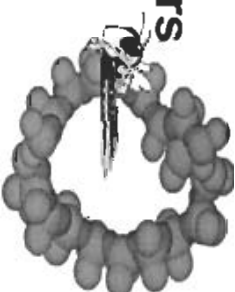


# Surface Modification via Stitching of Amphiphilic Polymers



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## Abstract

A novel approach to surface modification is presented whereby an amphiphilic polymeric material can be created using linear and cyclic polymers. This material would have an advantage over blends because without the use of chemistry, the surface modified moiety will not wash off or phase separate. The goal is to entrap a cyclic polymer onto the surface of a polymer film by the use of solvent, heat and pressure.

## Introduction

As seen in Figure 1 Scheme 1, the base polymer is already polymerized. However, a "good" solvent for both the linear and cyclic components is used to swell the polymers and promote diffusion. The two layers are heated and put under pressure, increasing the diffusion rate and causing the solvent to evaporate, leaving the cyclic component entrapped in the linear base polymer. Similarly in Figure 1 Scheme 2, the cyclic component is layered on top of the already polymerized base polymer. Polymer diffusion in this case is achieved by raising the temperature above the base polymer's glass transition temperature. These schemes are ideal because the only portion of the coating that is modified is the surface and theoretically, any cycle or polymer backbone can be used with no additional chemistry.

## Results and Discussion

Three molecular weights of polystyrene (PS) films were modified at the surface with three molecular weights of both cyclic and linear polydimethylsiloxane (PDMS) and analyzed using a goniometry whose measurements are accurate  $\pm 2^\circ$ . The static contact angle measurements were performed only at ambient conditions,  $\sim 25^\circ\text{C}$  in air. Deionized distillation water was the liquid used for contact angle analyses.

When a liquid does not spread on a substrate, a contact angle ( $\theta$ ) is formed which is defined as the angle between the two interfaces. Hydrophilic surfaces like water and cause

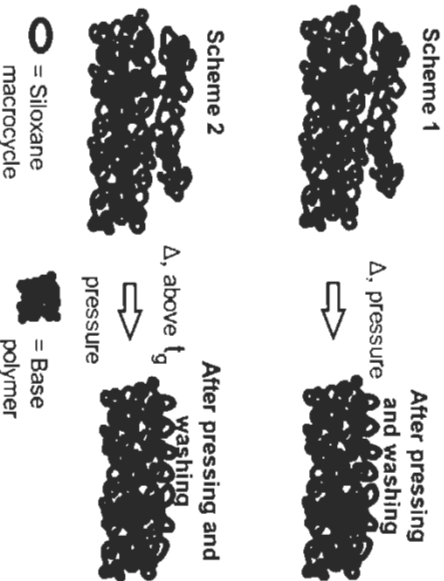


Figure 1. Schematic of entrapment process Before Washing

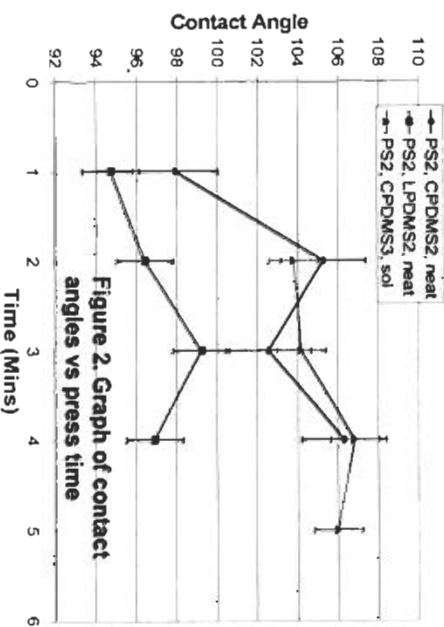


Figure 2. Graph of contact angles vs press time

Table 1 - Results	$\theta$ Before Washing	$\theta$ 1 Week Washing
PS2, LPDMS1-sol 3min	101.2	96.3
PS2, LPDMS1- neat 4min	103.5	96.9
PS2, CPDMS3-sol 3min	104.1	98.9
PS2, CPDMS3-neat 4min	101.5	97.7

spreading, decreasing the contact angle, while hydrophobic surfaces will cause water to bead increasing the contact angle. A PDMS surface are slightly more hydrophobic than a PS surface, where solution cast films of each have a contact angle of 105-110° and 90-92° respectively. Upon initial pressing of PDMS, the contact angle should  $\theta=9\text{PS} \rightarrow 9\text{PDMS}$ , and after washing if entrapped  $\theta=9\text{PDMS}$ .

As seen in Figure 2, contact angle measurements confirm linear and cyclic PDMS is on the surface of PS and as press time increased the contact angle increases. This was expected since the pressing process if not done long enough could actually pull PDMS from the surface of the PS film. A more important observation is that the solvent aided pressing method on average gave higher contact angles with lower variation. Suggesting the solution method was a more effective delivery method giving higher and more homogenous PDMS surface coverage.

In Table 1 are the before and after washing contact angles for four samples, they show a slight decrease in contact angles. This suggest after one week of washing with water some PDMS remains on surface. Excess non-penetrated PDMS was most likely removed via the physical stirring motion of the water bath.

## Conclusions and Future Work

Linear and cyclic PDMS were pressed into the surface of a PS film; this was facilitated by dropping a solution of PDMS onto the surface (as opposed to neat PDMS). The presence of the linear and cyclic PDMS on the surface was followed by contact angle measurements. After washing, the degree of entanglement of PDMS in the surface of the PS films can be evaluated. It will be determined whether the cyclic PDMS, which can thread linear polymers, can be trapped more permanently than linear PDMS.

## References

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