

Functionalizing Mica with Silanes using Wet Chemistry

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Key Finding

Mica cannot be silanated to be non-wetting by wet chemistry methods with chlorotrimethylsilane (CTMS) or Sigmacote.

Introduction

Surfaces treated with silane have increased hydrophobicity. This property is desired for certain fundamental studies. Mica is atomically smooth, but is hydrophilic. Can mica be silanated to be non-wetting to the same extent as glass?

Materials and Methods

Silanes

- | | |
|-----------|-----------------|
| CTMS | • Gelest Inc |
| Sigmacote | • Sigma Aldrich |

Cleaning

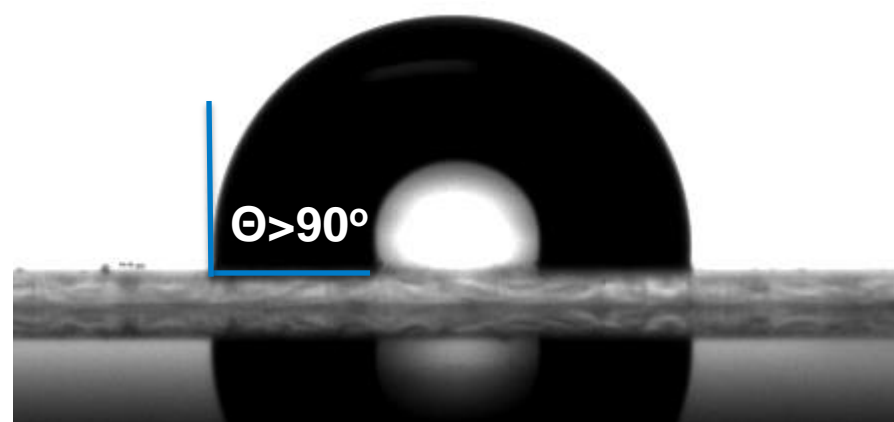
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| Glass | • 1:1 MeOH:HCl for 30 min +
H ₂ SO ₄ for 30 min |
| Mica | • Scotch tape |
| Etch | • 2 M NaOH for 60 min |

Functionalization

- | | |
|-----------|---|
| CTMS | • 1 vol%, 3 vol%, 10 vol%
for 20 min or 200 min. |
| Sigmacote | • As is for 20 or 200 min |

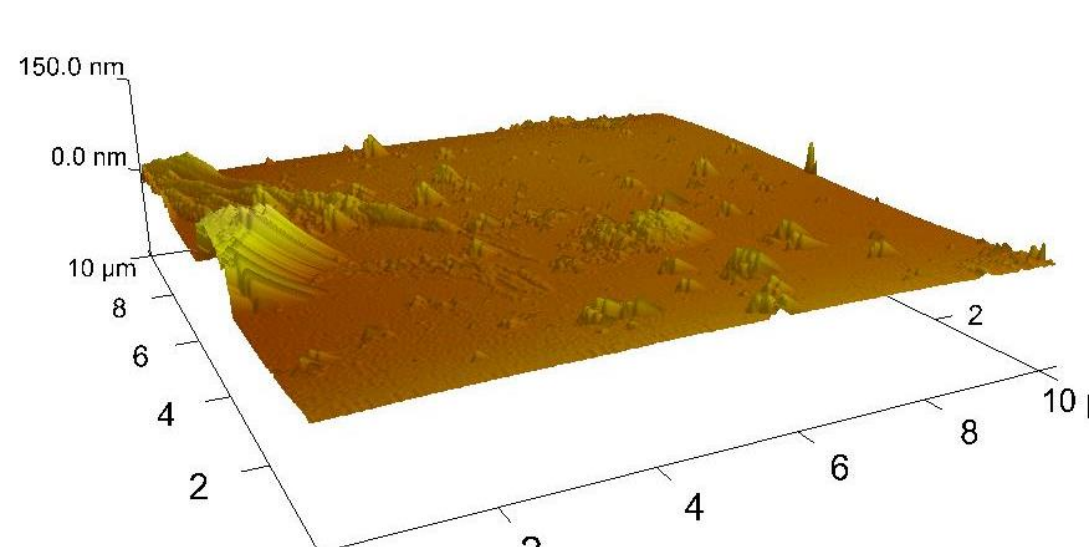
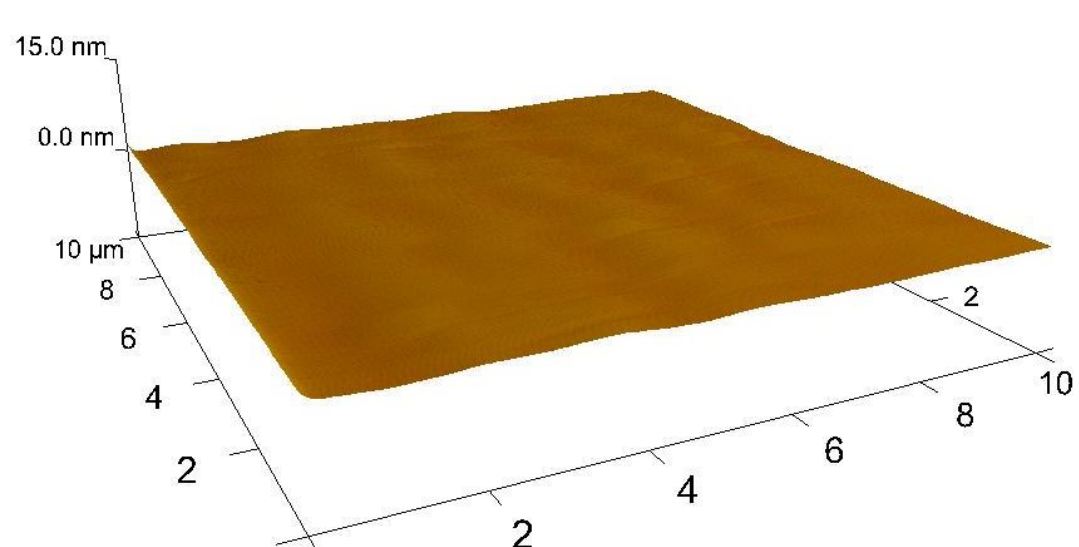
Characterization

- | | |
|--------------------|---|
| Contact Angle (CA) | • 4 μ L deionized water
• Rame-Hart Goniometer
• DROPImage software |
|--------------------|---|



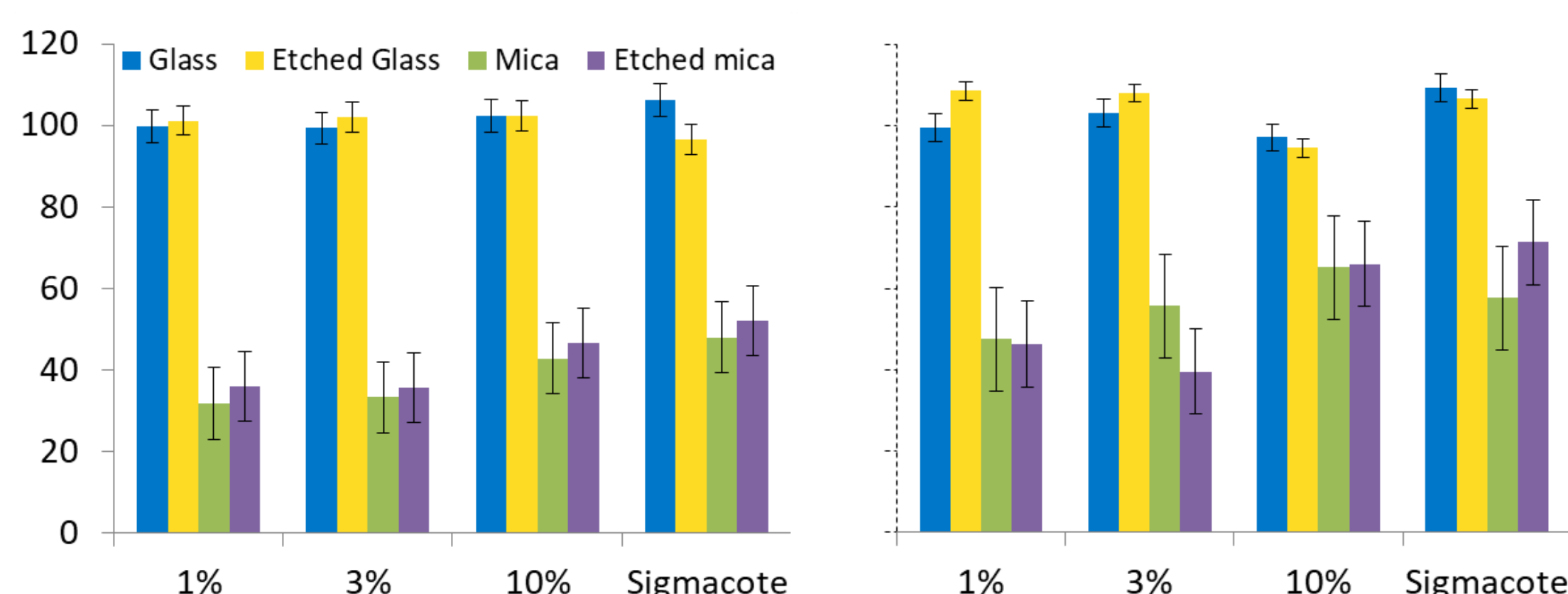
Non-wetting and wetting water droplets showing hydrophobic and hydrophilic behavior.

Atomic Force Microscope (AFM)

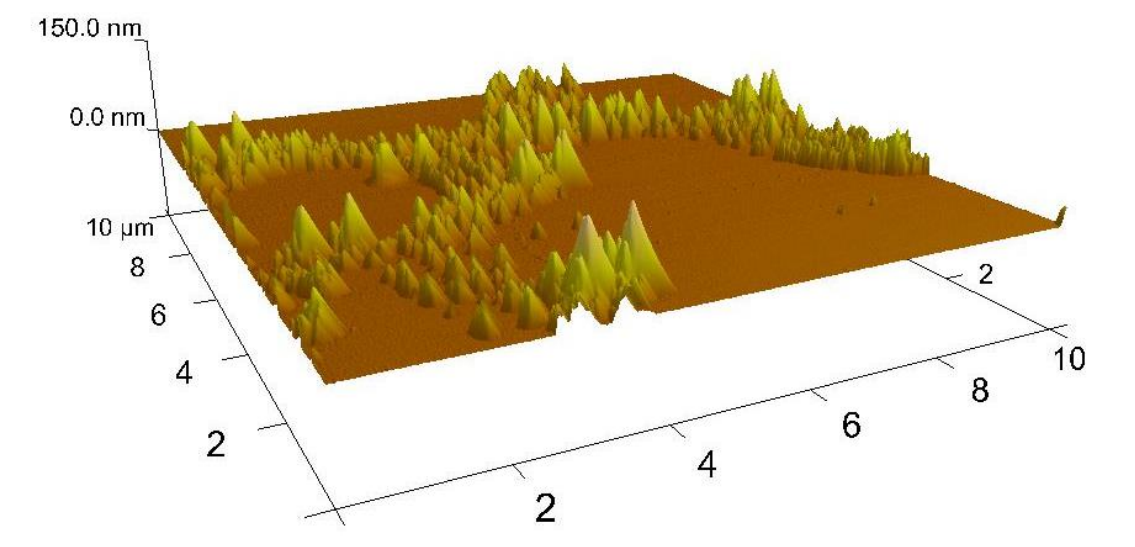
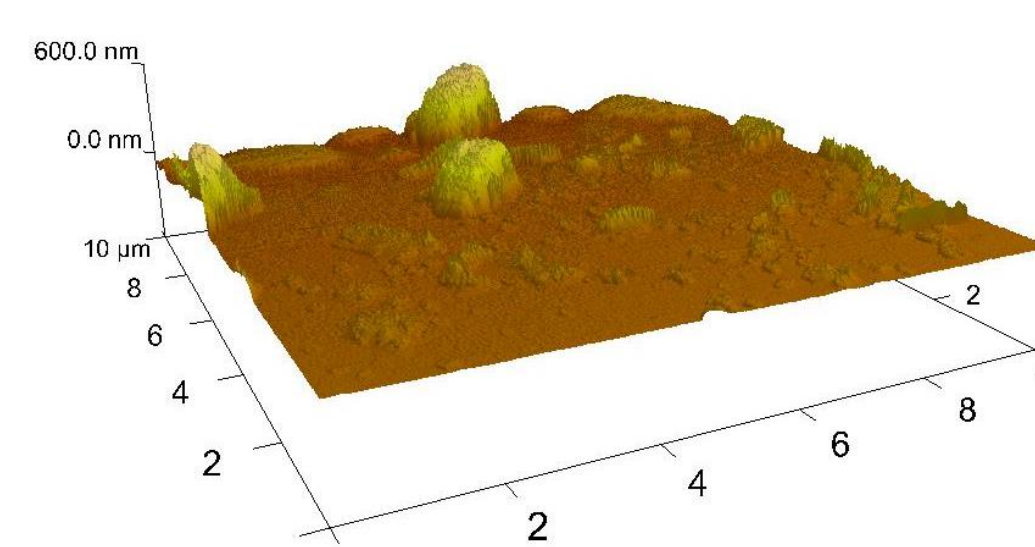
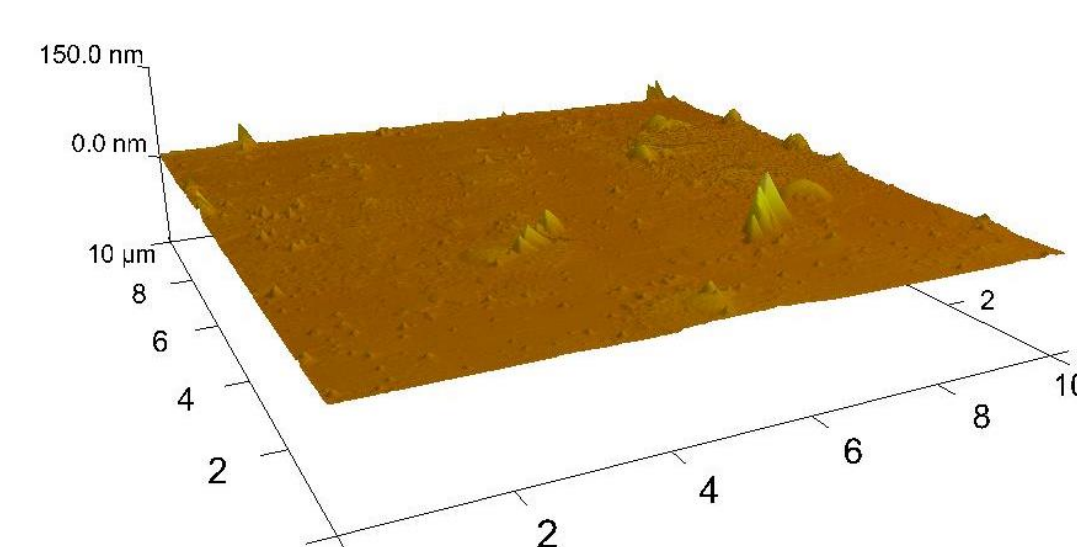
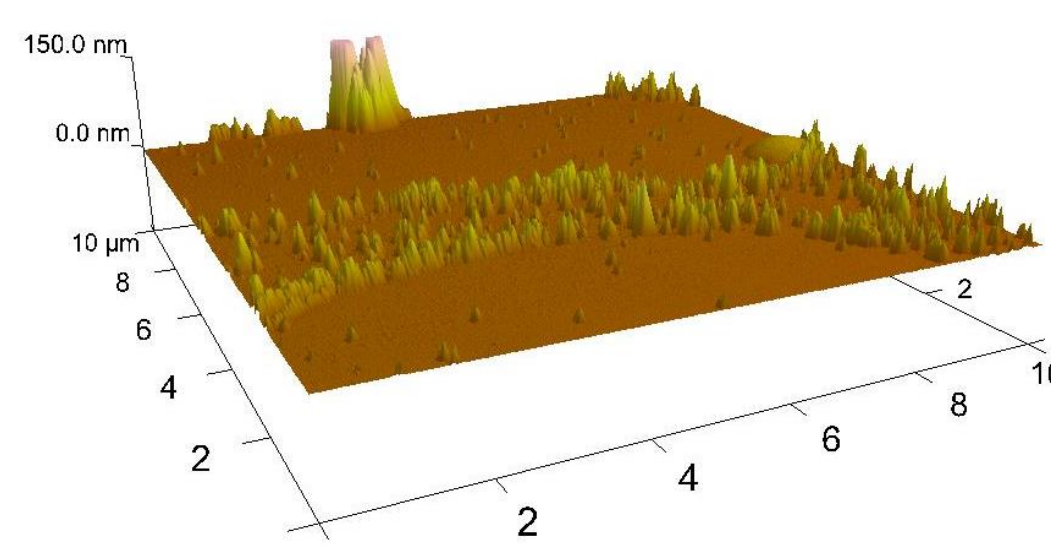


AFM images of freshly cleaved mica (left), and etched mica (right).

Results and Discussion



Contact angles for 20 min (left), and 200 min (right) with four substrates.



Silanated mica for 20 min. Clockwise from top left: CTMS on cleaved mica, Sigmacote on cleaved mica, CTMS on etched mica, and Sigmacote on etched mica.

Conclusions

- Mica cannot be silanated to the same extent as glass using sigmacote or CTMS.
- Etched mica generally produces greater CA, at the expense of surface smoothness.
- Etched glass does not produce significant differences in CA from cleaned glass.

Future Work

- Study diffusion of silane into the mica substrate.
- Perform experiments with alkoxysilanes to compare reaction kinetics.

Acknowledgements

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