

Patterning of Dendrimer-Like DNA

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(The full report can be found in the 2006 REU Research Accomplishments. http://www.idx-hs.com/products/product_index.aspx) Here is an abbreviated report for users interested in patterning PDMS by etching...Beth

Abstract

Microwell arrays with a depth and diameter of 5 μm and lattice distance of 15 μm were patterned into PDMS using photolithography and reactive ion etching. The patterned PDMS acts as a template, guiding DNA combing in microscale dimensions. The patterned DNA can then be transferred to glass or mica by placing and holding the PDMS stamp against a glass slide.

Experimental Procedure:

Photolithography

PDMS was spun onto silicon wafers to a thickness of 100 μm , and cured for 90 min at 60°C. To improve the adhesion of the PDMS, silicon wafers were initially treated with air plasma (29 W) at 250 mTorr for 2 min. After curing, SPR 220-7 photoresist was spun onto the PDMS to a thickness of 7 μm and allowed to soft-bake for 30 min at 90°C. After being exposed on an EV620 contact aligner, the substrates were post-baked at 90°C for 30 min and developed.

Etching

Cured PDMS substrates were treated with O₂ plasma (100 W) at 170 mTorr for 60 sec to improve the adhesion of the photoresist. PDMS samples were then dry etched at 43 mTorr for 30 min using a 1:3 ratio of O₂ to CF₄. Etch rates were optimized by varying the pressure and ratio of gases in the REI process. Etch rates were determined by attaching Kapton tape to the PDMS before etching, and

then measuring the step height using profilometry. After PDMS stamps were characterized with SEM and AFM. The depth of the microwell array was measured using optical profilometry.

Stamping

Molecular combing experiments were performed as previously described [2]. However, an additional force of 250 mN was exerted on some of the samples as the PDMS stamps were peeled off. Fluorescence microscope images were taken during all molecular combing experiments.

Results and Conclusions:

The fluorine-based REI process developed in this study etched PDMS with a stable and directional etch rate (Figure 1). A 1:3 mixture of O₂ to CF₄ at 43 mTorr was found to anisotropically dry etch PDMS at a rate of approximately 10 μm per hour. Optical profilometry results revealed well depths of 4.5 μm.

Molecular combing of λ-DNA produced uniform one-dimensional arrangements of DNA. As previously reported [2], linear strands of λ-DNA were observed to attach at the edges of the wells. However, the arrangements did not possess long-range order. It is hypothesized that the treatment of PDMS with O₂ plasma and/or exposure to n-methyl-pyrrolidine within Shipley 1165 remover altered the surface roughness and perhaps even the hydrophobicity of the stamp, compromising the molecular combing process.

Acknowledgements & References:

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