

# EVALUATION OF SURFACE WETTABILITY OF THIN SILANE COATED GLASS FIBERS

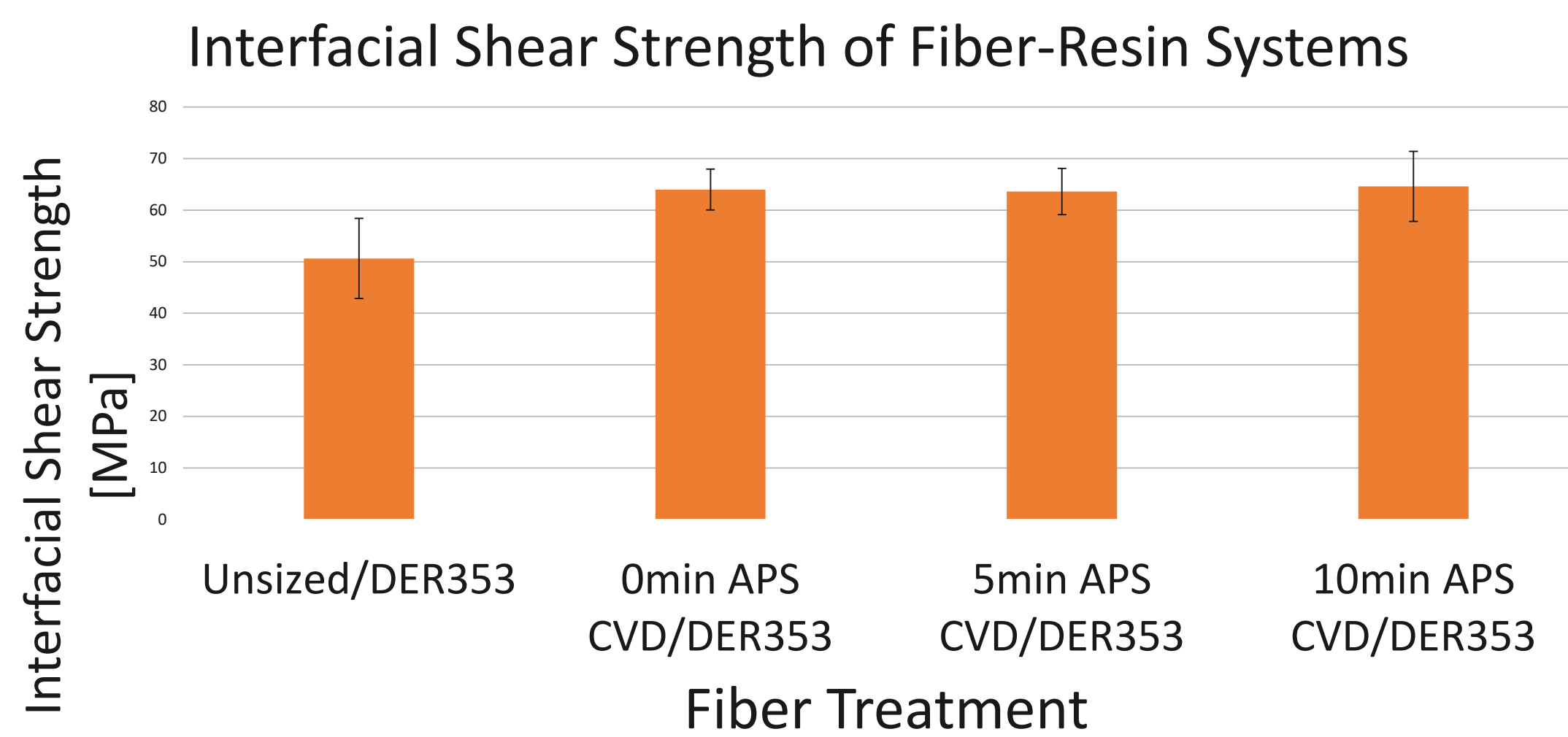
James Tallman (B.M.S.E.)<sup>1</sup>, Dylan Huang (B.C.E.)<sup>2</sup>, Joshua Yu (B.C.E.)<sup>2</sup>, Mr. Munetaka Kubota (MSME/MBA)<sup>3</sup>, Dr. Steve Sauerbrunn<sup>3</sup>, Dr. Joseph M. Deitzel<sup>3</sup>  
Cornell University Department of Material Science and Engineering<sup>1</sup>, University of Delaware Department of Chemical & Biomolecular Engineering<sup>2</sup>, University of Delaware Center for Composite Materials<sup>3</sup>

## Introduction

A potential for optimizing composite mechanical properties lies in the fiber matrix interface

A CVD process developed at UD deposits silane with the glass surface

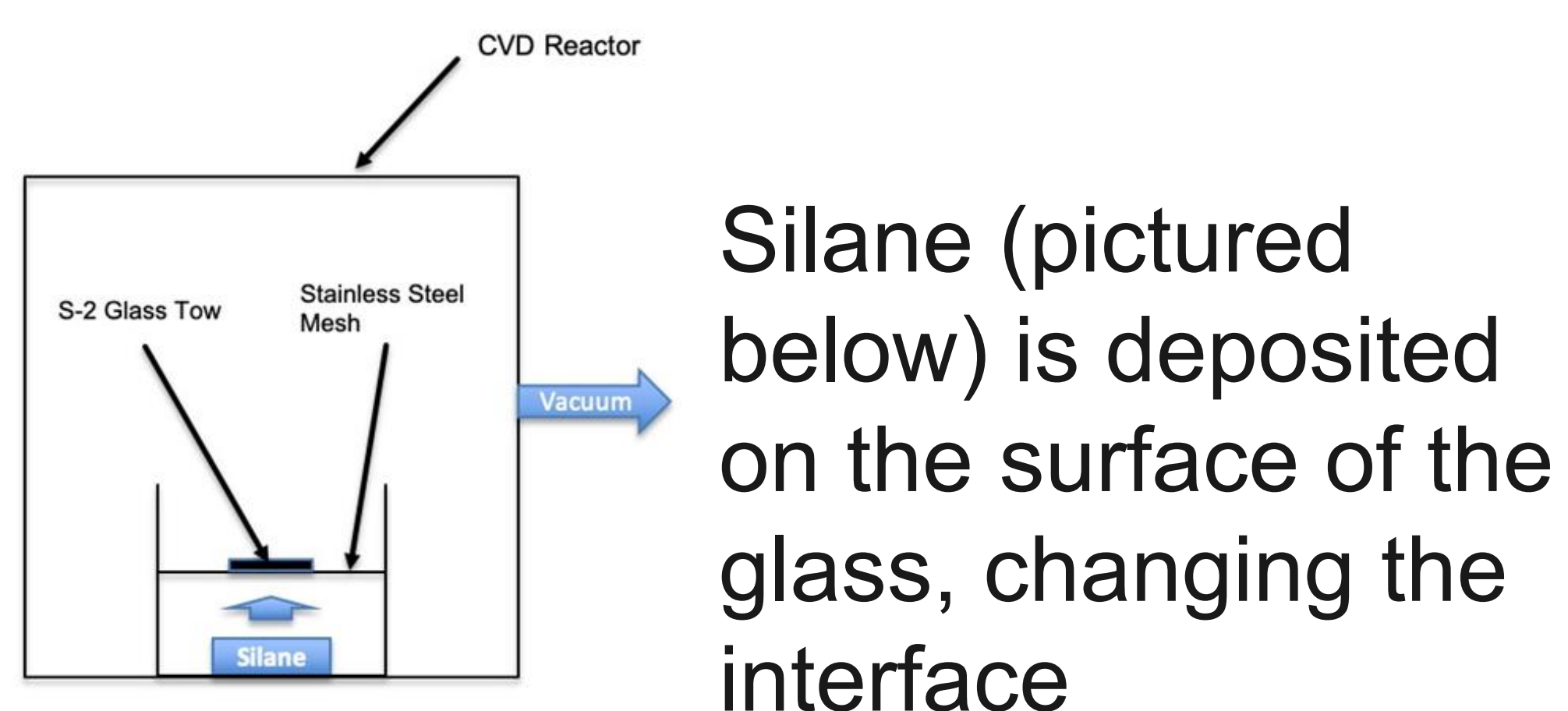
Interface testing done at CCM shows improvement in the interface with deposition.



Modeling by Dr. Sanjib Chowdhury suggests optimal properties at monolayer thickness

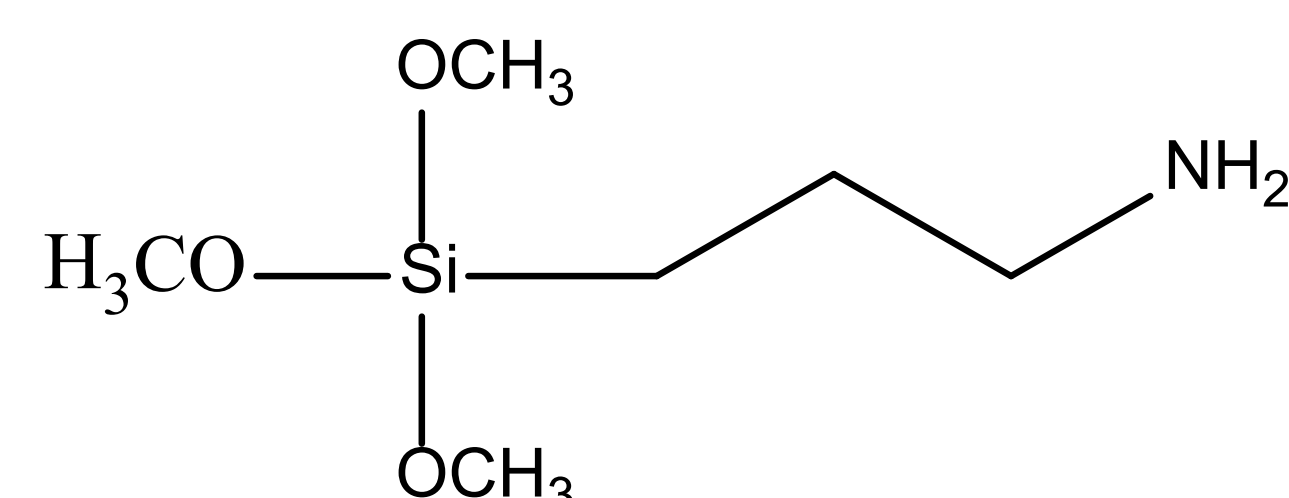
There is an opportunity to detect and characterize this coating using contact angle measurement

## Creating Silane Coated Fibers



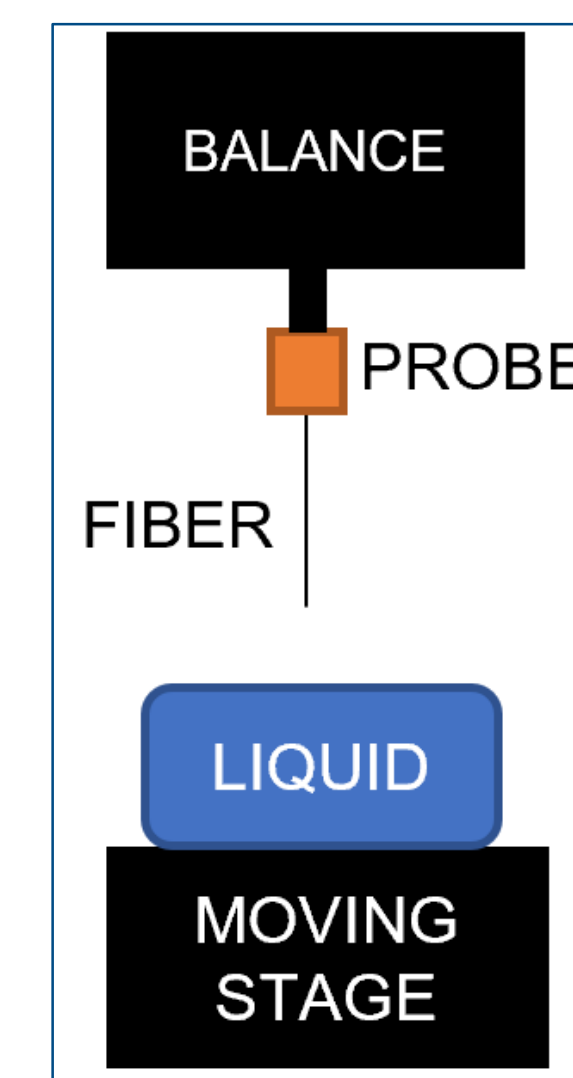
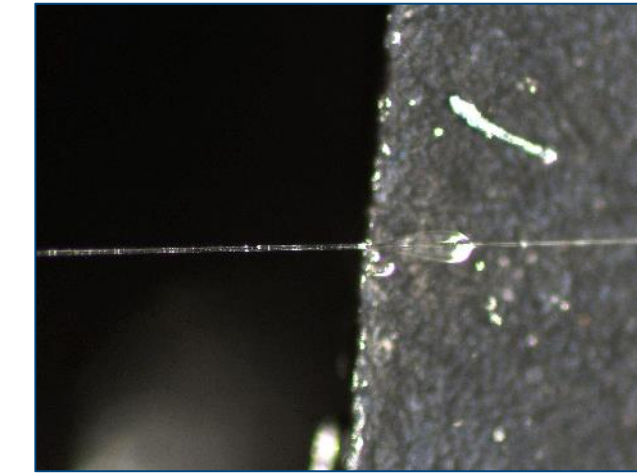
Silane (pictured below) is deposited on the surface of the glass, changing the interface

Intervals of 0, 5, and 10 minutes of dwell time after an initial pump down to 1 torr are evaluated



## Measuring Contact Angle

Fibers are mounted on adhesive probes to tested



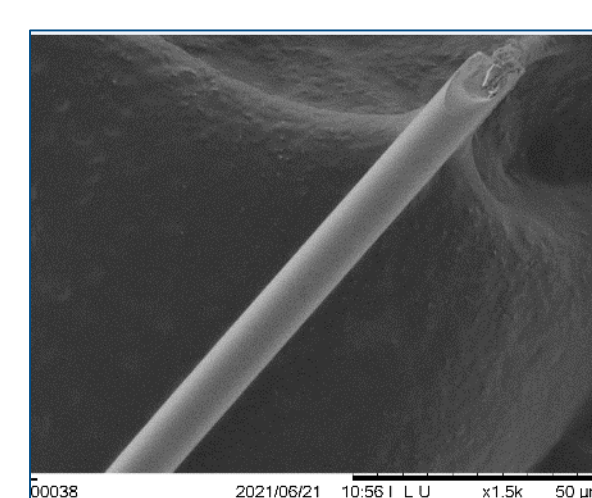
Using Dataphysics' DCAT25SF, the diameter and contact angle of single fibers can be measured.

Contact angle, the angle a fiber makes with a liquid, is measured using the modified Wilhelmy plate equation,

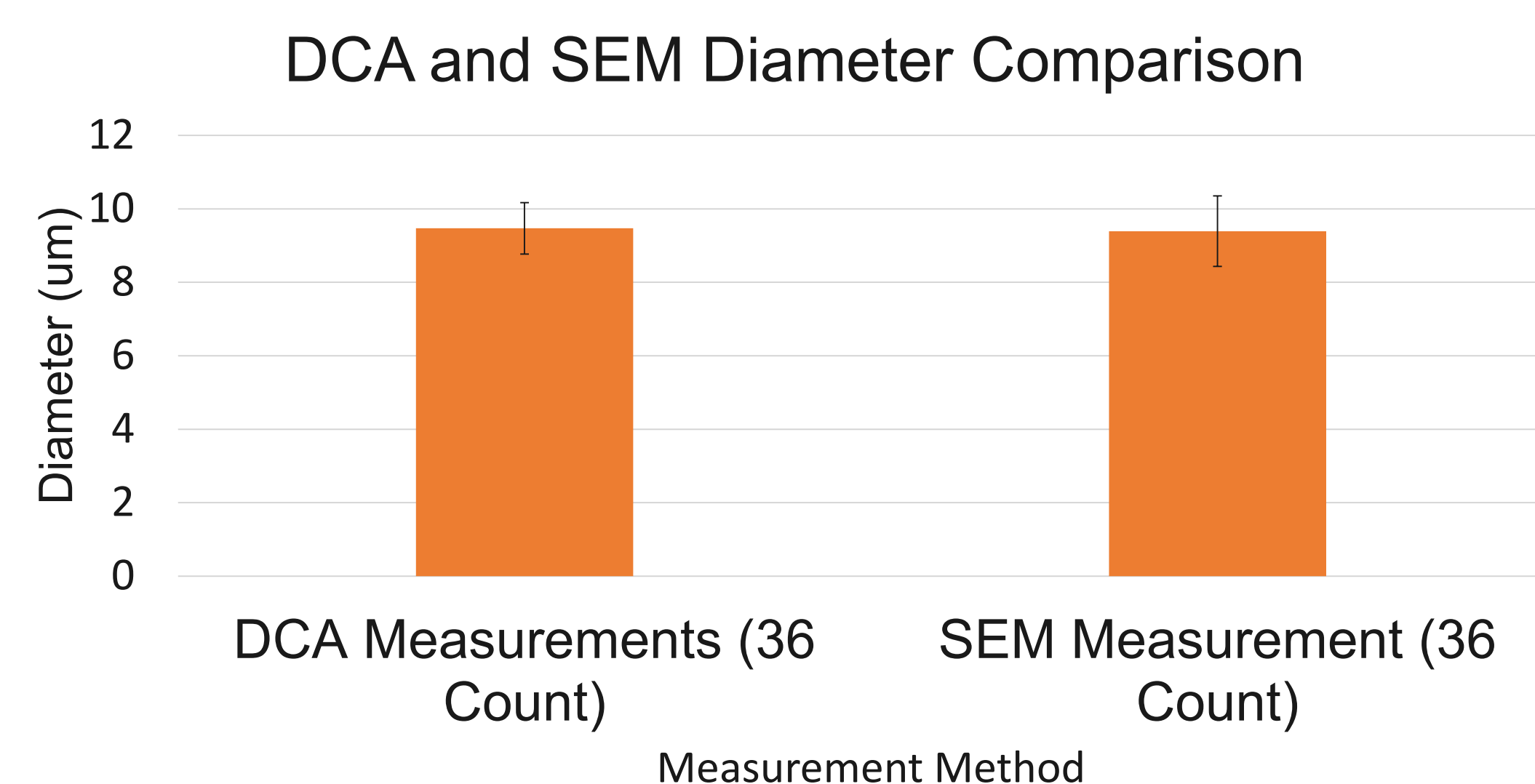
$$\theta = \cos^{-1} \left( \frac{m \cdot g}{\pi d_f \gamma} \right)$$

$d_f$ : fiber diameter  
 $m$ : mass  
 $g$ : gravitational constant  
 $\theta$ : contact angle  
 $\gamma$ : surface tension

By using toluene, a liquid with known total wetting (CA = 0°), diameter can be obtained.

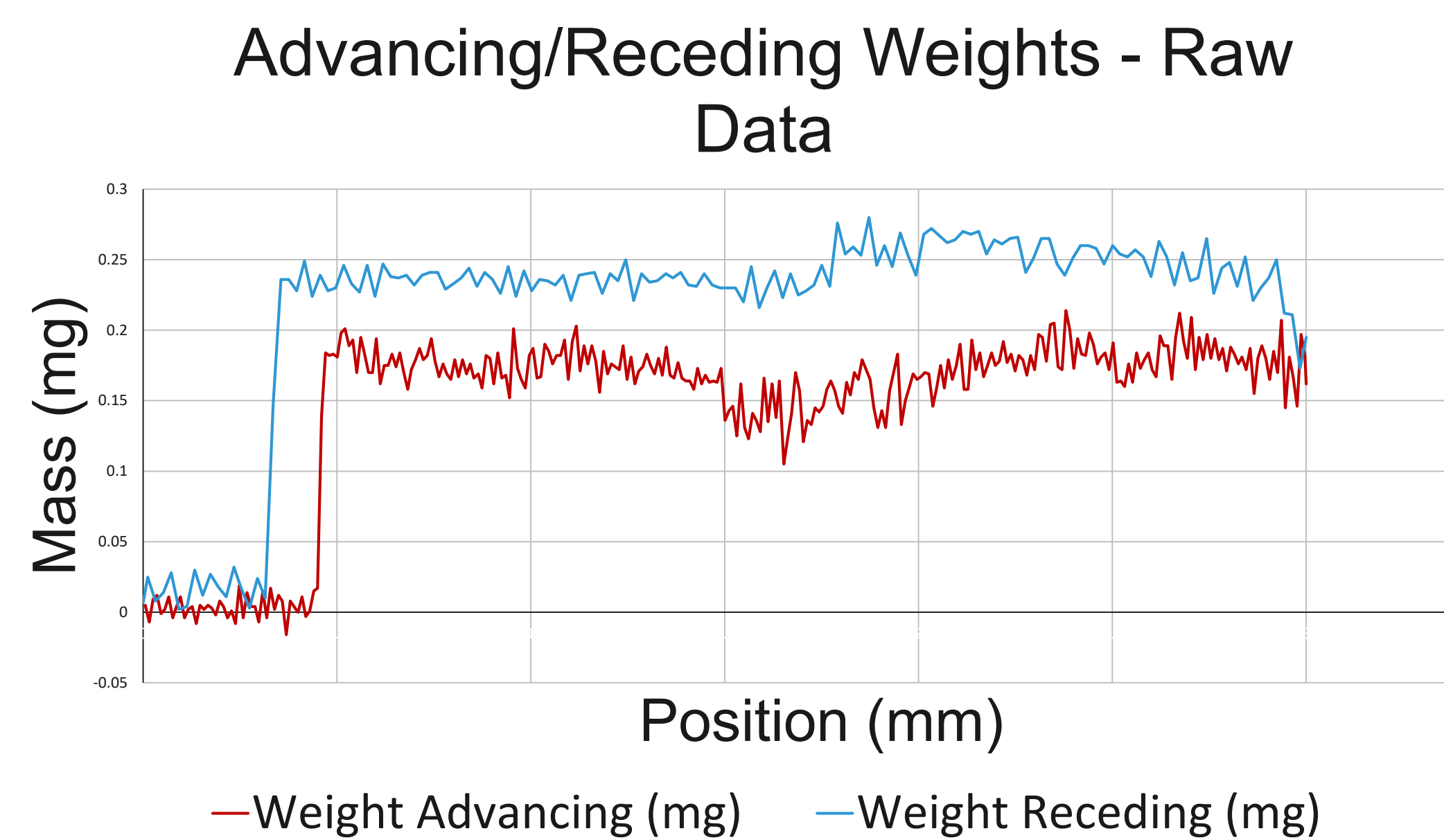


Diameters were validated with measurements from SEM images



## Measuring Contact Angle

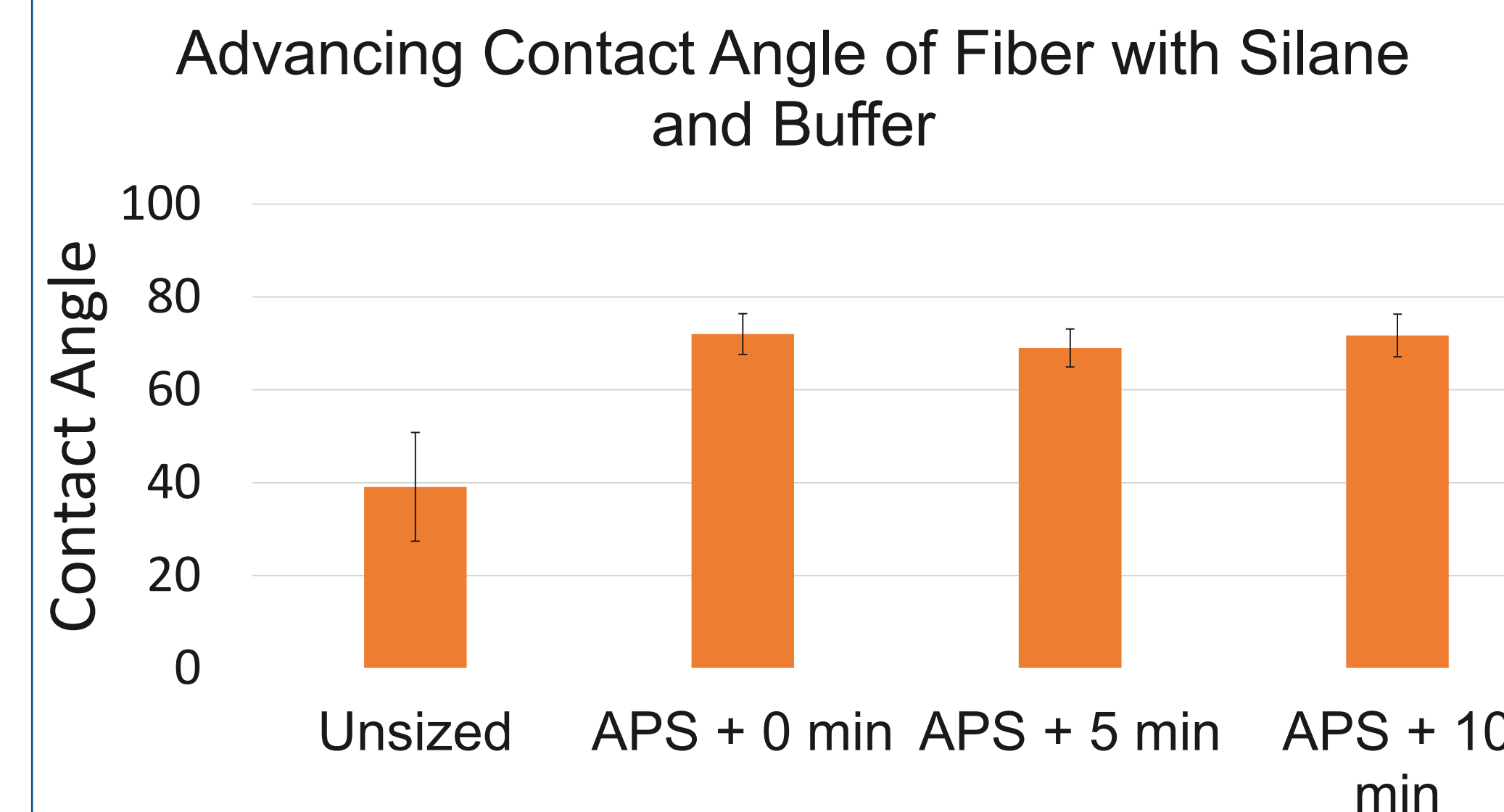
Contact angle measurements yield raw data in the form:



Contact angle is obtained using the Wilhelmy plate method

## Results and Discussion

Hydrogen bonding can occur between the amine group and the glass, thus a slightly acidic buffer solution as the liquid (pH of 6.0),.



The contact angle of the silane displays a notable jump and plateau, like the interfacial data presented before.

Statistical significance was determined with a t-test.

## Summary and Conclusion

- Diameter measurements performed by contact angle are accurate, even at the length scale of 10 microns.
- There is a statistical difference between the contact angle of unsize fiber and fibers with silane deposition
- The lack of statistical difference in the three dwell times suggests that the fibers are thoroughly coated even in the initial pump down

Surface wettability and interfacial chemistry can be evaluated using contact angle measurements, providing essential understanding of the molecular interactions at play in a fiber composite system.

## Future Work

- Change solvents to determine surface energy
- Determine contact angle with resin to optimize wettability, increasing fiber volume fraction and processability
- Explore deposition of different silanes

## Acknowledgements

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