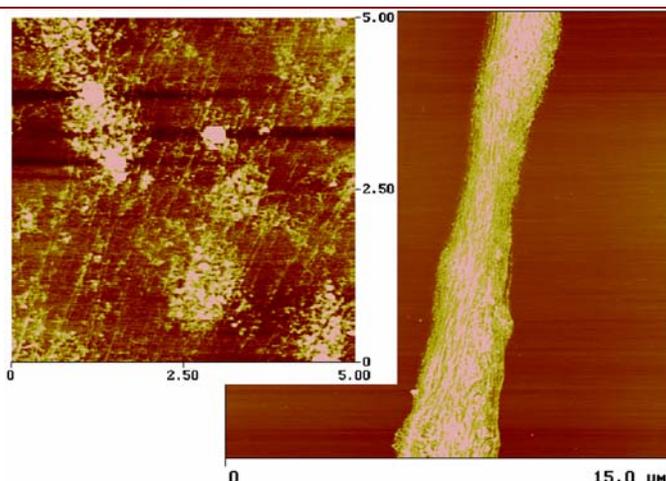


Figure 1. AFM images of large DNA molecules combed together.

significant number of individual DNA molecules combed in the same direction.

## CONCLUSIONS

A simple, feasible and rapid method of combing large DNA molecules has been demonstrated. The processing time to obtain such a DNA chip falls well below one hour from the stretching process with the Nano eNabler™ system through AFM imaging. Negligible sample volume requirements, a simple chip processing procedure, and easy to use instrumentation are among the major advantages of this method. This novel technique of obtaining large DNA molecules oriented parallel to each other serves as a unique and convenient method to obtain DNA chips that could further be used for DNA mapping and sequencing.

## REFERENCES

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